Understanding how high-level synthetic stimulant traffickers in Australia adapt to changes in their drug supply

Author:
O'Reilly, Matthew

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Understanding how high-level synthetic stimulant traffickers in Australia adapt to changes in their drug supply

Matthew O'Reilly, BA Sc (Psyc Hons)

Submitted in accordance with the requirements for admission to the degree of Doctor of Philosophy

Drug Policy Modelling Program

National Drug and Alcohol Research Centre

School of Public Health and Community Medicine

Faculty of Medicine, University of New South Wales

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Introduction

Illicit drug markets and associated supply disruptions have been studied for many years but with limited attention to how drug traffickers adapt to supply changes: the aim of this thesis. It combined five studies that examined past supply changes in Australia's synthetic stimulant market, trafficker adaptations and consequences thereof.

Method

In study 1, novel methods were developed to improve trend analysis of Australian law enforcement seizure data. Using these methods, studies 2 and 3 analysed supply changes in Australia's ecstasy and meth/amphetamine markets between 2002 and 2014 using unit-record law enforcement seizure/purity data and various other indicators. Trends in six kinds of supply changes were analysed: quantity, purity, supply routes, mode of transport, precursor type, and form. In study 4, a quantitative content analysis was conducted on judges' sentencing comments made between 2002 and 2016 (n=455), to systematically identify trafficker adaptations to quantity, purity/quality and form changes. In study 5, a mixed methods social network analysis was applied to a high-level trafficking network, to examine how it adapted to quantity and purity/quality changes over 15 years.

Results

Significant supply changes were identified in Australia's ecstasy and meth/amphetamine markets, including a decline in quantity and purity of ecstasy in 2010 (one year after Europe's shortage) followed by a partial resurgence. Individual trafficker adaptations were diverse and depended on many factors (e.g. whether the supply change was caused by law enforcement or not). The studied network changed its structure and modus operandi after exposure to supply changes (e.g. a shift from mostly international trafficking to mostly domestic manufacture). Finally, most traffickers continued to sell drugs after supply changes.

Conclusion

This research highlighted the complex adaptive nature of the illicit drug trade and its resilience to market change. Some adaptations had the potential to result in lower harm to the public (e.g. increasing the price or decreasing the purity), while others had the potential to result in greater harm (e.g. decreasing the price or adulterating the drugs). This makes it difficult to predict the outcome of any policy change or law enforcement intervention that aims to disrupt the supply of illicit drugs.

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Abbreviations

3,4-MDP-2-P	3,4-Methylenedioxyphenylpropan-2-one
95% CI	95% Confidence Interval
AUD	Australian Dollar
AustLII	Australasian Legal Information Institute
Border data	Data obtained from the Department of Immigration and Border Protection
EDRS	Ecstasy and related Drugs Reporting System
EMCDDA	European Monitoring Centre for Drugs and Drug Addiction
IDRS	Illicit Drug Reporting System
UNODC	United Nations Office on Drugs and Crime
UK	United Kingdom
USD	United Sates Dollar
USA	United States of America
Vic purity data	Data obtained from the Drug Sciences Group, Victoria Police Forensic Services Department

Chapter 1: Introduction

The illicit drug trade was estimated to be worth 322 billion (USD) in 2003 (Chawla, 2005) and represents a significant health and social problem to societies across the globe. Most research associated with the illicit drug trade has focussed on the epidemiology of drug use and/or harms (Degenhardt et al., 2008; Degenhardt et al., 2013; Lim, Cogger, Quinn, Hellard, & Dietze, 2015; Lloyd, Matthews, & Gao, 2014; Morgan, Muetzelfeldt, Muetzelfeldt, Nutt, & Curran, 2009; Roxburgh, Ritter, Slade, & Burns, 2013), or on clinical and harm reduction responses to illicit drug use (Degenhardt & Day, 2006; e.g. Degenhardt et al., 2016; Lim, Cogger, Quinn, Hellard, & Dietze, 2015; Lintzeris et al., 2006; McKetin, Kelly, & McLaren, 2006; Moore et al., 2005; Tscharke, Chen, Gerber, & White, 2015). There has been less research on drug supply (Caulkins et al., 2016; Degenhardt & Day, 2006; Hughes, Chalmers, Bright, Matthew-Simmons, & Sindicich, 2012; Moore et al., 2005; Reuter, 2017; Tzvetkova et al., 2014). Given that the illicit drug trade has both supply and demand characteristics, this limits ability to have informed discussions around optimal harm minimisation policies in response to illicit drugs.

Most research on illicit drug supply has focussed on cocaine and heroin (Caulkins et al., 2016; Caulkins et al., 2015; Chandra & Joba, 2015; Day, Degenhardt, & Hall, 2006; Degenhardt, Day, & Hall, 2004; Degenhardt, Reuter, Collins, & Hall, 2005; Dietze & Fitzgerald, 2002; Harris, Forseth, & Rhodes, 2015; Hughes, Chalmers, Bright, Matthew-Simmons, & Sindicich, 2012; Tzvetkova et al., 2016), with only limited attention to the supply of illicit synthetics stimulants like ecstasy and meth/amphetamine[1] (Fowler, Kinner, & Krenske, 2007; McKetin, McLaren, & Kelly, 2005; Scott & Burns, 2011; Scott, Caulkins, Ritter, Quinn, & Dietze, 2015). This is despite there being more people who use synthetic stimulants world-wide than heroin or cocaine combined (Global SMART Programme, 2010).

Drug supply indicator data from around the globe (including law enforcement seizure data, purity data, and subjective reports of drug supply from people who use drugs) show that the supply of drugs frequently changes over time both in Australia (Australian Crime Commission, 2013; Australian Crime Commission, 2014; Australian Customs and Border Protection Service, 2015; Chalmers, Matthew-Simmons, & Hughes, 2013; Hughes, Chalmers, Bright, Matthew-Simmons, & Sindicich, 2012) and overseas (Brunt, Poortman, Niesink, & van den Brink, 2011;

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[1] Throughout this thesis, the term 'meth/amphetamine' is used in reference to either amphetamine or methamphetamine, and 'ecstasy' is used in reference to any of the following three compounds: 3,4-methylenedioxymethamphetamine (MDMA), 3,4-methylenedioxy-N-ethylamphetamine (MDEA) and 3,4-methylenedioxyamphetamine (MDA).

EMCDDA, 2016a; Miliano et al., 2016; Parrott, 2004; Vogels et al., 2009). This is particularly so for the synthetic stimulant market which has seen some major changes in recent years. For example, see the European Monitoring Centre for Drugs and Drug Addiction (EMCDDA) report on recent changes in Europe's ecstasy market (EMCDDA, 2016a). Drug supply can change for many reasons. One of the main causes is law enforcement intervention. But the extent to which drug traffickers and their networks adapt to supply changes, how they adapt specifically, how this impacts on their ability to continue selling drugs—the broad aims of this thesis—has been understudied. This limits ability to have informed, evidenced based discussions around optimal policy responses to illicit drugs. Given the lack of attention to illicit synthetic stimulant trafficking to date, this thesis focusses on the supply of, and those who traffic, the two main illicit synthetic stimulants: ecstasy and meth/amphetamine.

Distribution level focus: The High Level

Like all licit markets, the illicit synthetic stimulant market consists of multiple distribution layers. Here, drugs are manufactured synthetically at the top of the chain in large quantities. The drugs are passed on to high-level traffickers who divide the batch up into smaller quantities and then on sell to multiple traffickers lower in the chain for an inflated price. This process repeats until the drugs reach retail-level dealers who deal in small quantities to people who use drugs (Caulkins et al., 2015). This thesis focusses on high-level traffickers in Australian markets. It does not focus on lower-level dealers or people who use drugs.

Defining High-Level Trafficker

There is no universal way to define high-level trafficker and how this distinguishes from mid or lower-level traffickers, albeit one of the most common methods is by reference to the quantity of drugs trafficked. Even then, quantities used to define high-level differ. For instance, Reuter and Haaga (1989, p. V) defined the high-level in the United States to be "at which kilogram bundles of cocaine or hundred-pound bundles or marijuana are sold". Adler and Adler (1983, p. 195) indirectly referred to high-level traffickers in the United States as those who purchase "more than 100 kilos of marijuana or single ounces of cocaine at time". Pardal et al. (2014) required transactions of cocaine to be at least 100 grams before they were defined as high-level in a European context. There is clearly variation in high-level trafficking definitions in the literature. Generally speaking, however, high-level traffickers have been defined to operate in quantities of several hundred grams to several hundred kilograms.

In a review of high-level drug trafficking, Desroches (2007) outlined the ambiguity in defining high-level trafficking as an issue present in the literature, and provided a more general definition. According to Desroches (2007, p. 828), high-level drug traffickers are "importers, growers, manufacturers, or wholesalers who market large quantities of illicit drugs to other dealers". Given that this thesis focusses on synthetic stimulant traffickers only, the term "growers" was not relevant in this context. Hence derived from Desroches (2007), the following definition of a high-level drug trafficker was used herein: importers, manufacturers or wholesalers who market large quantities of illicit drugs to other traffickers.

Why Focus on The High-Level?

To date, most of the existing knowledge of drug trafficking stems from studies of the retail-level (Bernasco & Jacques, 2015; Caulkins, Johnson, Taylor, & Taylor, 1999; Caulkins, Larson, & Rich, 1993; Chalmers & Bradford, 2013; Grundetjern & Sandberg, 2012; Jacinto, Duterte, Sales, & Murphy, 2008; Jacqueline, Wilpen, & Piyusha, 2003; Jacquesa, Allenb, & Wright, 2014; Kleiman & Young, 1995; Lenton, Grigg, Scott, & Barratt, 2016; MacCoun & Reuter, 1992; Oteo Pérez, Benschop, & Korf, 2013; Sommers, Baskin, & Fagan, 1996; Taylor & Potter, 2013). In comparison, there have been fewer studies which have focussed on high-level drug trafficking specifically, both in Australia (Degenhardt, Day, & Hall, 2004; Hughes, Bright, & Chalmers, 2017; Hughes, Chalmers, Bright, & McFadden, 2016a; Loxely, 1998; McKetin, McLaren, & Kelly, 2005; Ovenden, Loxely, & McDonald, 1995; Ritter, Bright, & Gong, 2012; Shearer, Johnston, Kaye, Dillon, & Collins, 2005) and overseas (Caulkins et al., 2016; Decker & Chapman, 2008; Desroches, 2005; Desroches, 2007; Matrix Knowledge Group, 2007; Pearson & Hobbs, 2001; Reuter & Haaga, 1989; Tzvetkova et al., 2014). This thesis seeks to reduce the disproportionate gap in knowledge on high-level drug trafficking specifically.

Exposure to Supply Changes

High-level drug traffickers are reliant on receiving precursor or end-product supply to operate. However, throughout their career, they often experience supply changes such as supply shortages, law enforcement interventions, and purity increases (Matrix Knowledge Group, 2007; Ovenden, Loxely, & McDonald, 1995; Tzvetkova et al., 2014). As an illicit market, there is no guarantee of stable supply, and it is expected that most high-level drug traffickers will experience supply interruptions and changes throughout their career (Matrix Knowledge Group, 2007). Certainly, we know that the illicit drug market is inherently unstable as demonstrated by the several major drug supply "shortages" that have been reported. This

includes: the global ecstasy shortage in the late 2000s (EMCDDA, 2016c; Scott & Burns, 2011), the Australian heroin shortage in the early 2000s (Degenhardt, Day, & Hall, 2004; Degenhardt, Reuter, Collins, & Hall, 2005), the UK heroin shortage in the early 2010s (Harris, Forseth, & Rhodes, 2015), and the United States methamphetamine shortage in the mid-1990s (Dobkin & Nicosia, 2009). Similarly, there have been supply surges, including the Australian mid to late 90s heroin "glut" (Dietze & Fitzgerald, 2002), a significant decrease in the price per pure gram of meth/amphetamine in Victoria (indicating increased supply), (Scott, Caulkins, Ritter, Quinn, & Dietze, 2015), and a near doubling of Afghan opium production between 2016 and 2017 (UNODC, 2017). In this thesis, supply changes are categorised in three ways: by kind, cause and direction (each of which is outlined below).

First, there are many different *kinds* of supply changes that traffickers of illicit synthetic stimulants can be exposed to, 10 of which are outlined Table 1: quantity, purity, content quality, textural quality, form, price, supply origin, supply routes, mode of transport, and precursor type. Note, this is not intended to be an exhaustive list of supply change kinds, but rather, these are the kinds of supply changes more commonly discussed in the literature (Arkes, Pacula, Paddock, Caulkins, & Reuter, 2008; Australian Crime Commission, 2017; Pearson & Hobbs, 2001; Tzvetkova et al., 2014).

Table 1

Ten common kinds of supply changes experienced by traffickers or manufacturers of illicit synthetic stimulants

Supply change kind	Definition
1. Quantity	The total amount of drugs available to the trafficker may change. For example, the trafficker may be exposed to a new, additional supplier of a drug and is therefore exposed to a quantity increase of that drug. Or, a trafficker may import a quantity of drugs which is then seized by law enforcement officers. This would be a quantity decrease to the trafficker (i.e. a decrease in the total amount of drugs available to the trafficker).
2. Purity	Illicit substances can vary greatly in purity. A drug sample with a purity of 50% contains 50% of the active ingredient (e.g. meth/amphetamine) and 50% of impurities. A trafficker may receive drugs of less or more purity than usual. A higher purity means a

higher proportion of the active ingredient is present in the sample.

3. Content quality	A drug sample may contain adulterants (such as filler drugs with psychoactive effects that are not the main active ingredient). For example, an ecstasy tablet may contain 40% ecstasy and 20% ketamine. In this example, the ketamine is an adulterant because it is not ecstasy. A content quality change is defined as a change in the proportion of the substance that contains adulterants. An increase in content quality means a decrease in adulterants. Conversely, a decrease in content quality means an increase in adulterants.
4. Textural quality	A change in textural quality is defined as a change in the quality of a drug's physical texture. For example, tablets that were once firm may crumble or break into pieces and hence become poorer in textural quality. Or meth/amphetamine that is a dry powder or crystal may become be gluggy in texture if it is contaminated with water (i.e. poorer textural quality).
5. Form	Drugs exist in a variety of forms. The main forms available on the illicit synthetic stimulant market are tablet, powder, crystal, capsule and paste. Drugs can be converted from one form to another. For example, an ecstasy powder can be converted into ecstasy tablets using a pill pressing machine.
6. Price	Illicit drugs are a commodity sold for profit. A supplier may regularly sell a given quantity of drugs to a customer at a given price. A price change is simply when the trafficker receiving the drugs (i.e. the customer) is asked to pay a different price than usual for that given quantity of drugs.
7. Supply origin	Synthetic stimulants are manufactured world-wide. A trafficker may receive drugs that were manufactured in a different world location–hence a change in supply origin. Different countries may have different production skills or have access to different qualities of resource. Therefore, a change in the origin of supply could potentially be associated with other kinds of supply changes, such as changes in purity, quality or price.
8. Supply routes	Drug importations follow a particular supply route to the receiving country. A trafficker may receive drugs that had embarked on a different supply route than previously. For example, ecstasy may be

	manufactured in Europe and then exported directly to Australia. At a later time, the supply route may change so that the drugs are transported from Europe to Canada first, and then to Australia. A change in supply routes may be associated with other kinds of supply changes, including price, purity or form (as the drugs pass through a different country).
9. Mode of transport	Drugs can be imported into the country via different modes of transport, such as sea or air cargo, passenger jet, or parcel post. A trafficker may change the mode of transport used to import drugs.
10. Precursor type	There is more than one precursor type that can be used to synthesise the same synthetic stimulant. For example, ecstasy can be synthesised with any of the following precursor types: safrole, piperonal, 3,4-MDP-2-P, or isosafrole. Different precursors types are associated with different methods of manufacture.

Second, there are three ways in which the direction of the supply change can be categorised, which are outlined in Table 2: increase, decrease, and undirected.

Table 2

The three directions of supply changes that traffickers or manufacturers of illicit synthetic stimulants may be exposed to

Supply change direction	Definition
1. Increase	There can be an increase in the quantity, purity, textual quality, content quality or price of drugs.
2. Decrease	There can be a decrease in the quantity, purity, textual quality, content quality or price of drugs.
3. Undirected	When the supply change is not associated with a direction. The following supply change kinds cannot be associated with an increase or decrease and are hence referred to as undirected supply changes: form, supply routes, mode of transport, origin of supply or precursor type.

Finally, there are many events that may cause supply changes. Causes in this thesis are clustered into two groups, which are outlined in Table 3: supply changes caused by law enforcement and non-law enforcement caused supply changes.

Table 3

The two causes of supply changes that traffickers of illicit synthetic stimulants may be exposed to

Supply change cause	Definition
Law enforcement	Law enforcement officers can intervene on drug supply in three main ways. First, they can seize drugs in transit, replace them with an inert substance, then make a controlled delivery to the suspected trafficker in order to make an arrest. This causes a purity decrease as the active ingredient no longer exists in the substance. Second, law enforcement officers can seize drugs without replacing them. This causes a quantity decrease as it reduces the total quantity of drugs available to the trafficker. Third, law enforcement can arrest a trafficker's supplier which may cause a decrease in the quantity of drugs available to that trafficker (if the individual arrested was the only link between the trafficker and suppliers higher in the chain).
Non-law enforcement	All other supply changes not directly caused by law enforcement are defined as non-law enforcement supply changes. For example: there may be natural disaster which disrupts a drug market (causing a quantity decrease to the trafficker), a trafficker may come into contact with new drug suppliers resulting in an increased quantity of drugs available to him or her, or a trafficker may receive drugs in a different form.

Adapting to Supply Changes

Knowing that supply can change at any time, high-level drug traffickers use several strategies to minimise the risk of supply disruptions to their business (Bouchard, 2007). For instance, incarcerated traffickers report having multiple back up suppliers in the event that their regular

supplier was unavailable or stocking up drugs when they envisaged a period of low supply (Matrix Knowledge Group, 2007; Ovenden, Loxely, & McDonald, 1995; Tzvetkova et al., 2014). However, when supply actually does change, traffickers and their networks typically make one or more adaptations to ensure a continuous income is maintained.

This paragraph briefly introduces findings from past studies with respect to how traffickers might adapt to supply changes (see Chapter 2 for a literature review of adaptations to supply changes). When exposed to supply changes of a particular drug, incarcerated high-level traffickers have reported: looking for or switching to alternative suppliers, raising the price of that drug to their customers, selling a different drug type instead, manufacturing the drug themselves, expanding the business, or becoming inactive and waiting for new supply to arrive (Adler, 1985; Adler & Adler, 1983; Bouchard, 2007; Desroches, 2005; Matrix Knowledge Group, 2007; Ovenden, Loxely, & McDonald, 1995; Pearson & Hobbs, 2001; Tzvetkova et al., 2014). Other studies have shown adaptations to supply changes are possible in the broader network of drug traffickers (Bright & Delaney, 2013; Morselli & Petit, 2007). For example, Morselli and Petit (2007) found that after exposure to supply changes, a drug trafficking network in Montreal decentralised (i.e. became less dependent on any one individual) and recruited new people into the network to assist with future trafficking operations.

The Consequence

After traffickers or networks make an adaptation (or not), there is a consequence. Different adaptations may lead to different consequences. For example, the consequence of exposure to a price increase may be a reduction in selling frequency (i.e. the trafficker or network buys and sells less drugs than usual due to the higher price). The consequence of adapting to a supply change by trafficking a different drug type could be the increased sales of a new drug type in the community. The consequence of a switch from domestic manufacture to importing drugs may be a change in the purity or price of that drug, for example if the exporting country has cheaper and/or higher purity drugs available.

Further, it has been recognised that traffickers may adapt differently in short and long-term time frames (Bouchard, 2007; Dorn, Levi, & King, 2005) and hence the supply change consequence may differ between short and long-term time frames. Despite recognition that length of time is an important variable to consider, there is no clear consensus as to what defines short-term versus long-term time frames. Nonetheless, it is an important variable to consider when studying the consequence of a supply change and will be discussed in more detail later in the thesis.

Changes to the Potential for Harm to the Public

Adaptations and consequences to supply changes can vary. Therefore, supply changes may result in varying potentials for harm to the public. Harms can be health, social, cultural or economic in nature. The harm may be specific to the individual who uses drugs or may extend to friends, family or the wider community.

Some adaptations have the potential to result in less harm, such as increasing the price, returning drugs to the supplier, or decreasing the purity. For example, a price increase should result in less demand, and decreasing the purity should result in less potential for harm to people who use drugs. On the other hand, some adaptations traffickers make may have the potential to result in greater harms, such as decreasing the price, looking for alternative suppliers, adulterating their drugs, increasing the purity or manufacturing their own drugs. For example, if supply changes caused traffickers to look for alternative suppliers, it may result in the formation of a new network of collaborators and the expansion of trafficking routes into different areas. If traffickers manufacture drugs locally then this would be particularly hazardous if they had no prior experience and/or if the laboratory was in a residential area (which they sometimes are), (UNODC, 2014). There is always a risk of explosion (Moor, 2014), and the waste products produced by illicit drug manufacture are potentially toxic for the environment (Pal, Mallavarapu, Naidu, & Kirkbride, 2008).

Summary: The Four Aspects to Studying Supply Changes

In sum, there are four aspects to consider when studying supply changes. Identifying:

1) the supply change category;
2) the adaptation(s);
3) the consequence; and
4) whether there is any change to the potential for harm to the public.

Figure 1 summarises the key points with respect to these four aspects. The supply change category is obtained by firstly identifying the supply change kind, then secondly by identifying the cause, then thirdly by identifying the direction, then finally by identifying the drug type. For example, a supply change category might be a non-law-enforcement-caused availability increase of ecstasy, a law-enforcement-caused availability decrease of meth/amphetamine, or a non-law-enforcement-caused purity decrease of ecstasy. Once the supply change category is identified, the next step is to identify whether the trafficker adapted and if so the

adaptation(s) used. Next, identify the consequence: specifically, did the trafficker continue to sell drugs? Finally, explore whether there may be a change to the potential for harm to the public as a result of the adaptation and consequence.
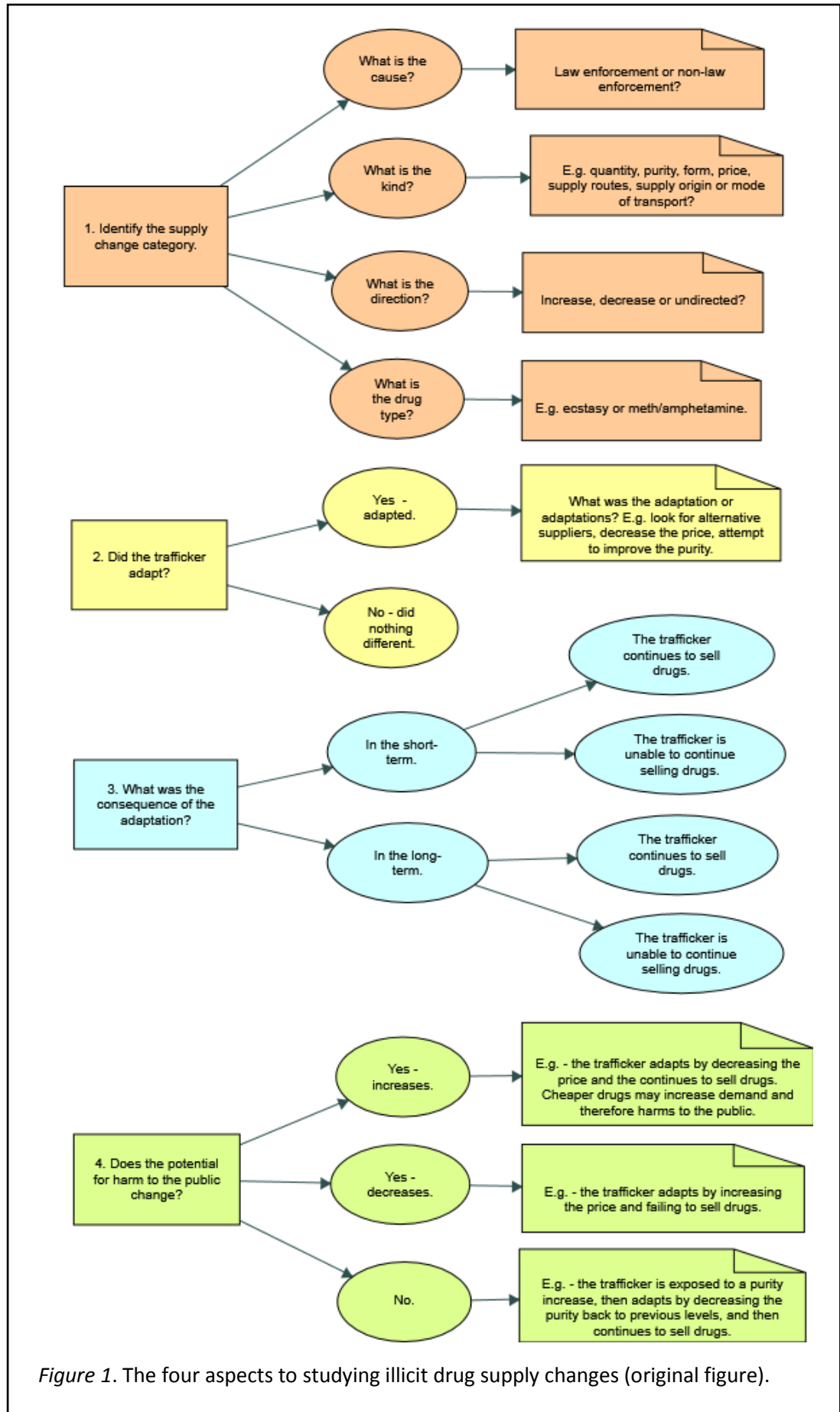
Figure 1. The four aspects to studying illicit drug supply changes (original figure).

Thesis Objectives

There are seven overarching aims of this thesis, which are:

(1) To improve the analysis of Australian ecstasy and meth/amphetamine law enforcement seizure data when used as an indicator of supply changes in Australia's ecstasy and meth/amphetamine markets;

(2) To identify supply changes that have occurred in Australia's ecstasy and meth/amphetamine markets between 2002 and 2014;

(3) To systematically identify the most common and the least common adaptations made by high-level synthetic stimulant traffickers after exposure to a supply change;

(4) To examine the relationship between the adaptation(s) undertaken and various supply change characteristics, including:

    a. the cause;

    b. the kind;

    c. the direction;

    d. the drug type associated with the supply change;

    e. whether the trafficker is exposed to one or multiple supply changes;

    f. the length of time that passes after the supply change; and

    g. trafficking style (i.e. whether the trafficker exposed to the supply change is a mono or poly drug trafficker);

(5) To examine the relationship between the various supply change characteristics and whether the trafficker exposed to the supply change continues to sell drugs;

(6) To examine whether any additional insights can be gained about adaptations to supply changes and the consequences thereof through a drug trafficking network lens. Specifically, whether / to what extent a high-level synthetic stimulant trafficking network changes in structure and functionality after exposure to supply changes; and whether / to what extent there is a relationship between the network's adaptations and the various supply change characteristics; and

(7) To explore the relationship between the supply change adaptations and the extent to which harm to the public may be increased or decreased.

Thesis Structure

There are nine chapters in this thesis. Following this chapter are two literature review chapters, five results chapters, and a discussion chapter.

Chapter 2 reviews the relevant literature on drug supply, drug markets, drug traffickers and adaptations to supply changes. It concludes by highlighting the research gaps still present in the literature. Chapter 3 reviews the literature on methodological approaches to studying drug supply changes and drug traffickers. It specifically outlines the range of data sources available to study drug supply and trafficking and outlines their strengths and limitations. One aspect of Chapter 3 focusses on limitations associated with the analysis of law enforcement seizure data–one of the main indicators of drug supply changes in many countries, including Australia.

Hence Chapter 4, the first of the results chapters, examines ways of improving the analysis of law enforcement seizure data when used as an indicator of drug supply changes. Using those methods, Chapters Five and Six comprise supply trend analyses of law enforcement seizure data and various other supply indicators, specifically to identify supply changes in Australia's ecstasy and meth/amphetamine markets respectively between 2002 and 2014. In particular, six kinds of supply changes are examined: quantity, purity, form, supply routes, mode of transport, and precursor type.

How traffickers and drug networks adapt to supply changes is examined in chapters Seven and Eight respectively. Chapter 7 uses judges' sentencing comments from Australian court cases of high-level synthetic stimulant trafficking to examine how traffickers adapted to five kinds of supply changes (quantity, purity, textural-quality, content-quality and form) and the consequences thereof. Chapter 8 uses judges' sentencing comments, a biography of an Australian high-level drug trafficker, and mainstream media, to examine how one high-level drug trafficking network adapted to supply changes over a 15-year period.

The final chapter, Chapter 9, is a discussion which draws together findings from all five results chapters. It concludes by discussing implications for research, policy, and practice, followed by limitations with the present research and suggestions for future work in this field.

Chapter 2: Drug Supply and High-Level Trafficking

This chapter provides a literature review of global and Australian drug supply (focussing on synthetic stimulants), the structure of illicit drug markets, high-level drug traffickers (including their characteristics, motivations for entry, and resilience to market shocks), how they defend against market shocks, and then what is known about their adaptability to supply changes. It concludes by providing the gaps in knowledge, followed by the rationale for the research in this thesis.

Global and Australian Drug Supply

The five most commonly sold drugs in the illicit drug trade are heroin, cocaine, ecstasy, meth/amphetamine and cannabis. Thousands of tons of these drugs are seized each year worldwide (UNODC, 2009; UNODC, 2014b). Unlike cannabis, cocaine and heroin, which are grown or derived from plant-based materials, ecstasy and meth/amphetamine are synthetic stimulants which are produced in laboratories using chemical precursors. The main precursors used to synthesise meth/amphetamine in a global context are phenyl-2-propanone (P2P), pseudoephedrine and ephedrine, whereas for ecstasy they are safrole, isosafrole, piperonal and 3,4-MDP-2-P (or PMK) (UNODC, 2014).

Unlike heroin and cocaine, in which production is limited to mostly the middle-east and South-America respectively due to optimal climate conditions (UNODC, 2017), synthetic stimulants can be manufactured anywhere where precursor materials are available. Cannabis production is even less restricted and is grown indoors or outdoors in most countries around the globe (Decorte & Potter, 2015; UNODC, 2014b).

Overtime global synthetic stimulant production appears to have been steadily increasing, as evidenced by steady increases in the annual total weight of global seizures of this drug class. For instance, in 2005 approximately 60 tons of synthetic stimulants were seized (UNODC, 2011). By 2010 approximately 90 tons were seized and by 2015 approximately 200 tons were seized. From around 2010, seizures of synthetic stimulants began to overtake that of heroin for the first time and by 2015, meth/amphetamine seizures were approximately double that of heroin (UNODC, 2017). Despite tentative evidence for large increases in global synthetic stimulant trafficking over the past seven or eight years, most research on drug supply has continued to focus on heroin, cocaine or cannabis (Belackova & Wilkins, 2018; Caulkins et al., 2016; Caulkins et al., 2015; Chandra & Joba, 2015; Day, Degenhardt, & Hall, 2006; Decorte &

Potter, 2015; Degenhardt, Day, & Hall, 2004; Degenhardt, Reuter, Collins, & Hall, 2005; Dietze & Fitzgerald, 2002; Harris, Forseth, & Rhodes, 2015; Hughes, Chalmers, Bright, Matthew-Simmons, & Sindicich, 2012; Tzvetkova et al., 2016).

There are important features to Australian drug markets which distinguish them from other drug markets. First, drug prices in Australia are much higher compared to most other countries. For instance, cocaine is less than $15 AUD in many South American countries, in the US it is approximately $130 AU ($100 USD) per gram, and in Europe it is around $70 AUD (50 Euros) per gram. In Australia cocaine can sell for nearly $400 AUD per gram (Global Drug Survey, 2017). Second, Australia also has one of the highest per capita rates of drug use anywhere in the world. For example, in 2010 there was an estimated 3% and 2.1% of the Australian population using ecstasy and meth/amphetamine respectively (Australian Institute of Health and Welfare, 2014). This compared to an estimated 0.9% and 1.3% of the North American population using ecstasy and meth/amphetamine respectively (UNODC, 2013). Third, meth/amphetamine supply in Australia is both domestically manufactured and imported in significant quantities (Australian Crime Commission, 2014; McKetin, McLaren, & Kelly, 2005; Ritter, Bright, & Gong, 2012). Fourth, Australia has a much larger border than most other countries with many ports, making it particularly difficult to prevent the importation of illicit drugs.

Finally, crystal meth/amphetamine supply has been of particular concern to the Australian government since around 2013 due evidence of increased use, purity and associated harms (Degenhardt et al., 2016; Degenhardt et al., 2016; Lim, Cogger, Quinn, Hellard, & Dietze, 2015; Scott, Caulkins, Ritter, Quinn, & Dietze, 2015). For these reasons, meth/amphetamine has been the focus of law enforcement and government supply reduction strategies in recent years (Department of the Prime Minister and Cabinet, 2015).

The Structure of Illicit Drug Markets

The traditional view of drug markets endorsed many decades ago by law enforcement agencies and mainstream media is as a "pyramid" or "kingpin" structure, in which the market is controlled by a single large-scale organisation (see Figure 2) (Mitchell, 2017; Palin, 2017; Sutton, 2017). Here, a drug-lord or kingpin is positioned at the top of the chain who controls a network of traffickers underneath all the way through to the retail-level.

After decades of research, the pyramid model as the dominant structure of drug markets has been challenged. Large volumes of research suggest that drug markets are often highly

fragmented and comprised of many small freelance groups that are only loosely connected via facilitators or brokers (see Figure 3), (Bright, Greenhill, Ritter, & Morselli, 2015; Bright, Hughes, & Chalmers, 2012; Desroches, 2005; Matrix Knowledge Group, 2007; Paoli, 2000; Paoli, Greenfield, & Reuter, 2009; Tenti & Morselli, 2014). In a fragmented structure, there is no centralised drug-lord or group that controls everything, and subgroups can operate independently from one another.

Figure 2. A king-pin/pyramid network structure: comprises a formalised structure in which a single large organisation controls all distribution levels from the high-level to the retail level (original figure).

Figure 3. A fragmented network structure: smaller sized groups are loosely connected to other small groups via brokers (original figure).
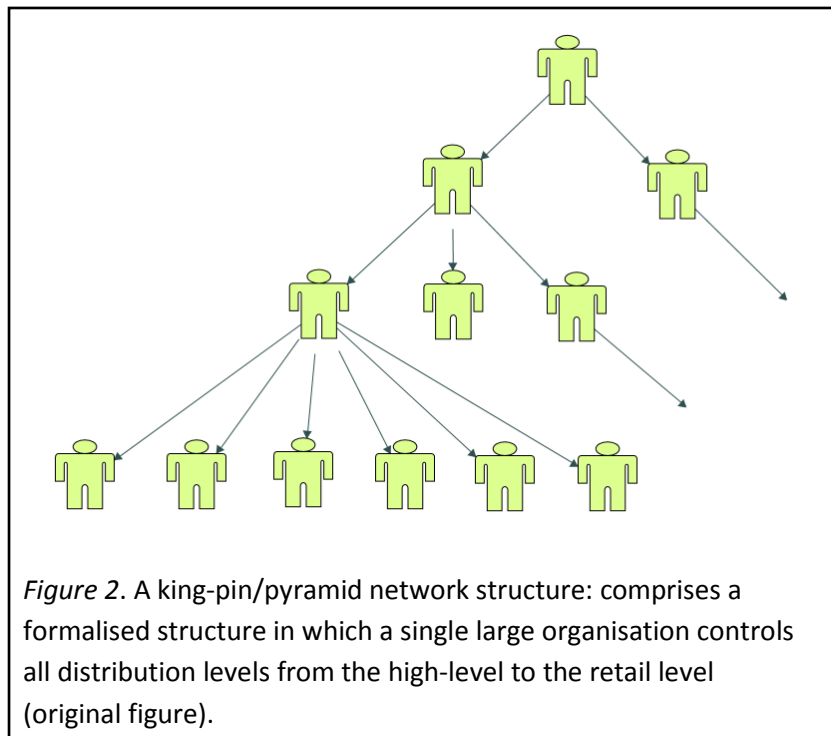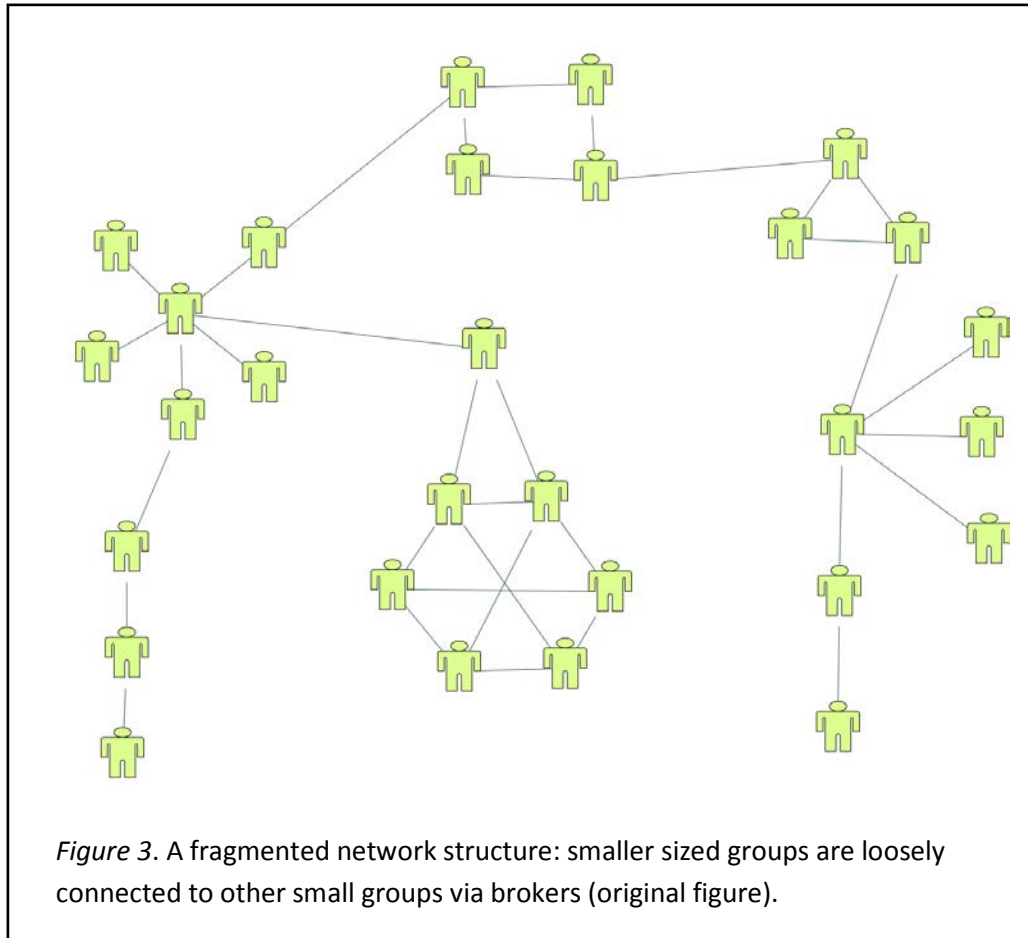
Many studies from across the globe have found that traffickers work in small, loosely structured groups based on ethnic, family, or friendship bonds. For example, Desroches (2005), who interviewed 70 incarcerated high-level traffickers in Canada, found traffickers either worked independently or in small close-knit groups comprised of three to nine people. The Matrix Knowledge Group (2007), who interviewed 222 incarcerated traffickers of mostly cocaine, heroin and cannabis in the UK, reported that 80% of the sample worked in small to medium sized groups or loosely structured collaborative networks, while about 20% were solo traders. Most groups were found to be comprised of less than 15 associates. In contrast, just one participant in the study by Matrix Knowledge group (2007) reported being part of a large organisation with more than 100 people. Decker and Chapman (2008), who interviewed 34 high-level cocaine smugglers in the USA, reported that participants usually worked in groups of eight to 10 people, and that almost all traffickers in this study believed it was important to keep networks small to reduce the risk of detection.

Several Australian studies also provide support for a fragmented model of illicit drug markets (Bright, Greenhill, Ritter, & Morselli, 2015; Degenhardt, Day, & Hall, 2004; Hughes, Chalmers, Bright, & McFadden, 2016a). For example, Bright, Hughes, and Chalmers (2012), who applied social network analysis to a meth/amphetamine trafficking syndicate using judges sentencing comments from Australian court cases, identified a network of 36 members which was comprised of two loosely connected sub-groups. Shearer, Johnston, Kaye, Dillon, and Collins (2005) interviewed cocaine dealers from Sydney and Melbourne and found that the cocaine market in those cities was comprised of tight, socially based networks.

In contrast, pyramid structures have been less commonly reported and appear to be mostly identified amongst specific groups or locations. Ritter, Bright, and Gong (2012) found evidence of both structures in the Australian meth/amphetamine market, but the pyramid structure was mostly associated with outlaw motor cycle gangs. McKetin, McLaren, and Kelly (2005) produced similar conclusions about the Sydney meth/amphetamine market in the early 2000s. Morselli (2009a), who examined the structure of a cocaine trafficking network in Canada, run by an outlaw motorcycle club, found evidence that this group also operated in a pyramid structure. Calderoni (2012) analysed judicial documents associated with criminal investigations to examine the structure of two cocaine trafficking Mafia organisations in Italy, both of which resembled pyramid structures.

To summarise, pyramid structures are not widespread or conventional as depicted by the traditional view of drug markets, albeit they appear more common amongst groups involving outlaw motorcycle clubs or mafia. The main view in the literature is that most high-level drug traffickers operate in a fragmented structure.

There are two important roles in any fragmented network: 'hubs' and 'brokers' (Bichler, Malm, & Cooper, 2017) (See Figure 4). Hubs (in red) have a high degree of influence in the network and are often in managerial roles and form the 'core' of a sub-network or group. Hubs are in a position to directly communicate or exchange goods with more network participants than most others. Brokers on the other hand (in blue) connect subgroups together and hence exert a high degree of power over those they connect. In some cases, brokers may be the only link between two groups of network participants. This gives brokers a high degree of control the flow of information and goods within the network. It is also possible for brokers and hubs to be assumed by a single person if a hub participant is the only link between two or more sub-networks.

Figure 4. A fragmented network structure highlighting the hubs in red and brokers in blue (original figure).
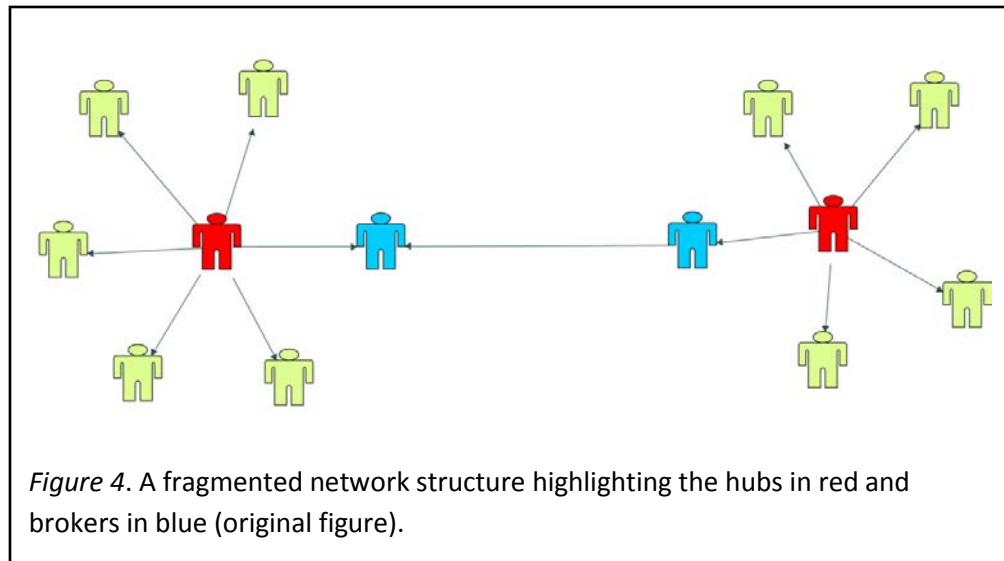
Research has increasingly showed that the removal of key brokers has can disrupt a criminal network (Bichler, Malm, & Cooper, 2017). For example, Bright, Greenhill, Britz, Ritter, and Morselli (2017) performed social network analysis on a meth/amphetamine trafficking network of 128 individuals during the 1990s. The authors tested the effectiveness of six law enforcement intervention strategies by simulating the removal of participants with a particular status or resource. They found that removal of brokers was the most effective strategy to disrupt the network, and much more effective than random "opportunistic" removal. Removal of actors based on targeted skills was the second most effective approach, particularly when targeting those with money.

Despite the removal of brokers being an effective disruption strategy, it is difficult to implement in practice (Duijn, Kashirin, & Sloot, 2014). This may be for several reasons. First, it requires a thorough understanding of the network at hand in real time, which is challenging. Networks may evolve or change in relatively short periods of time (Bright & Delaney, 2013; Morselli & Petit, 2007). Second, there may be law enforcement limits with time, resources, and access to specialist social network analysis training and technologies.

High-Level Drug Traffickers

This section reviews the motivations of high-level drug traffickers for market entry, their characteristics, and some pertinent differences across particular types of traffickers.

Motivations for market entry

Most people who enter the business never sought out a career in drug trafficking prior to entry, and the way in which this happens is usually through family or friends who are already in the business, or through chance meetings with others in the business. This was reported by most traffickers in studies in the UK (Matrix Knowledge Group, 2007), the USA (Reuter & Haaga, 1989), Australia (Ovenden, Loxely, & McDonald, 1995), and Germany, Italy and Slovenia (Tzvetkova et al., 2014).

Those who are presented with an opportunity to become a trafficker are often motivated to enter the business for financial reasons (Desroches, 2005; Matrix Knowledge Group, 2007; Tzvetkova et al., 2014). The large potential profits that can be made with seemingly little effort allows the trafficker to enjoy a wealthy lifestyle that they would not have otherwise had, or to recuperate significant financial loses obtained in their legitimate life. For example, in the study by Reuter and Haaga (1989), one trafficker reported making $75,000 US per month while another made $32,000 US a month. Similarly, Desroches (2005) reported one high-level trafficker to be making $40,000 to $70,000 per week, while another cocaine smuggler made more than $2 million per year. Pardal et al. (2014), who interviewed 72 incarcerated traffickers in Italy, reported that the median monthly income of a multi-kilo trafficker in this group was 250,000 Euros.

In the context of the illicit environment there are rarely any specific requirements to join. For example, Decker and Chapman found it was rare for traffickers to be recruited because they had a particular skill and previous experience was not required. Instead trust was singled out as the most important requirement when recruiting. Desroches (2005) similarly found that the most important skill required was people skills (i.e. trust). This is not to rule out the benefit of specialist skills, as the studies below show that many high-level drug traffickers do have legitimate business skills. However, trust appears most important for entering the trade.

There remains no consensus about the level at which traffickers enter the business. Desroches (2005) found 2 out of 3 participants, most of whom did not use drugs, entered straight at the higher levels. Adler (1985) found 75% of traffickers entered at the middle market and then 80% went on to the higher market from there. Most who entered at the higher levels did not use drugs. Drug use was more likely to occur amongst those who entered at the low-level. Reuter and Haaga (1989) found most entered at the low level (motivated by their own use) and worked their way up from there via chance meetings with people higher in the chain. Taken together, these studies suggest that it is possible to enter the business at any level.

However, if the trafficker used drugs then they appear more likely to have first entered at the lower-level.

Characteristics of drug traffickers

While studies above show that there are few entry requirements for high-level drug traffickers, studies from across the globe show that high-level drug traffickers often share similar characteristics. Of note, most are male, aged between the mid 20s and mid 40s, and have little to no criminal history (excluding their current incarceration). For example, the 34 incarcerated cocaine smugglers in the USA—interviewed by Decker and Chapman (2008)—were all male. Most were without a prior criminal history and over 25 years old. Reuter and Haaga (1989) similarly found that their 40 incarcerated high-level cocaine and cannabis traffickers in the USA had an average age of 39, and most had business experience in the legitimate world. Adler (1985), in her ethnographic study of 65 high-level cannabis and cocaine traffickers in the USA, found most were mostly from well off backgrounds, had limited criminal history, and were mostly males between 25 and 40 years old. In Canada, Desroches (2005) reported that his sample of 70 incarcerated traffickers (mostly cocaine and heroin) were 40 years old on average, were all male, and were mostly from well off families with legitimate jobs and/or businesses. Moreover, the majority of this sample did not use drugs or have prior convictions. Finally, the Matrix Knowledge Group (2007) found that their sample of 222 incarcerated traffickers from all distribution levels in the UK were mostly male, aged in their 30s and 40s, and often employed in legitimate businesses.

However, analyses suggest there may be some subtle differences across countries. For example, Pardal et al. (2014) interviewed male traffickers in three European countries: Germany ($n = 19$), Italy ($n = 72$) and Slovenia ($n = 44$). In Italy, most were unemployed at the time of arrest, whereas most were employed in Slovenia and Germany. There also appears to be differences in characteristics specifically between developed and developing countries. Chin and Zhang (2007) interviewed 578 incarcerated traffickers in China and Myanmar. Most had limited education and about half were unemployed at the time of arrest. There was a relatively even split of male and female traffickers in the sample, albeit the researchers noted that females were oversampled in order to make the ratios similar in the obtained sample. This research suggests that in developing countries, there is a higher proportion of female traffickers, and that traffickers overall are less likely to be employed or educated.

One other important difference to have been identified is whether or not traffickers are mono or poly drug traffickers (Europol, 2013; Hughes, Bright, & Chalmers, 2017; Hughes, Chalmers,

Bright, & McFadden, 2016a; Hughes, Chalmers, Bright, & McFadden, 2016b). Mono drug traffickers traffic only one drug type. Poly drug traffickers traffic multiple drug types. In 2013, Europol argued that poly drug trafficking is now a common and more harmful modus operandi of high-level traffickers (Europol, 2013). However, academic studies suggest this remains a more specialised form of drug trafficking, albeit one that is more harmful. For example, Matrix Knowledge Group (2007) reported that 32.6% of their sample of 222 traffickers in the UK from retail, mid, and wholesale levels sold multiple drugs during their careers. Pearson and Hobbs (2001) reported 38% of their UK sample of 51 retail and wholesale-level traffickers sold multiple drugs. Ovenden, Loxely, and McDonald (1995) reported 41% of their sample of 32 high-level traffickers in Western Australia dealt multiple drugs throughout their career. That said, the main academic study to have examined poly drug trafficking specifically was an Australian study by Hughes, Chalmers, Bright, and McFadden (2016b). Through using border seizure data and case data from the Australian Federal Police, they estimated that up to 35% of traffickers who import drugs into Australia traffic multiple drugs. Importantly, they also assembled matched comparisons of poly-drug and mono-drug traffickers and showed that poly drug traffickers were associated with much larger quantities of drugs, money and assets seized, larger trafficking networks, more involvement in other serious and organised crime, and a longer history of drug trafficking (an average of 13 years compared to 4 years). Poly drug traffickers were also associated with distinct network features including a higher level of inter-connectedness across network members. This suggests that poly drug traffickers may be a distinct albeit minority category of trafficker, who may be more profitable, resilient, and harmful than mono drug traffickers.

To conclude, most high-level drug traffickers appear to be male, aged between the mid 20s and mid 40s, are employed in legitimate work, have little to no criminal history, and are from well-off backgrounds. However, there appears to be some subtle differences between countries which may be more pronounced between developed and developing countries and between traffickers who trade only one drug (mono-drug traffickers) versus multiple drugs (poly-drug traffickers). The latter will be one important factor explored in the current thesis: to explore whether stimulant traffickers who trade in multiple drugs are more able to navigate supply changes and/or whether they respond in different ways to their mono-drug counterparts.

Resilience to Market Shocks

The studies reviewed above suggest that poly drug traffickers are more resilient to market shocks than mono drug traffickers, but there are many studies world-wide suggesting drug traffickers and their networks are resilient in general (Bouchard, 2007; Desroches, 2007; Dorn, Levi, & King, 2005; Hastings, 2015; Hughes, Bright, & Chalmers, 2017; Hughes, Chalmers, Bright, & McFadden, 2016a; Ovenden, Loxely, & McDonald, 1995; Pearson & Hobbs, 2001). Sources of market shock to illicit drug markets may include anything from law enforcement intervention, policy changes, increases in competition, and decreases in consumer demand for drugs. According to Bouchard (2007, p. 329), resilience in drug markets refers to "the ability of market participants to preserve the existing levels of exchanges between buyers and sellers, despite external pressure aimed at disrupting the trade". He argued that drug trafficking networks are resilient to external shocks because they are highly elastic. For example, as outlined earlier, there are few barriers to becoming a drug trafficker and there are high financial incentives to join. In most cases, no previous experience is required, and start-up capital is rarely an issue either. This means that if any traffickers in the network are arrested they can easily be replaced in a short period of time and the network can continue to function.

The fragmented structure of most drug trafficking networks also provides resilience and contributes to elasticity. First, a fragmented structure is decentralised, meaning its operation does not depend highly on any one individual. Even if well connected traffickers are arrested, the network is likely to still function with acceptable efficiency. This makes it more resilient to targeted attacks by law enforcement (Morselli, 2009b)[2]. Second, fragmented networks are typically low in density (Bright, Greenhill, Ritter, & Morselli, 2015; Bright & Delaney, 2013; Bright, Hughes, & Chalmers, 2012; Tenti & Morselli, 2014). In other words, there are relatively few connections between network participants. If there were to be any arrests, those arrested are less able to provide incriminating information about others in the network.

Finally, traffickers adopt many kinds of strategies to reduce their risk of disruption. Strategies include: only sharing knowledge that is essential to the operation (the less known by market participants the less law enforcement officers and competing traffickers can learn about them), selling drugs quickly and not holding onto them too long, corrupting public officials, keeping groups small, and using multiple bank accounts, phones, and encrypted software

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[2] As noted earlier, a decentralised network is vulnerable to disruption if an intervention targets and removes the brokers. However, this demands prior knowledge of who they are, which is a challenging task.

(Adler, 1985; Adler & Adler, 1983; Bouchard, 2007; Bright & Delaney, 2013; Decker & Chapman, 2008; Desroches, 2005; Matrix Knowledge Group, 2007; Morselli & Petit, 2007; Pearson & Hobbs, 2001; Tzvetkova et al., 2014). All of this adds to their resilience, and increases their likelihood of being able to provide a continuous flow of drugs at all times.

Although traffickers and their networks exert a high degree of resilience to market shocks, there may be times when the shock is so great that recovery becomes difficult. For instance, traffickers may be faced with supply shortages due to a natural disaster (Dunlapa, Gravesb, & Benoita, 2012) or large-scale law enforcement intervention (Dobkin & Nicosia, 2009). Major supply disruptions which have occurred in the past include: the global ecstasy shortage in the late 2000s (EMCDDA, 2016c; Scott & Burns, 2011), the Australian heroin shortage in the early 2000s (Degenhardt, Day, & Hall, 2004; Degenhardt, Reuter, Collins, & Hall, 2005), the UK heroin shortage in the early 2010s (Harris, Forseth, & Rhodes, 2015), and the United States methamphetamine shortage in the mid-1990s (Dobkin & Nicosia, 2009). When situations like these arise, traffickers may consider adapting to reduce their vulnerability. This means that they "find alternative ways of supplying demand" (Bouchard, 2007, p. 336).

Consistent with this view, several studies have provided evidence of traffickers adapting when faced with disruptions to their supply. For instance, known adaptations to supply shortages are to look for an alternative supplier or to increase the price of drugs to the customer. These adaptations have been reported by several incarcerated and active traffickers in the USA (Adler, 1985; Dunlapa, Gravesb, & Benoita, 2012; Reuter & Haaga, 1989), and by incarcerated traffickers in Italy and Slovenia (Tzvetkova et al., 2014), Western Australia (Ovenden, Loxely, & McDonald, 1995), and the UK (Matrix Knowledge Group, 2007).

Switching drug types is also a commonly reported adaptation to supply disruptions. Ovenden, Loxely, and McDonald (1995) found that some traffickers in Western Australia adapted to a reduction in cannabis availability by selling methamphetamine instead. Pearson and Hobbs (2001) found that some traffickers in the UK attempted to sell cocaine when there was no cannabis available and when there was no cocaine available they would sell meth/amphetamine. Decker and Chapman (2008) found that after exposure to a cannabis shortage, some traffickers switched to selling cocaine.

Other reported adaptations to supply disruptions have been to: attempt to manufacture drugs or precursors instead of looking for the end-product (Ovenden, Loxely, & McDonald, 1995; Vijlbrief, 2012), return the poor quality drugs to the supplier (Desroches, 2005; Pearson & Hobbs, 2001), refuse to buy the poor quality drugs (Desroches, 2005), attempt to sell the lower

quality drugs (Ovenden, Loxely, & McDonald, 1995), recruit new people into the network with specialised skills or contacts (Bright & Delaney, 2013; Morselli & Petit, 2007), attempt to import more drugs (Morselli & Petit, 2007), establish new partnerships (Hastings, 2015), become temporarily inactive and wait for new supply to arrive (Ovenden, Loxely, & McDonald, 1995; Tzvetkova et al., 2014), and decentralise the network (Morselli & Petit, 2007).

However, market changes, including supply changes, are not always disruptions. For example, traffickers are occasionally exposed to supply surges as well, such as the Australian heroin "glut" in the mid to late 90s (Dietze & Fitzgerald, 2002), a significant decrease in the price per pure gram of meth/amphetamine in Victoria (indicating increased supply), (Scott, Caulkins, Ritter, Quinn, & Dietze, 2015), and a near doubling of Afghan opium production between 2016 and 2017 (UNODC, 2017). When exposed to supply increases, some traffickers in Europe have reported attempts to buy more drugs than usual (Matrix Knowledge Group, 2007; Tzvetkova et al., 2014). Several participants reported that this adaptation was used to guard against potential supply disruptions at a later time. If supply dried up and they had a stockpile of good quality drugs, then they could still continue to supply their customers.

The studies reviewed above suggest that when traffickers are faced with supply changes, they are likely to adapt in order to ensure existing business relationships are maintained. One implication of this is that supply changes could lead to changes in the potential for harm to the public. For instance, some of the identified adaptations may increase the potential for harm, such as recruiting new people into the business, switching to more harmful drugs such as meth/amphetamine or heroin, and attempting to manufacture drugs. This highlights an importance of understanding which adaptations traffickers are likely to make, particularly given that law enforcement officers aim to cause supply changes.

The main challenge with current knowledge in this area is that studies reporting adaptations to supply changes have mostly been ad-hoc. That is, adaptations are seldom the focus of the study. Most of the above studies which reported adaptations originally sought to research trafficker practices in general, such as how and why they enter the business, the profits involved, typical group sizes, and general business strategies. Most adaptations to date have been reported by only a few participants in each sample as a side note. Finally, most research on this topic has been conducted outside of Australia. There is yet to be a systematic analysis of adaptations to supply changes in Australia, or overseas. This leaves many important unanswered questions. First, it is unclear what kinds of adaptations are the norm. Second, it is unclear whether there is a relationship between the adaptation used and the various

characteristics associated with a supply change (such as the supply change kind, cause or direction). For example, traffickers may adapt differently to law-enforcement-caused supply changes than they do to non-law-enforcement-caused supply changes, or may adapt differently to purity changes than to quantity changes. Third, it is unclear what proportion of traffickers continue selling drugs after a supply change, nor is it clear whether their ability to continue selling drugs is influenced by the various characteristics of the supply change. For example, traffickers may be less likely to continue selling drugs after purity changes than after quantity changes. The lack of knowledge in this area limits ability to understand whether / to what extent there will be changes in the potential for harm to the public when supply changes occur.

In sum, illicit drug traffickers and their networks exert a high degree of resilience to market shocks. But sometimes they are faced with supply disruptions which may leave them vulnerable. When situations like these arise, traffickers may engage in one or more adaptations in order to maintain existing business relationships with their customers.

Conclusion

This chapter presented a literature review of global and Australian drug supply, illicit drug markets, and high-level traffickers. It firstly outlined the characteristics of the global and Australian illicit drug market, showing that global illicit synthetic stimulant production is likely on the rise and has recently overtaken the production of heroin for the first time. It secondly outlined the typical features of drug markets and drug traffickers; specifically: that they often comprise small groups which are loosely connected, that there are minimal entry barriers other than trust connections, that there are high financial incentives for new people to become a trafficker, and that there is a special minority class of trafficker–the poly drug trafficker–who appears more resilient and harmful. It thirdly showed that traffickers and networks in general, exert a high degree of resilience to market shocks. However, a clear challenge for traffickers is when they are faced with supply changes, which may leave them vulnerable. It seems that in many instances traffickers will adapt when faced with supply changes in order to preserve existing business relationships. Some of these adaptations may result in an increased potential for harm to the public. But given that a systematic analysis of adaptations is lacking, it remains unclear which adaptations are most likely to occur and whether traffickers will typically continue to sell drugs in the wake of a supply change. This makes it difficult to understand whether there will be any changes to the potential for harm to the public when supply changes occur. The present thesis addresses this gap in knowledge.

The next chapter reviews the literature around methodological challenges with respect to studying drug supply changes and drug trafficking.

Chapter 3: Methodological Challenges in Studying Drug Trafficking and Drug Supply

Research in the field of illicit drug trafficking, whether studying supply changes or the traffickers themselves, is challenging as it addresses hidden populations or behaviours. Research on high-level trafficking specifically (as opposed to research on low-level dealers) is particularly challenging because high-level traffickers have much more at stake if caught (e.g. greater prison time and financial loss) and consequently are more likely to remain in the shadows. Moreover, there are fewer high-level traffickers compared to retail-level dealers (Reuter et al., 2009). It is perhaps for these reasons that most research on illicit drug trafficking has been conducted on the lower-level (Aitken, Moore, Higgs, Kelsall, & Kerger, 2002; Chalmers & Bradford, 2013; Coomber & Maher, 2006; Curtis, 1996; Grundetjern & Sandberg, 2012; McKetin, McLaren, Kelly, & Chalmers, 2009). Due to the difficulties gaining access to high-level drug trafficker populations, most data on high-level drug trafficking and drug supply is derived from law enforcement data or from traffickers who have already come to the light of authorities.

There are two parts to this chapter. The first part provides a discussion of the methods available to research high-level drug trafficking. This includes an analysis of their advantages, limitations (including whether there are any potential issues with reliability, validity, or bias), and practical constraints. The second part of this chapter provides a discussion of the methods available to research drug supply changes and follows the same format as the first part.

Available Methods to Research High-Level Drug Trafficking

Available methods to research high-level drug trafficking are qualitative interviews with incarcerated traffickers, ethnographic research with active drug traffickers, analysis of court transcripts, analysis of judges' sentencing comments, analysis of prosecution files (such as wiretap data or files from criminal registries), interviews or surveys with law enforcement officers, and interviews or surveys with people who use drugs. A detailed review of each method is conducted below.

   Incarcerated traffickers

Perhaps the most common method used to research high-level drug trafficking is interviews with incarcerated high-level traffickers. This kind of research more commonly occurs overseas

than in Australia. Overseas countries include the UK, Germany, Italy and Slovenia (Caulkins et al., 2015; Matrix Knowledge Group, 2007; Pardal et al., 2014; Pearson & Hobbs, 2001; Pearson & Hobbs, 2003; Pearson & Hobbs, 2004; Tzanetakis, 2012; Tzvetkova et al., 2016; Tzvetkova et al., 2014), as well as the USA (Decker & Chapman, 2008; Reuter & Haaga, 1989), China and Myanmar (Chin & Zhang, 2007), and Canada (Desroches, 2007). In comparison, only two studies of this nature have been published in Australia. The first was an analysis of trafficker practices and their perceptions of drug availability in Western Australia, which led to a book publication in 1995 (Ovenden, Loxely, & McDonald, 1995) and an article in 1998 (Loxely, 1998). The second was a PhD thesis on heroin importation (Beyer, 2004). Interview studies have been used to study the modus operandi of drug traffickers, including their business strategies, risk management strategies, profits, and the role of violence in drug markets.

There are several advantages of interviews with incarcerated traffickers. First, most studies of this nature use semi-structured interviews, meaning the participant can answer freely and elaborate on any given topic in detail. This can result in a very rich and in-depth dataset. Second, given that the research is on a captive audience, it can attract a large sample of participants. For example, Matrix Knowledge Group (2007) interviewed 222 incarcerated traffickers, while Chin and Zhang (2007) interviewed 578. Third, it's possible to ask the participant about a broad range of topics not limited to a specific criminal event. This provides a real advantage over the other methods of research. In particular, analysis of court transcripts, judges' sentencing comments, and prosecution files, only allow analysis of specific criminal events that are relevant to the judicial process. Interviews with incarcerated traffickers on the other hand allow a broader range of data to be collected and analysed. For example, Matrix Knowledge Group (2007) examined a vast range of topics based on interviews alone, including market dynamics (such as market size, levels, and prices), enterprise structures (such as conditions for market entry, nature of relationships, roles, and business structures), and the strategic responses of traffickers (such as growing an enterprise, competition, and risk management).

There are several reliability issues with this method. Participants must be willing to report sensitive information that may or may not be known to police. This may result in dishonest or untrue answers, or answers depicting only part of the story. Inconsistencies in participants' accounts of events have been reported in previous interview studies (Pardal et al., 2014). Participants may be required to recall events that happened some time ago (sometimes many years), which may be difficult to recall accurately. It also may mean that the data are outdated, particularly if the participant was imprisoned for 10 or more years and is asked to recall events

from more than a decade ago. There is also a possible selection bias towards particular types of traffickers participating which may pose threats to validity. For example, those from outlaw motorcycle clubs appear less likely to participate in interviews (Decker & Chapman, 2008), and those who have a motivation to participate may operate systematically differently from those who have no motivation to participate.

The main practical constraint is access issues. Different countries have different ethics standards, some of which may prevent research of this nature taking place. For example, Tzvetkova et al. (2014) and Pardal et al. (2014) were not permitted to interview traffickers in some European countries. In Australia, obtaining ethics approval to interview traffickers and permission to publish the findings is particularly challenging. For example, Beyer (2004) obtained ethics approval to interview heroin importers, but the data had to be deleted prior to the thesis being published. More recently, Ritter Bright and Gong (2012) applied to interview incarcerated meth/amphetamine traffickers in Australia, but were declined by the prison ethics committee[3]. One of the main reasons for difficulties in an Australian setting is participant confidentiality and security concerns within a prison setting. While researchers may go to great lengths to ensure confidentially is maintained (such as never asking for identifying information like the participant's name, birthday, or specific details of a crime) confidentially and the security of prison inmates can never be guaranteed.

Ethnographic research with active drug traffickers

Ethnographic research in the field of drug trafficking involves one or more researchers observing and interacting with illicit drug traffickers over an extended period of time in a real life setting as they carry out their business. This may also involve interviews or focus groups with the traffickers being observed.

The most cited ethnographic study of high-level drug trafficking to date was conducted approximately 30 years ago in Southwest County, California (Adler, 1985). Adler engaged with members of the cannabis and cocaine trafficking community after becoming friends with a group of cannabis traffickers whom she met through her neighbour. She spent six years on a

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[3] The original plan for this thesis was to conduct interviews with incarcerated high-level ecstasy traffickers. A semi-structured interview schedule was devised that asked inmates hypothetical scenarios, including how they *would have* adapted to a range of supply change categories. Although the research was noted to be interesting and valuable by New South Wales Corrective Services, the ethics application was declined on the grounds of confidentially concerns and the potential risks to interviewees.

daily basis between 1974 and 1980 interacting and networking with traffickers by attending their social gatherings, partying with them, travelling with them and watching them plan and execute trafficking deals. Other published ethnographic studies of drug trafficking include a study of how a local US market responded to a natural shortage during Hurricane Katrina in 2005 (Dunlapa, Gravesb, & Benoita, 2012) and studies of drug trafficking in East Harlem (Bourgois, 1995), on the US-Mexico border (Campbell, 2005), in the Tierra Caliente region of Michoacán (Malkin, 2001), and in Peru (Roberts, 1990). To the best of knowledge, there has been no Australian ethnographic study of high-level drug traffickers, albeit there was a study involving interviews with 55 active meth/amphetamine dealers in Sydney (McKetin, McLaren, & Kelly, 2005).

The main advantage of ethnographic research is that traffickers can be observed in their natural state. All actions taken by the trafficker can be observed first hand as they happen. This provides a rich understanding of trafficker behaviour which is both holistic and contextual—much more so than other methods. For instance, if incarcerated traffickers are interviewed, their answers about how they operate may be filtered or only partially correct due to confidentiality concerns or an unwillingness to disclose sensitive information. Similarly, court or law enforcement data may only contain fragmented pieces of information (only what has come into the light of authorities). These shortcomings are less apparent in ethnographic research as the researcher can observe events as they happen from the source.

Ethnographic research is particularly susceptible to biases from the researcher's own past experience and goals. For example, by being immersed in the lives of the drug traffickers over a long period of time, the researcher is likely to become close to them. This can bias the lens on how the offending behaviour is interpreted. The actions of traffickers may also be interpreted differently by different researchers. For example, if the researcher used drugs, then this can affect the researcher's narrative of events and conclusions about the research findings. They may describe an event as being more positive or negative, important or unimportant, given their past experience with drugs. Further, a novice researcher may have difficulties interpreting the language and actions used by drug traffickers, which can affect the quality of the data coded.

There are practical constraints to this method of research, with the main one being length of time to do the research. Ethnographic research requires rapport building and trust with participants which can take a long time to achieve. For example, one of the ethnographers in the study by Sandberg and Copes (2012) reported a period of eight months rapport building

with traffickers before they allowed her into their world to begin the research. For this reason drug trafficking ethnographic research tends to result in a low sample size (Sandberg & Copes, 2012). It also requires a large commitment over several years. For example, Adler (1985) spent six years on a daily basis observing traffickers in California, and Bourgois (1995) spent more than five years collecting data while observing crack dealers operating New York City. Another practical challenge is safety risks for the researcher. Given the researcher is immersed in the drug trafficking culture, there is always a risk of violence. Episodes of threats or actual violence towards an ethnographic researcher in this field has been documented several times in the past (Sandberg & Copes, 2012). While it is also possible for incarcerated traffickers to become violent during interviews, the safety risk is higher during ethnographic research as there are no prison guards or police around to intervene.

Court transcripts

Research using court transcripts involves reading the transcriptions of proceedings from court cases involving drug trafficking crimes and identifying the data of interest to the research questions. A court transcript includes text of the crown and defence opening and closing statements, witness testimonies, cross examinations, and court rulings (Le & Lauchs, 2013; Natarajan, Zanella, & Yu, 2015). Court transcripts have been used to study drug trafficking practices and networks in Australia (Le, 2013; Le & Lauchs, 2013) and in a variety of other countries including Canada (Morselli & Petit, 2007), Greece (Kostakos & Antonopoulos, 2010), the USA (Natarajan & Belanger, 1998; Natarajan, Zanella, & Yu, 2015), and Europe (Tzanetakis, 2012).

Advantages to using court transcripts are that they contain a detailed articulation of case facts in narrative from, and the facts are presented by the Crown and the Defence Barristers in addition to the judge. This allows the researcher to analyse evidence presented by both sides of the case: an opportunity not present using any of the other research methods presented here.

The disadvantages of using this data source are that only evidence relevant to the prosecution is presented in court. This means the data may be biased around central participants in a criminal network, rather than those at the periphery. For example, see (Berlusconi, 2013) who showed that court judgements miss many peripheral players but are effective at identifying the key network participants. Data are also only what has come to the light of authorities. Hence key details of crimes may be missed.

There is a practical constraint of analysing court transcripts specifically in an Australian context: the financial cost of the research. To obtain a hard copy court transcript in New South Wales, a fee of up to $11 per page is charged (Le, 2013). However, this appears to be less of an issue in other countries. For example, in America or Canada, court transcripts are free to access and publicly available (Morselli & Petit, 2007; Natarajan, 2000). One final practical constraint is the length of each transcript, which may be thousands of pages (Le, 2013). This makes court transcripts less feasible for systematic analyses of large samples.

Judges' sentencing comments

One further research method for studying high-level drug trafficking that appears specific to Australia is analysis of judges' sentencing comments: an abridged transcription of the comments provided by the judge at the time an accused is sentenced in a criminal court. This method has received growing interest in recent years following the work of Bright, Hughes, and Chalmers (2012) who tested their feasibility and utility for analysis of high-level drug trafficking practices and networks. Sentencing comments have been used to study steroid trafficking (Van de Ven, Dunn, & Mulrooney, 2018), the structure of three poly drug trafficking networks (Hughes, Chalmers, Bright, & McFadden, 2016a), the crime commission process of meth/amphetamine manufacture (Chiu, Leclerc, & Townsley, 2011), and the structure of a meth/amphetamine trafficking network (Bright, Hughes, & Chalmers, 2012). Transcripts of judges' sentencing comments are accessible in electronic form via the Australasian Legal Information Institute (AustLII).

The advantages of sentencing comments are that they comprise a concise summary of case facts articulated by the judge and comprise only several pages in length (as opposed to several thousand pages as per the full court transcript). For example, the maximum length of a transcript in the study by Hughes, Chalmers, Bright, and McFadden (2016a) was 42 pages. The concise format means that it is feasible to quantitatively analyse a large sample from multiple jurisdictions in a systematic way. For example, Van de Ven, Dunn, and Mulrooney (2018) systematically analysed a sample of 144 steroid traffickers in multiple Australian jurisdictions. Studies have also shown a utility of judges' sentencing comments for social network analysis (Bright, Hughes, & Chalmers, 2012; Hughes, Chalmers, Bright, & McFadden, 2016a). Finally, the facts presented by the judge are derived from multiple sources of evidence (e.g. witness testimonies, forensic evidence and investigator field notes). This is a form of data triangulation which enhances the credibility of the data.

There are potential reliability and validity issues with judges' sentencing comments, which are similar to that of court transcripts. In addition, sentencing comments are a condensed summary of facts, and not all cases are published online. Serious or precedent cases from higher courts are the main type published. Cases involving more minor offences from lower courts are less likely to be published. Taken together, this may result in an incomplete, fragmented, or biased or picture of events. That said, sentencing comments have be shown to have enough details to study the actions of key participants in a drug trafficking network (Bright, Hughes, & Chalmers, 2012).

In the Australian context judges' sentencing comments are less affected by practical constraints than the other methods. They are free to view, publicly available, and can be downloaded at any time without application from the AustLII website.

Prosecution files

Data on drug trafficking may be collected from prosecution files which are defined here to be any piece of evidence collected by law enforcement investigators which could be used to prosecute a suspected trafficker. This includes, but is not limited to, transcripts of intercepted phone conversations and listening devices, police surveillance reports, written memos of the investigators, criminal history statements, and witness statements. Research on drug traffickers utilising prosecution files has been undertaken in Australia (Bright, Greenhill, Reynolds, Ritter, & Morselli, 2015; Bright, Greenhill, Ritter, & Morselli, 2015; Bright & Delaney, 2013; Morselli, 2009a; Morselli & Petit, 2007) and in countries such as Sweden (Heber, 2009) and Italy (Calderoni, 2012).

Prosecution files have primarily been used to identify the organisational structure of drug trafficking networks (Bright, Greenhill, Ritter, & Morselli, 2015; Calderoni, 2012; Heber, 2009; Morselli, 2009a; Natarajan, Zanella, & Yu, 2015), the structural and functional changes of a drug trafficking network over time (Bright & Delaney, 2013), and key individuals including their attributes within a drug trafficking network (Bright, Greenhill, Reynolds, Ritter, & Morselli, 2015).

One of the main strengths of this data source is the depth of the data present. It may contain evidence that did not make it to court and therefore may have more detail than sentencing comments or court transcripts, but less depth than data obtained from interviews or ethnography. For example, during a criminal investigation there may have been intercepted phone conversations between drug traffickers discussing key bits of information relevant to

the research, but such evidence may not have reached court if it beared no relevance to the prosecution case. Lastly, since prosecution files are derived from multiple sources of evidence (e.g. witness testimonies, forensic evidence and investigator field notes), it could be argued that this data source has already undergone data triangulation, which strengthens its credibility.

Given that prosecution files are largely based on law enforcement investigations, they share the same potential biases as court data: missing data is possible. The main practical constraint with prosecution files is that due to the data being very detailed and lengthy, the data collection and analysis process can be laborious. For instance, one study collected and analysed data from New South Wales Office of the Director of Public Prosecutions to identify the attributes of key participants in a meth/amphetamine trafficking network. The data comprised a range of documents that filled a total of 24 boxes (Bright, Greenhill, Reynolds, Ritter, & Morselli, 2015). This means that prosecution files are less suitable for an analysis of a large sample.

Interviews or surveys with law enforcement officers

Interviews with law enforcement officers are seldom the sole data collection method when studying drug trafficking. Rather, they are commonly used in conjunction with other data collection methods. For example, Pearson and Hobbs (2001) interviewed law enforcement officers as well as incarcerated traffickers, to understand how mid-level traffickers operate in the UK. Ritter, Bright, and Gong (2012) interviewed law enforcement officers, reviewed the literature, and analysed judges' sentencing comments, to study meth/amphetamine trafficking in Australia. Chin and Zhang (2007) interviewed law enforcement officers, incarcerated traffickers, people who use drugs, and researchers, to study drug trafficking practices in China and Myanmar.

A key advantage with interviewing or surveying law enforcement officers is that they may have first-hand experience watching or interacting with traffickers (as an undercover), and so can provide detailed insight into trafficking practices. Further, they may be more willing to discuss drug trafficking practices than the traffickers themselves as they are not risking lengthy prison sentences or retaliation from other traffickers. Finally, similar to interviews with traffickers, officers can also be asked about a broad range of topics not limited to a specific criminal event. This provides an advantage over analysis of court transcripts, judges' sentencing comments, and prosecution files, which only allow analysis of specific criminal events that are relevant to the judicial process.

There are a few limitations with interviews or surveys with law enforcement officers. First, their knowledge is based only on what has come to the light of authorities. It is not information straight from the traffickers themselves. This may result in an incomplete, fragmented, or biased recount of events. Second, as with any self-report data, the interviewee may have to recall events from several years ago, which may be difficult to recall accurately. Third, given their job is to prevent and deter illegal behaviour, they may over inflate their success or downplay the success of traffickers when recalling events.

A practical constraint with this method is gaining access to law enforcement officers, which can be challenging. Moreover, due to professional reasons, officers may be unable to disclose many key details about traffickers, particularly if it could jeopardise current or future investigations, or reveal investigation techniques.

Interviews or surveys with people who use drugs

As above, interviews with people who use drugs are seldom the sole data collection method when studying drug trafficking. For example, Degenhardt, Conroy, Gilmour, and Collins (2005) analysed interviews with people who use drugs and law enforcement, as well as law enforcement data (including arrests and police documents), to examine the effects of the Australian heroin shortage in New South Wales. McKetin, McLaren, and Kelly (2005) interviewed people who use drugs alongside active meth/amphetamine traffickers in Sydney.

The advantage of interviews with people who use drugs is that they have much less at stake than high-level traffickers. This means that it is more feasible to obtain a much larger sample size than interviewing incarcerated or active traffickers, as there will be more people willing to participate in the research. For example, the main studies in Australia which survey people who use drugs obtain an annual sample of between 600 and 900 participants (Sindicich & Burns, 2015; Stafford & Breen, 2016). In comparison, most studies with traffickers have less than 100 participants (Adler, 1985; Decker & Chapman, 2008; Pearson & Hobbs, 2001).

The downside is that insights provided by these groups are not from the traffickers themselves; and given that people who use drugs are unlikely to interact with traffickers at the high-level, this method in particular is more suited to studying low-level dealing (not high-level trafficking).

Available Methods to Research Drug Supply Changes

There are many different methods that can be used to research drug supply changes. Prompted by recognition of the limitations with existing methods, there is also a fast-growing field about what data to use and how to most optimally analyse it. The work of the RAND in Santa Monica (Kilmer & Hoorens, 2010) and ECMDDA (Singleton, Cunningham, Groshkova, Royuela, & Sedefov, 2018) warrants particular attention for leading the field. For example, the EMCDDA has been working on ways to improve analysis quality of law enforcement seizure data: by way of improving the data collection processes, extending the detail at which these data are collected, and by improving analytical methods. The section below reviews some of the core methods to studying drug supply changes.

Law Enforcement Seizure data

Law enforcement data on drug seizures is the main indictor of drug supply changes in most countries, including Australia. To indicate supply changes from seizure data, the most common approach is to examine trends in total seizure quantities, such as trends in the annual total weight or number of seizures (Bramness, Reid, Solvik, & Vindenes, 2015; Degenhardt, Reuter, Collins, & Hall, 2005; Fowler, Kinner, & Krenske, 2007; Hughes, Chalmers, Bright, Matthew-Simmons, & Sindicich, 2012; Leone, Scatigna, Donati, & Pesce, 2012; Schifano, Corkery, Deluca, Oyefeso, & Ghodse, 2006; Stoneberg, Shukla, & Magness, 2017). The rationale being that changes in total seizure quantities depend on changes in the quantity of drugs trafficked. When all other variables are held constant, the more drugs trafficked, the more likely it is that law enforcement officers will discover and seize drugs, and vice versa. Several law enforcement agencies also collect contextual information about seizures, such as the form, mode of transport, and country of embarkation (Australian Crime Commission, 2011; UNODC, 2011). Seizure data can therefore be used to indicate a range of different supply changes other than just quantity. For example, Hughes, Chalmers, Bright, Matthew-Simmons, and Sindicich (2012) examined changes in the mode of transport of Australian border detection data to indicate changes in cocaine importation methods. Therefore, the key advantage of seizure data is that the one data source can provide an opportunity to understand many kinds of drug supply changes in a given region.

Seizure data are, however, not without limitations. Changes in total quantities of seizures could reflect any one of three factors: supply fluctuations, the ability of traffickers to conceal their drugs, or the extent of law enforcement activity (Kilmer, Reuter, & Giommoni, 2015). See for example debates about the complexities of seizure data in the context of the Australian

heroin shortage (Degenhardt, Day, & Hall, 2004). This means that it is possible to see an increase or decrease in total seizure quantities even if the quantity of drugs trafficked in the community remains unchanged. As such, the reliability of seizure data as an indicator of supply changes is less than perfect (Degenhardt, Topp, & Day, 2003; Kilmer & Hoorens, 2010; Kilmer, Reuter, & Giommoni, 2015; Weatherburn & Lind, 1997; Willis, Homel, & Gray, 2006).

Further, in federated nations, seizure data are collected by numerous law enforcement agencies, all of which may have different reporting or data collection methods (Singleton, Cunningham, Groshkova, Royuela, & Sedefov, 2018). Different reporting and collection methods may significantly affect trends produced by the data, and in turn limits ability to compare trends reliably between states or other countries (UNODC, 2011). For example, the legal and social status of cannabis can differ largely from country to country (Belackova, Brandnerova, & Vechet, 2018). Countries which view cannabis as more socially acceptable may have different priorities on enforcing cannabis supply laws. If seizures of cannabis were lower in one country compared to another, it therefore does not necessarily mean that cannabis supply was less in that country. Finally, traffickers in some countries may be more likely to import larger quantities of drugs in a single shipment, which could result in a number of unusually large seizures. This may skew trends in the annual total quantity of drugs seized in those countries.

Several methods have been suggested for a more optimal analysis of drug supply indicator data. First, rightly argued by Degenhardt, Topp, and Day (2003), data triangulation is one of the best means to reduce the risk of biases associated with these data. Multiple indicators, rather than just one, should be examined in tandem and the degree of consistency measured. If all supply indicators produce trends with a high degree of consistency, then any apparent trends can be reported with more confidence. While data triangulation methods are common for many research areas, it is particularly important in drug supply research given a reliance upon data sources that can be easily skewed. Second, adjustments for outliers (i.e. a few unusually large seizures) could be made to reduce the risk of projecting a skewed picture of the market (Kilmer & Hoorens, 2010). Finally, rather than simply examine the total weight of drug seizures (the traditional analysis), analysis by weight bin could be used to examine trends at different levels of the supply chain (i.e. retail, mid-level and wholesale) offering insight into supply changes at different distribution levels (Kilmer & Hoorens, 2010). The utility of the latter two methods for supply trends analysis of ecstasy and meth/amphetamine in Australia will be specifically tested in Chapter 4 of this thesis.

Forensic purity data

In some jurisdictions, drug samples are analysed for purity in a laboratory, which can be used to indicate changes in the purity of drugs over time. There are two approaches to this. First, drug seizures by law enforcement agencies can be analysed for purity in a laboratory. Forensic purity analyses of seizure data are more common in the USA (Arkes, Pacula, Paddock, Caulkins, & Reuter, 2004; Arkes, Pacula, Paddock, Caulkins, & Reuter, 2008; Dobkin & Nicosia, 2009; Fries, Anthony, Cseko, Gaither C. C, & Schulman, 2008), but also occur in Australia (Scott, Caulkins, Ritter, Quinn, & Dietze, 2015) and in parts of Europe (Kilmer & Hoorens, 2010). For example, Kilmer and Hoorens (2010) analysed the purity of heroin seizures to indicate changes in heroin purity in Europe. The other approach is to analyse trends in forensic purity data of drug samples provided by people who use drugs. In some countries, the public can submit drug samples to a drug checking service. The content of the samples is forensically analysed by qualified analysts, and the data can be used for monitoring drug supply trends (in addition to informing the owners of the samples about the results). Forensic purity data from drug checking services has been used to indicate ecstasy purity changes in Italy (Giné et al., 2016) and in the Netherlands (EMCDDA, 2016a).

The advantage of forensic purity data is that they are arguably the best available indicator of drug supply changes (Kilmer & Hoorens, 2010; Scott, Caulkins, Ritter, Quinn, & Dietze, 2015): they are the most objective, sensitive and reliable measure of drug supply fluctuations available, are less likely to depend on changes in law enforcement activity than total seizure quantities and are not subjected to the biases associated with self-reports.

The biggest challenge to produce a meaningful purity analysis is that it should be conducted using price-adjusted purity and not raw purity (Kilmer & Hoorens, 2010; Kilmer, Reuter, & Giommoni, 2015). This is to compensate for any changes that suppliers may make to the price of their product. For example, the average purity of meth/amphetamine may be identical in one month compared to the next. But if the price of meth/amphetamine rose in that time, customers must pay a higher price per pure gram. An analysis of raw purity cannot detect this supply change. The challenge is, however, that both price and purity data are not always available, particularly outside of the USA (Kilmer, Reuter, & Giommoni, 2015). The quality of data is also affected by whether or not the analysis is of a non-random selection of seizures, or all seizures. Other challenges are that the purity of drugs seized by police may systematically differ to the purity of drugs not seized; and drug samples submitted by people who use drugs will most likely be reflective of retail-level purity only (not mid or high-level purity).

In Australia specifically, Victoria remains the only jurisdiction to analyse the purity of all drug seizures made within the state, regardless of the weight or legal significance (Scott, Caulkins, Ritter, Quinn, & Dietze, 2015). All other states and territories only analyse the purity of seizures likely to go before the court (Australian Crime Commission, 2016), which is likely to skew purity trends. This has hindered the ability to utilise this data source at the national level (albeit not sub-national level).

Price data

The price of illicit drugs varies as a function of supply, demand, and perceived risk. For instance, the price of drugs may increase if there is a shortage of supply, or if there is an increase in demand, or an increase in law enforcement activity (meaning increased risk of being caught), (Reuter & Klieman, 1986). Price data can be collected using a number of methods. One method includes asking people who use or traffic drugs what they pay to purchase a given quantity of drugs (Caulkins, Gurga, & Little, 2009; Caulkins, Johnson, Taylor, & Taylor, 1999; Sindicich & Burns, 2013; Stafford & Breen, 2016). Another method includes obtaining price data from undercover officers who record the price of drug transactions they make with traffickers they are investigating (Gong, Ritter, Bright, & Doran, 2012).

As with analysis of purity, key challenges remain data access and availability. Moreover, the most useful data requires standardised measures of price at different levels of the market, which is to date hard to access: that is, the purity-adjust price for high, mid, and retail market levels (EMCDDA, 2017).

Arrest data

Law enforcement data on arrests for drug supply offences are often used as an indicator of the scale of trafficking (Degenhardt et al., 2016; Dobkin & Nicosia, 2009; UNODC, 2012), which is assumed to be related to the size of the market. If there is more supply, it is assumed that more arrests will be made because more people will be trafficking and/or because existing traffickers will be more active.

Arrest data have the same limitations as seizure data and are therefore seldom analysed alone. For instance, the number of arrests depends on not just quantity fluctuations, but also on the ability of traffickers to conceal drugs, and the extent of law enforcement activity.

Self-reports from people who use or traffic drugs

People who use and/or traffic drugs can be asked about their perceptions of changes in drug supply, such as changes in purity or quantity (Patterson, Goldsmid, & Gannoni, 2016; Sindicich & Burns, 2015; Stafford & Breen, 2016). For example, people who used heroin in the UK were interviewed about their perceptions of heroin supply changes in 2010 and 2011 (Harris, Forseth, & Rhodes, 2015); incarcerated traffickers in Western Australia were asked to report on the availability of a range of different drugs (Ovenden, Loxely, & McDonald, 1995); and as noted above, people who use drugs in Australia are asked on an annual basis about perceived price, purity, and availability of illicit drugs in Australia (Sindicich & Burns, 2013).

Data obtained from people who use and/or traffic drugs have several limitations. First, people's reports of availability and purity are subjective and not scientific measurements. Perceptions of purity for example are dependent on the participant's tolerance to the substance in question. A participant with a high tolerance to ecstasy may report a pill to be low in purity, but a different participant with a low tolerance may report the purity of the same pill to be high. Subjective reports can therefore result in noisy data which are less reliable than other methods, such as a forensic purity analysis of seizure data. Second, the quality of the data is dependent on participants' ability to accurately recall information. Third, self-report data are usually collected in a limited number of areas which limits the generalisability of findings. For example, the main survey in Australia capturing ecstasy use patterns and perceptions of supply is conducted with a sentinel group of participants in major cities only, meaning the findings are not necessarily representative of the Australian population or regional areas (Sindicich & Burns, 2013).

Wastewater data

Wastewater analysis was first introduced in 2005 in an Italian context (Zuccato et al., 2005) and is increasingly being used to supplement analysis of drug markets (Benjamin J. Tscharke, 2016; Chen, 2013; Chen et al., 2011; Tscharke, Chen, Gerber, & White, 2015). Wastewater data are measurements of the concentration of drug molecules in sewerage systems. They are primarily used to infer drug consumption patterns in a given geographic location. For instance, an increase in meth/amphetamine excrements was interpreted as an increase in the prevalence of use (Tscharke, Chen, Gerber, & White, 2015). However, these data are increasingly being used to indicate drug supply changes in a given region (EMCDDA, 2017). The logic behind this, is that the more quantity of a drug available, the more use of that drug is

then likely to take place, and therefore the more of that drug is likely to be excreted into the sewer system.

There are, however, challenges with wastewater analysis. First, there are multiple reasons why the concentration of drug molecules in any given sewer may increase or decrease. For example, an increase in ecstasy in the wastewater may have been caused by an increase in the purity of supply, an increase in the frequency of use, and increase in the prevalence of use, or it may be due to any combination of those. This makes it difficult to infer which supply changes have occurred. For example, was the increasing trend due to a quantity increase, purity increase, or both? Second, these data are derived from a relatively new technology, that was first trialled in Australia in 2009 (Benjamin J. Tscharke, 2016; Chen, 2013; Tscharke, Chen, Gerber, & White, 2015). The Australian National Wastewater Drug Monitoring Program only started in 2016, and the number of sites are still expanding annually (Australian Criminal Intelligence Commission, 2017). Hence analysis of long term trends, particularly at the national level, is not currently possible using this method in Australia.

Conclusion

This chapter outlined the range of data sources that can be used to study drug trafficking and drug supply changes, noting their strengths and limitations (including potential issues with reliability, validity, and bias). As shown, there is no ideal method to studying drug trafficking or drug supply changes. Limitations can be minimised when multiple methods are used in tandem.

Given that law enforcement seizure data are the main indicator of drug supply changes in many countries, researchers across the globe have been looking into ways of improving analysis of these data in order to more accurately represent supply changes (Kilmer & Hoorens, 2010; Singleton, Cunningham, Groshkova, Royuela, & Sedefov, 2018). Expanding on their work, the next chapter of this thesis tests ways in which analysis of law enforcement seizure data could be improved. These analyses are then used to examine changes in Australia's ecstasy and meth/amphetamine markets in Chapter 5 and Chapter 6 respectively.

Chapter 4: Improving Methods for Analysing Law Enforcement Seizure Data

Law enforcement seizure data remain a key indicator of drug supply changes in many countries, including Australia. However, there has been longstanding international recognition of limitations with analysis of these data for that purpose (Degenhardt, Topp, & Day, 2003; Kilmer & Hoorens, 2010; Kilmer, Reuter, & Giommoni, 2015; Willis, Homel, & Gray, 2006). In light of these limitations (which were reviewed in Chapter 3), the EMCDDA has been working on ways to improve the quality of analysis of these data: by way of improving the data collection processes, extending the detail of which these data are collected, and by improving analytical methods (Singleton, Cunningham, Groshkova, Royuela, & Sedefov, 2018). The aim of this chapter is to contribute to this body of research by examining ways in which analysis of law enforcement seizure and forensic purity data can be improved in an Australian context to indicate supply changes in a more accurate and insightful way.

Traditional Versus Novel Methods for Analysis of Seizure Data

The annual total weight of seizures or annual total number of seizures are commonly used to indicate changes in the quantity of drugs available. As outlined in Chapter 3, the main limitation with this is that changes in total seizure quantities are reflective of more than just supply changes. Changes in the quantity of drugs seized also depend on the extent of law enforcement activity at the time and the ability of traffickers to conceal their drugs (Kilmer & Hoorens, 2010). Trends may also be influenced by the presence of unusually large seizures which are occasionally made either due to targeted searches based on intelligence or due to chance findings of random cargo searches (Singleton, Cunningham, Groshkova, Royuela, & Sedefov, 2018). Hence significant increases or decreases in total seizure quantities can occur at any given time even if the quantity of drugs available remains constant. It is therefore unsurprising that mixed results have been reported on the extent to which changes in total seizure quantities by weight and/or number is indicative of supply fluctuations.

Some studies have found a relationship between total seizure quantities and other indicators of drug supply. Toprak and Cetin (2009) found the total weight of heroin seizures in Turkey was significantly correlated with the number of heroin related deaths. The UNODC showed that between 1985 and 1997, there was a strong correlation between the annual number of heroin related deaths in the European Union and the annual total weight of heroin seizures in the

European Union (UNODC, 2000). Schifano, Corkery, Deluca, Oyefeso, and Ghodse (2006) found that the number of ecstasy seizures made in the UK was significantly correlated with the number of ecstasy related deaths and the price of ecstasy in the UK. Similarly, Schifano and Corkery (2008) found that the number of cocaine seizures in the UK was significantly correlated with cocaine related deaths and the price of cocaine in the UK.

On the other hand, some studies have found no relationship between total seizure quantities and other indicators of supply. Weatherburn and Lind (1997) found no relationship between the fortnightly total weight of Australian border and state (New South Wales) heroin seizures >1kg and the price, purity or perceived availability of heroin at the street-level in the Sydney suburb of Cabramatta. Wood et al. (2003) found that a 100kg seizure of heroin in Canada had no relationship with trends in heroin use, methadone use, or subjective reports of heroin availability and purity by people who use drugs. Nordt and Stohler (2009) found no relationship between the annual total weight of heroin seizures in Zurich and the price of heroin at the street-level.

There is a need to improve the reliability of the analysis of law enforcement seizure data as in many countries these data are the only available indicator of drug supply. Hence the question remains: how can the current methods of analysis be improved so that they are more reliable indicators of changes in the quantity of drugs available?

As mentioned earlier, one of the factors which can influence trends when analysing total weight is the presence of a few unusually large seizures, which is an issue that has been raised by several academics (Kilmer & Hoorens, 2010; Singleton, Cunningham, Groshkova, Royuela, & Sedefov, 2018). Therefore, excluding potential outliers from the data series may be one method to improve reliability of the analysis, but this is yet to be tested.

Furthermore, an alternative approach to analysing the total number of seizures is to examine the total number of large-scale seizures only. One study in Australia found the number of large-scale seizures (defined as those in the top 75th percentile by weight) significantly predicted the purity of heroin at the street level (Smithson, McFadden, & Mwesigye, 2005). A more recent study in New South Wales found that an increase in the number of large-scale seizures of heroin, but not cocaine or amphetamine-type-stimulant seizures (defined those in the top 20th percentile by weight), significantly predicted an increase in emergency department admissions associated with that drug (Wan, Weatherburn, Wardlaw, Sarafidis, & Sara, 2016). The authors of both studies concluded that an association existed between the number of large-scale seizures and the level of supply in the community. Whether changes in

the number of large-scale seizures is indicative of supply fluctuations in other contexts or for other drugs remains unknown. The extent to which this alternative method improves the analysis of Australian ecstasy and meth/amphetamine border detection data, two of the main indicators of national ecstasy and meth/amphetamine supply in Australia, is yet to be examined.

Weight bins

Illicit drug markets are comprised of multiple distribution levels, each of which appear to operate differently from one another (Arkes, Pacula, Paddock, Caulkins, & Reuter, 2008; Caulkins et al., 2016; Day, Degenhardt, & Hall, 2006; Kilmer & Hoorens, 2010). Another limitation with examining changes in total seizure quantities or in the average/median forensic purity of all seizures is that these analyses cannot indicate supply changes specifically at each distribution level. One method to analyse supply trends at different distribution levels is through the use of weight bins, which is becoming an increasingly common approach to supply trend analysis (Hughes, Chalmers, Bright, Matthew-Simmons, & Sindicich, 2012; Hughes, Chalmers, Bright, & McFadden, 2016b; Kilmer & Hoorens, 2010; Leone, Scatigna, Donati, & Pesce, 2012; Scott, Caulkins, Ritter, Quinn, & Dietze, 2015; Wan, Weatherburn, Wardlaw, Sarafidis, & Sara, 2016). In particular, the ECMDDA now endorses this method, and law enforcement agencies in 15 European countries are now employing weight bins for their analysis of seizure data (Singleton, Cunningham, Groshkova, Royuela, & Sedefov, 2018).

A weight bin analysis clusters seizures into several groups based on their weight and analyses trends separately for each group (i.e. by 'weight bin'). This method assumes that heavier seizures would have been made at a higher distribution level and lighter seizures would have been made at a lower distribution level. For example, one might cluster all seizures that are greater than 1kg and use this weight bin to indicate changes at the high distribution level.

Some examples of weight bins used in past research and the insights gained are as follows. Kilmer and Hoorens (2010) examined the purity distribution of American heroin seizures between 1999 and 2003 in four weight bins: 'less than 1g', 'between 1g and 10g', 'between 10 and 200g', and 'more than 200g'. They found that seizures in lower weight bins were associated with lower purities, indicating that heroin traffickers were diluting their heroin in this market as it passed from higher to lower distribution levels. Similar findings occurred with weight bin analyses of other American seizure datasets for heroin and cocaine (Arkes, Pacula, Paddock, Caulkins, & Reuter, 2008). Other studies have analysed seizures in only one weight bin to focus specifically on one distribution level. Scott, Caulkins, Ritter, Quinn, and Dietze

(2015) analysed the purity of methamphetamine seizures less than 10 grams to indicate changes in purity at the retail level. Wan, Weatherburn, Wardlaw, Sarafidis, and Sara (2016) analysed the total number and weight of heroin, amphetamine-type-stimulant and cocaine seizures in New South Wales that were in the top 20% of the distribution of seizures by weight to indicate changes in high-level supply. Hughes, Chalmers, Bright, Matthew-Simmons, and Sindicich (2012) examined trends in commercial border detections of cocaine, using limits defined by Australian Commonwealth legal threshold limits (Criminal Code Regulations, 2002). Finally, Hughes, Chalmers, Bright, and McFadden (2016a) examined changes in the scale of high-level poly drug trafficking at the Australian border using the total number and weight of commercial seizures defined using a modification of the Australian Criminal Code Regulations 2002 (also see Hughes, Chalmers, Bright, and McFadden (2016b).

As shown above, weight bins can be used to indicate supply changes at different distribution levels of illicit drug markets. But what remains unclear is which method of defining weight bin thresholds is most optimal for analysis. As noted by Kilmer and Hoorens (2010), the optimal weight bin thresholds are likely to vary by country and drug type.

Chapter Aims

There are two aims to this chapter, specifically:

1) to examine whether two alternative methods to analysing Australian ecstasy and meth/amphetamine border detection data–removing outliers and examining only large-scale seizures–are more indicative of changes in the total quantity of ecstasy and meth/amphetamine available than the traditional analysis of these data (the annual total weight and number of detections); and

2) to compare four different methods of defining weight bins through analysis of trends in Australian ecstasy and meth/amphetamine border detections and in the forensic purity of seizures in Victoria, to examine which method is most optimal for each drug type and form.

Method

Unpublished unit record data on Australian ecstasy and meth/amphetamine end-product border detections were obtained from the Australian Department of Immigration and Border Protection (referred to herein as 'ecstasy border data' and 'meth/amphetamine border data' respectively). Department of Immigration and Border Protection is the organisation

responsible for enforcing customs border policy in Australia (Australian Customs and Border Protection Service, 2014). Unpublished unit record data on the forensic purity of ecstasy and meth/amphetamine seizures made in Victoria (referred to herein as 'ecstasy Vic Purity data' and 'meth/amphetamine Vic purity data' respectively), were obtained from the Drug Sciences Group, Victoria Police Forensic Services Department. All border and Vic purity datasets comprised information on the date, weight and form of the drug seized over the period January 1st, 2002, to December 31st, 2014.

The first part of this method section outlines the methodological approach to testing alternative methods to aggregate weight and number for the border data. The second part outlines the methodological approach to testing which of four methods to defining weight bin thresholds are most optimal for analysis of the border and Vic purity data.

Part 1

Two methods to aggregate weight were compared:

1. *Annual total weight of detections*. The traditional analysis of law enforcement seizure data by weight (referred to herein as the 'annual total weight' analysis).

2. *Annual total weight of detections excluding potential outliers*. Given there is no standard approach to dealing with outliers, three variations of this analysis were tested: the annual total weight of detections excluding the heaviest detection per year (referred to herein as the 'exclude heaviest 1' analysis); the annual total weight of detections excluding the heaviest two detections per year (referred to herein as the 'exclude heaviest 2' analysis); and the annual total weight of detections excluding the heaviest three detections per year (referred to herein as the 'exclude heaviest 3' analysis).

Two methods to aggregate number were compared:

3. *Annual total number of detections*. The traditional analysis of law enforcement seizure data by number (referred to herein as the 'annual total number' analysis).

4. *Annual total number of large-scale detections*. This chapter defined 'large-scale' detections to be the heaviest 100 detections made over the analysis period (referred to herein as the 'heaviest 100' analysis).

All comparison methods to aggregate weight and number were undertaken on three border data subsets: border detections of ecstasy (all forms), border detections of meth/amphetamine (powder), and border detections of meth/amphetamine (crystal).

To test the effectiveness of each alternative method of analysis as an indicator of the quantity of ecstasy and meth/amphetamine available, trends were compared with trends of subjective perceptions of ecstasy and meth/amphetamine availability and purity from people who regularly use stimulant drugs in Australia. There are two annual sentinel surveys of people who use stimulants in Australia. The first is the Ecstasy and related Drugs Reporting System (EDRS). This study annually samples approximately 700-800 people who have regularly used stimulants within the previous six months. The second is the Illicit Drug Reporting System (IDRS). This study annually samples approximately 800-900 people who have regularly injected drugs within the previous six months. These two sentinel surveys provide the opportunity to annually compare these supply indicators with the aggregated border data, between the years of 2002 and 2014. EDRS data were not available in 2002, so the analyses for the ecstasy seizure data compared trends between 2003-2014 only.

Specifically, the four alternative methods to aggregate weight and number for the ecstasy border data (all forms) were compared with two other indictors of changes in ecstasy availability and purity:

(1) the annual proportion of EDRS participants who said ecstasy (all forms) was 'easy' or 'very easy' to obtain (2003-2014); and

(2) the annual proportion of EDRS participants who perceived ecstasy purity (all forms) to be 'high' (2003-2014).

With respect to perceptions of ecstasy availability, EDRS respondents were asked "how easy is it to get ecstasy pills, powder, caps at the moment?" Participants chose between 'very easy', 'easy', 'hard' or 'very hard'. With respect to perceptions of ecstasy purity, respondents were asked "how strong would you say ecstasy pills, powder, caps are at the moment?". Participants chose between 'low', 'medium' or 'high'.

Ecstasy was analysed irrespective of form, as comparison data on perceptions of availability and purity were not available by form in the EDRS. On the other hand, meth/amphetamine data in both EDRS and IDRS were reported separately for powder and crystal forms. Hence comparisons for meth/amphetamine were examined separately for powder and crystal forms.

The four alternative methods to aggregate weight and number for the powder meth/amphetamine border data were compared with two other indictors of changes in powder availability and purity:

(1) the annual proportion of EDRS participants who said meth/amphetamine powder was 'easy' or 'very easy' to obtain (2002-2014);

(2) the annual proportion of EDRS participants who perceived meth/amphetamine powder purity to be 'high' (2002-2014);

(3) the annual proportion of IDRS participants who said meth/amphetamine powder was 'easy' or 'very easy' to obtain (2002-2014); and

(4) the annual proportion of IDRS participants who perceived meth/amphetamine powder purity to be 'high' (2002-2014).

The four alternative methods to aggregate weight and number for the crystal meth/amphetamine border data were compared with two other indictors of changes in crystal availability and purity:

(1) the annual proportion of EDRS participants who said meth/amphetamine crystal was 'easy' or 'very easy' to obtain (2002-2014);

(2) the annual proportion of EDRS participants who perceived meth/amphetamine crystal purity to be 'high' (2002-2014);

(3) the annual proportion of IDRS participants who said meth/amphetamine crystal was 'easy' or 'very easy' to obtain (2002-2014); and

(4) the annual proportion of IDRS participants who perceived meth/amphetamine crystal purity to be 'high' (2002-2014).

With respect to perceptions of powder and crystal meth/amphetamine availability, EDRS and IDRS respondents were asked "how easy is it to get meth/amphetamine powder at the moment?" and "how easy is it to get meth/amphetamine crystal at the moment?". Participants chose between 'very easy', 'easy', 'hard' or 'very hard'. With respect to perceptions of purity, EDRS and IDRS respondents were asked "how strong would you say meth/amphetamine powder is at the moment?" and "how strong would you say meth/amphetamine crystal is at the moment?". Participants chose between 'low', 'medium' or 'high'.

Analysis

Pearson correlations measured the strength of association between the annually aggregated border detection trends and annually aggregated EDRS/IDRS trends in the subjective reports of availability and purity.

Part 2

The four weight bin methods tested were: 'law', 'past research', 'third percentiles', and 'quarter percentiles'. Each of which is outlined below.

The first method defined weight bin thresholds based on trafficking thresholds set by law. With respect to border trafficking, the Australian government define three trafficking thresholds to determine the seriousness of the offence (Criminal Code Regulations, 2002). For ecstasy, these thresholds are: (1) '<0.5g', (2) '0.5g to <500g', (3) '≥500g'. For meth/amphetamine, these thresholds are: (1) '<2g'; (2) '2g to <750g'; (3) '≥750g'. Thresholds are based on mixed grams (i.e. not adjusted for purity). These thresholds were used to define 'law' weight bins for the respective ecstasy and meth/amphetamine border datasets. With respect to trafficking in Victoria, the Victorian government define four trafficking levels to determine the seriousness of the offence, which are the same for both ecstasy and meth/amphetamine: (1) '<3g', (2) '3g to <500g', (3) '500g to <1000g', (4) '≥1000g' (Drugs Poisons and Controlled Substances Act 1981, 2009). These thresholds were used to define the 'law' weight bins for the ecstasy and meth/amphetamine Vic purity datasets.

The second method defined weight bins based on bins defined by past researchers. In a recent study which examined trends in amphetamine-type-stimulant, cocaine and heroin seizures in New South Wales, Australia, Wan, Weatherburn, Wardlaw, Sarafidis, and Sara (2016) defined high-level seizures to be in the top 20% of the distribution of seizures by weight. In another study which examined trends in meth/amphetamine and heroin purity in Victoria, Australia, Scott, Caulkins, Ritter, Quinn, and Dietze (2015) defined low-level or retail seizures (for both powder and crystal forms) to be less than 10 grams. Therefore, 'research' thresholds for meth/amphetamine were defined as the following: (1) '<10g', (2) '10g to <80th percentile of the distribution of detections/seizures by weight', (3) '≥80th percentile of the distribution of detections/seizures by weight'. In regards to ecstasy, Fowler, Kinner, and Krenske (2007, p. 100) hypothesised that the Australian ecstasy market could be categorised into the following distribution levels: the high-level distributes quantities greater than 10,000 tablets at a time; the mid-level distributes between 1,000 and 10,000 tablets at a time; and the low-level

distributes less than 1,000 tablets at a time. Using the conversion of 0.29g per tablet (which is the assumed average weight of an ecstasy tablet (Fowler, Kinner, & Krenske, 2007)), 'research' thresholds for ecstasy were defined as: (1) '<290g' (or <1000 tablets), (2) '290 to <2,900g' (or 1,000 to 10,000 tablets), (3) '≥2,900g' (or ≥10,000 tablets).

The third and fourth methods defined weight bins using third and quarter percentiles of the distribution of detections/seizures by weight. Percentiles are often used in other fields to cluster data. The rationale for testing both third and quarter percentiles is because of the consensus by many that there are three to four general distribution levels (Adler & Adler, 1983; Caulkins et al., 2015; Matrix Knowledge Group, 2007; Natarajan & Belanger, 1998). The third percentile bins were defined as: (1) '<33.3% of the distribution of all detections/seizures by weight', (2) '33.3% of the distribution of all detections/seizures by weight to <66.6% of the distribution of all detections/seizures by weight', (3) ≥66.6% of the distribution of all detections/seizures by weight. The quarter percentile weight bins were defined as: (1) '<25% of the distribution of all detections/seizures by weight', (2) '25% of the distribution of all detections/seizures by weight to <50% of the distribution of all detections/seizures by weight', (3) '50% of the distribution of all detections/seizures by weight to <75% of the distribution of all detections/seizures by weight', (4) '≥75% of the distribution of all detections/seizures by weight'. See Table 4 for a summary of the five weight bin methods.

All four comparison weight bin methods were tested on 10 sub-datasets: ecstasy border data ('all forms'), meth/amphetamine border data ('all forms'), ecstasy Vic purity data ('all forms', 'tablets', 'powder', 'crystal'), and meth/amphetamine Vic purity data ('all forms', 'crystal', 'powder', 'tablets'). When border data were segregated by form the data became sparse (see data overview below), hence only 'all forms' were examined for these data sets.

Finally, it should be noted that although three of the comparison methods were derived from the academic literature, the thresholds cited were all arbitrarily defined by those authors.

Analysis

According to drug market theory, different distribution levels behave differently. For instance, past research shows the quantity of drugs sold per transaction, the frequency of transactions, purity and price all typically vary by distribution level (Arkes, Pacula, Paddock, Caulkins, & Reuter, 2008; Caulkins et al., 2016; Day, Degenhardt, & Hall, 2006; Kilmer & Hoorens, 2010). Based on this, the most optimal weight bin methods were defined as those that produce the most variance in trends between weight bins as market theory would suggest. For the border

data, this meant methods that produced weight bins which comprised different trajectories for the total weight trend in each bin. For the Vic purity data, this meant methods that produced weight bins with lower average purities in lighter weight bins and higher average purities in the heavier weight bins. Given the low sample sizes in each comparison trend (n = 13: i.e. one data point per year for 13 years), the extent of variance between trends was determined by visual inspection rather than statistically. Agreement on the extent of variance was obtained between three researchers (MO, CH and AR): my two supervisors and I.

Table 4

The four weight bin methods tested in this research, with details of each weight bin cut-off per data set

Method	Bin 1	Bin 2	Bin 3	Bin 4
1. Law				
Ecstasy border	<0.5g	0.5g to <500g	≥500g	N/A
Meth border	<2g	2g to <750g	≥750g	N/A
Ecstasy Victoria	<3g	3g to <500g	500g to <1000g	≥1000g
Meth Victoria	<3g	3g to <500g	500g to <1000g	≥1000g
2. Research				
Ecstasy both border and Victoria	'<290g' (or <1000 tablets)	290 to <2,900g' (or 1,000 to 10,000 tablets)	'≥2,900g' (or ≥10,000 tablets)	N/A
Meth / amphetamine both border and Victoria	<10g	10g to <80th percentile of the distribution of detections/seizures by weight	≥80th percentile of the distribution of detections/seizures by weight	N/A
3. Third percentiles				
All data sets	33.3% of the distribution of all detections/seizures by weight'	33.3% of the distribution of all detections/seizures by weight to <66.6% of the distribution of all detections/seizures by weight'	≥66.6% of the distribution of all detections/seizures by weight	N/A
4. Quarter percentiles				
All data sets	'<25% of the distribution of all detections/seizures by weight'	'25% of the distribution of all detections/seizures by weight to <50% of the distribution of all detections/seizures by weight'	'50% of the distribution of all detections/seizures by weight to <75% of the distribution of all detections/seizures by weight'	≥75% of the distribution of all detections/seizures by weight

Data overview

The ecstasy end-product border dataset comprised 11,868 border detections made between 2002 and 2014. The meth/amphetamine border dataset comprised 11,971 border detections between 2002 and 2014. Drug detections at the border are made by Customs officers on air/sea cargo consignments, in the post, or on air/sea passengers or crew. The data included the date, raw weight (i.e. not purity adjusted) and the form of the detected substance. Forty-seven ecstasy detections (0.4%) were excluded from analysis due to missing/unknown weight values, leaving a final sample of 11,821 ecstasy end-product detections. One-hundred-and-sixty-seven meth/amphetamine detections (1.4%) were excluded from analysis due to missing/unknown weight information, leaving a final sample of 11,804 end-product detections. See Table 5 for a breakdown of ecstasy detections by form and Table 6 for a breakdown of meth/amphetamine detections by form.

Table 5

Annual number of ecstasy border detections in Australia, distinguishing form, 2002-2014

Year	Form					Total
	Tablet	Powder	Crystal	Other	Unknown	
2002	297	7		5		309
2003	270	15		6	1	292
2004	200	13		6	4	223
2005	125	5		5	5	140
2006	112	22		3	2	139
2007	69	18		0	2	89
2008	46	8	2	30		86
2009	24	10	2	1	1	38
2010	51	15		3	1	70
2011	135	60	44	1	7	247
2012	1199	776	733	19	20	2747
2013	1717	1531	783	11	14	4056
2014	1181	902	1249	36	17	3385
Total	5426	3382	2813	126	74	11821

Table 6

Annual number of meth/amphetamine end-product border detections in Australia, distinguishing form, 2002-2014

Year	Tablet	Powder	Crystal	Capsule	Paste	Liquid	Unknown	Total
2002	109	7	15	91	3	12	4	241
2003	45	10	14	49	2	6		130
2004	97	6	9	65		2	4	186
2005	63	10	19	100	1	8	7	211
2006	325	30	24	265	2	10	10	690
2007	189	46	177	146	2	5	34	585
2008	126	29	27	279		2	20	477
2009	240	59	54	83		4	14	458
2010	525	71	149	126		2	18	894
2011	650	113	135	146	2	12	21	1087
2012	262	411	606	61	44	12	29	1460
2013	123	548	1225	102	194	17	64	2244
2014	324	390	1741	162	423	101	35	3145
Total	3078	1730	4195	1675	673	193	260	11804

The ecstasy Vic purity dataset comprised 11,549 seizures made by Victoria Police, state-wide, between 2002 and 2014. The meth/amphetamine Vic purity dataset comprised 29,105 seizures made by Victoria Police, state-wide, between 2002 and 2014. Both datasets comprised data on the date, weight, form and forensic purity of each seizure. A total of 615 ecstasy seizures (5.3%) were excluded from analysis due to missing purity information leaving 10,934 seizures remaining for analysis. A total of 2,876 meth/amphetamine seizures (9.9%) were excluded from analysis due to missing purity information and a further one seizure was excluded due to missing weight information. This left a final sample of 26,228 meth/amphetamine seizures. Data on the form of seizures comprised a range of main categories (e.g. powder or crystal) and sub categories (e.g. granular, damp or amorphous). These categories and sub-categories were collapsed into four form groups: tablet (which included either whole tablets or tablet portions), powder, crystal and other. The 'other' category contained any of the following rarely seized forms: liquid, paste, capsule, jelly, trace,

compressed substance. See Table 7 for a breakdown of ecstasy seizures by form and Table 8 for a breakdown of meth/amphetamine seizures by form.

The distribution of ecstasy Vic purity seizures by weight was largely positively skewed, with the 90th percentiles by weight for tablet, powder and crystal being just 7.9g, 4.3g and 8.1g respectively. The same was true for meth/amphetamine Vic purity seizures, with the 90th percentiles for tablet, powder and crystal being just 25g, 12.5g and 7.1g respectively. This indicates that most seizures in the Vic purity datasets happened at the low-level.

Table 7

Annual number of ecstasy seizures in Victoria, distinguishing form, 2002-2014

Year	Tablet	Powder	Crystal	Other	Total
2002	541	52	6	2	601
2003	1,042	89	3	1	1,135
2004	837	59	2	1	899
2005	1,119	85	3	2	1,209
2006	1,311	127	8	1	1,447
2007	1,376	112	10	3	1,501
2008	762	89	12	2	865
2009	441	40	2	0	483
2010	175	38	7	0	220
2011	126	27	13	0	166
2012	466	80	58	0	604
2013	485	79	125	1	690
2014	794	169	144	7	1,114
Total	9,475	1,046	393	20	10,934

Table 8

Annual number of meth/amphetamine seizures in Victoria, distinguishing form, 2002-2014

Year	Form				Total
	Tablet	Powder	Crystal	Other	
2002	159	1025	259	14	1,457
2003	171	1338	466	22	1,997
2004	103	1277	318	2	1,700
2005	69	1365	289	1	1,724
2006	73	1383	729	1	2,186
2007	38	1108	1080	4	2,230
2008	27	648	693	3	1,371
2009	32	369	601	3	1,005
2010	28	436	1192	1	1,657
2011	14	340	1752	0	2,106
2012	21	325	2042	2	2,390
2013	15	209	2646	3	2,873
2014	13	249	3262	8	3,532
Total	763	10072	15329	64	26,228

Results

Part 1

Figure 5 shows the four trends produced by each of the four methods to aggregate seizure weight for the ecstasy border detection data. As can be seen, each method produced different trends. The 'annual total weight' trend was substantially different to the others. This trend depicted a general increase between 2003 and 2007 with a very large peak in 2007, before dropping sharply to negligible amounts between 2008 and 2013, and then sharply increasing to a large level in 2014. On the other hand, the analyses which excluded potential outliers produced smoother trends, all of which depicted peaks in the trend during the earlier analysis years which then gradually declined before gradually increasing from 2012 onwards but to levels much lower than the earlier peak.

Figure 5. The annual total weight of ecstasy border detections (a), followed by that excluding the heaviest one (a), two (b) and three (c) detections per year, 2003-2014.
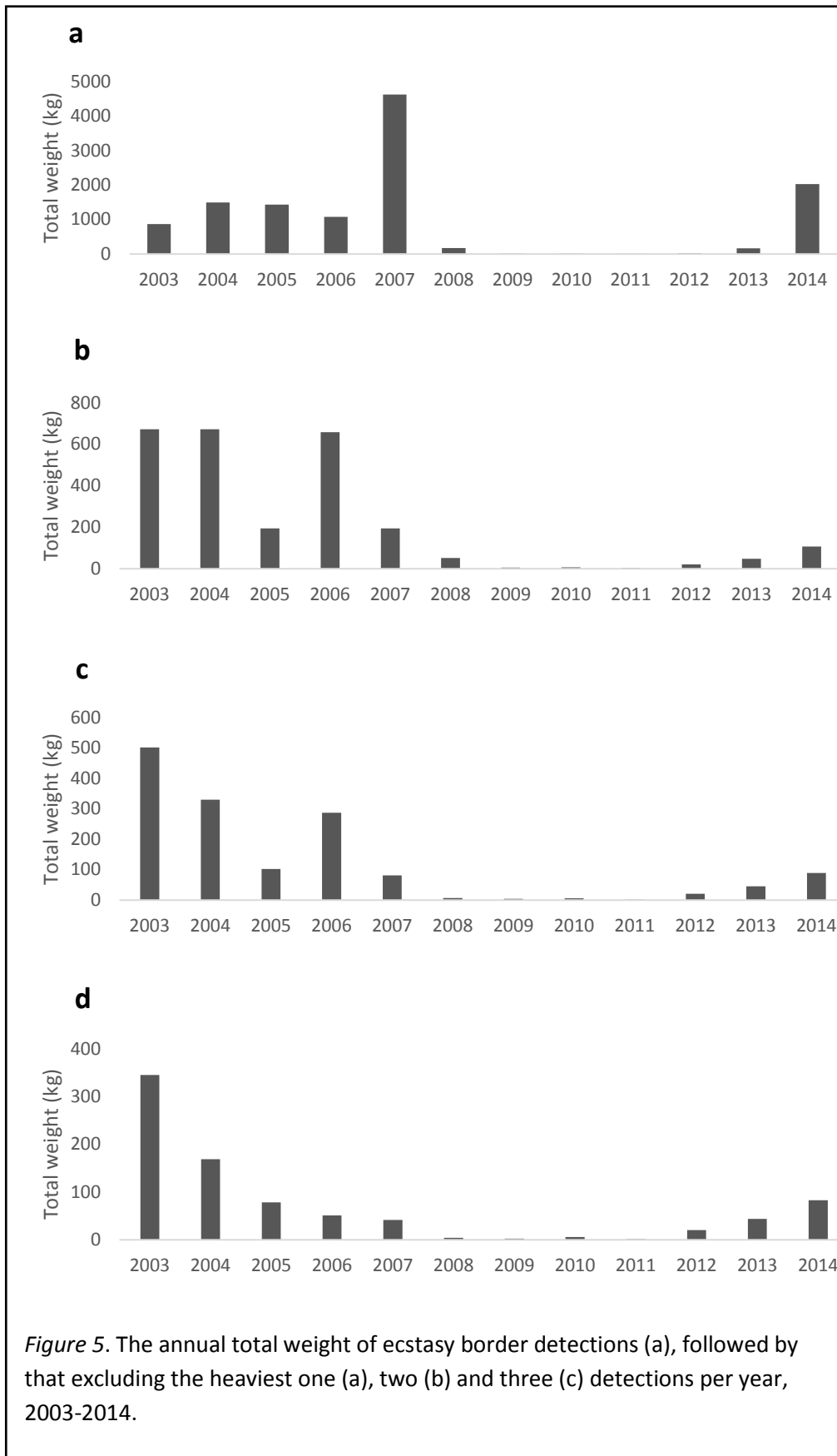
Figure 6 shows the two trends produced by each of the two methods to aggregate seizure number for the ecstasy end-product border data. As per aggregate weight methods, each method to aggregate seizure number analysis produced very different trends. The 'annual total number' was generally low until 2012 onwards after which levels increased markedly. On the other hand, the 'heaviest 100' trend showed a peak in the earlier years which gradually declined and then gradually increased from 2013 but to levels lower than the earlier peak.

Figure 6. The annual total number of ecstasy border detections (a) and the annual total number of ecstasy border detections from the heaviest 100 group (b), 2003-2014.
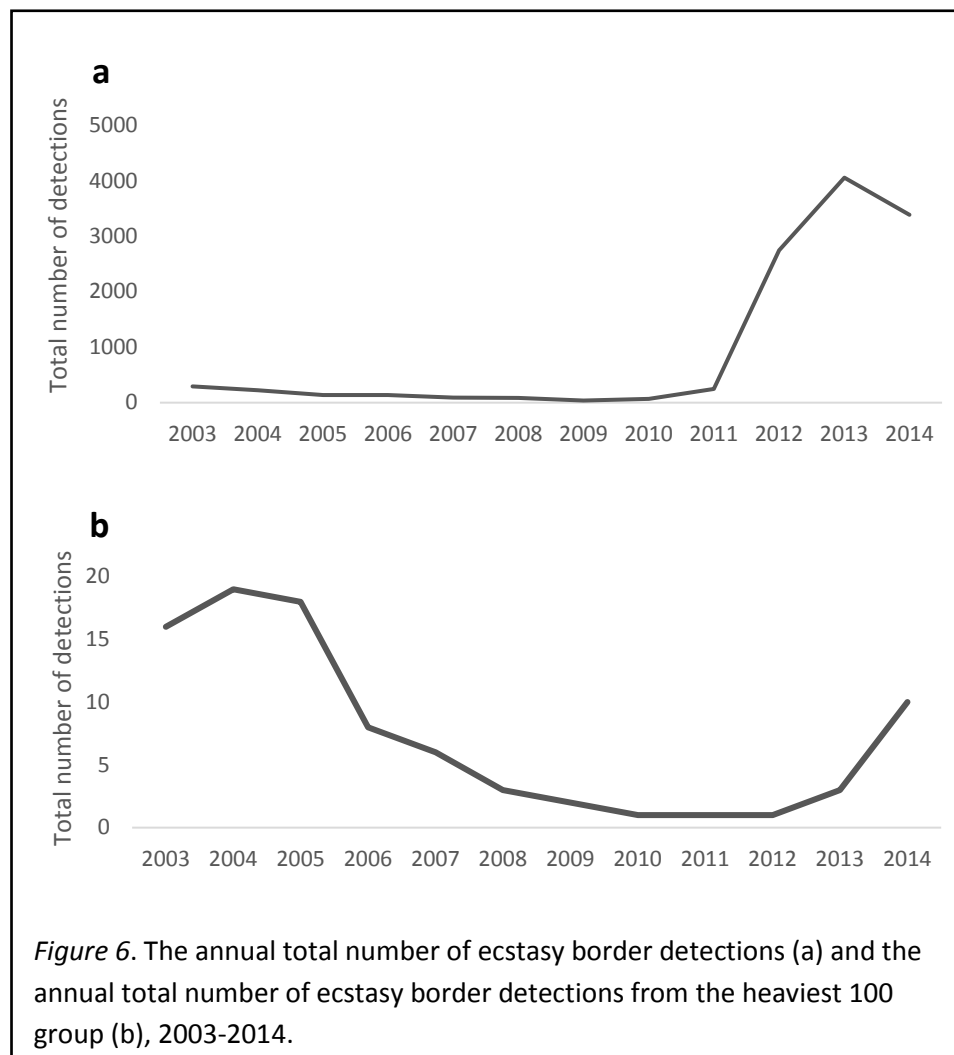
Figure 7 shows the EDRS trends to which the aggregate ecstasy border detection trends were compared: the national annual proportion of EDRS participants who reported ecstasy to be 'easy' or 'very easy' to obtain. Comparisons were tested using Pearson correlations and the results are given in Table 9. 'Exclude heaviest 1' was the only method to aggregate seizure weight to significantly correlate with EDRS perceptions of availability (r = .60) and purity (r =

.60). The 'heaviest 100' was the only method to aggregate seizure number to significantly correlate with EDRS perceptions of availability (r = .71) and purity (r = .84). This indicates that the 'exclude heaviest 1' and the 'heaviest 100' methods are likely to be better indictors of changes in the quantity of ecstasy available at the Australian border than 'annual total weight' and 'annual total number'.

Figure 7. Annual proportion of the national sample of EDRS participants who reported ecstasy purity to be 'high' (a) and ecstasy to be 'easy' or 'very easy' to obtain (b), 2003-2014. Source: Ecstasy and related Drugs Reporting System annual reports, 2004 to 2015.
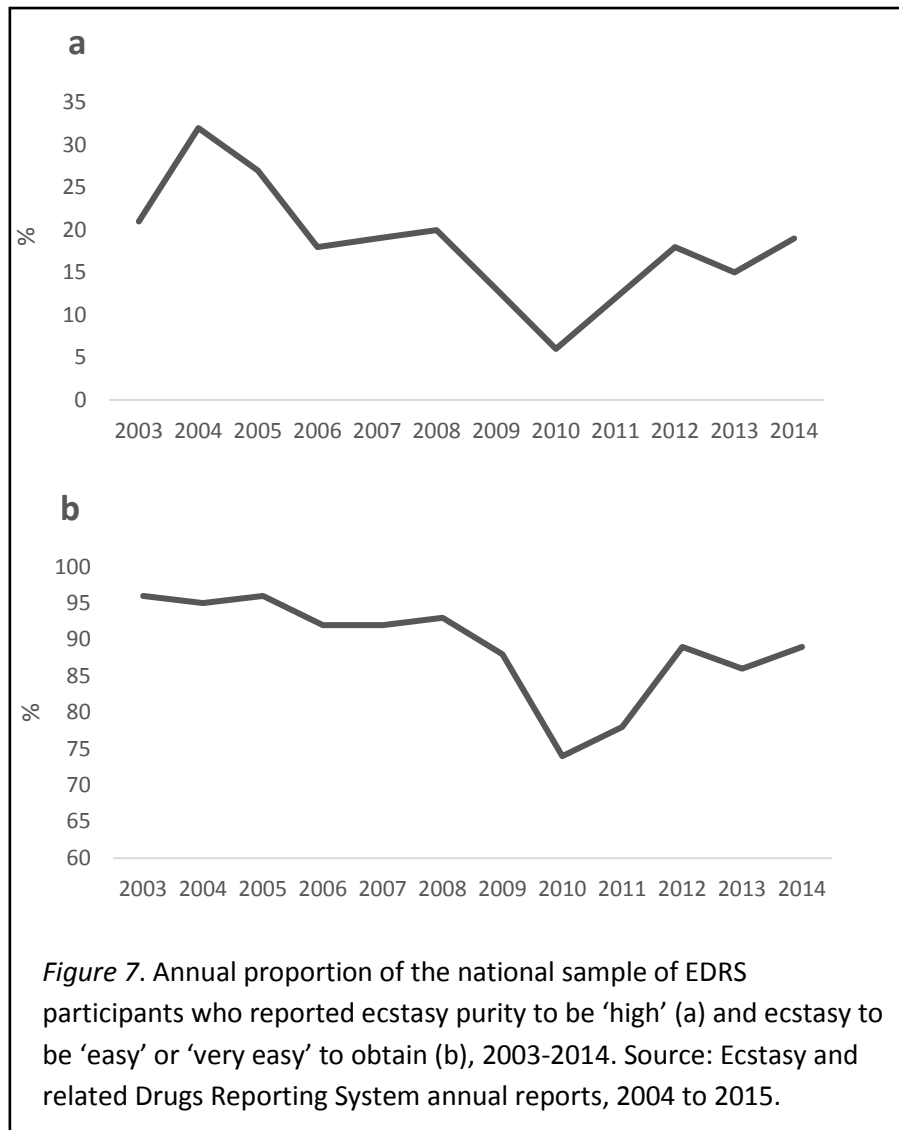
Table 9

Pearson correlations for the relationship between six alternative methods to analysis of Australian ecstasy border detections (all forms) and annual EDRS perceptions of ecstasy purity and availability (all forms)

	Comparator trend	
Method	EDRS Availability	EDRS Purity
To aggregate weight		
Annual total weight	.41	.39
Exclude heaviest 1	.60*	.60*
Exclude heaviest 2	.58	.54
Exclude heaviest 3	.54	.51
To aggregate number		
Annual total number	-.09	-.09
Heaviest 100 (n=12)	.71*	.84**

Note. There are 12 data points (i.e. years) per trend.
p < .05. **p* < .01

Figure 8 shows the four trends produced by each of the four methods to aggregate seizure weight for the powder meth/amphetamine end-product border data. Unlike the ecstasy results, each method produced trends that were similar to each other. All trends show a very low total weight for the first half of the analysis period, and then from 2008 or 2009 total weight increased slightly, and then by 2013 and 2014 total weight had increased substantially.

Figure 8. The annual total weight of meth/amphetamine powder border detections (a), followed by that excluding the heaviest one (b), two (c) and three detections per year (d), 2002-2014.
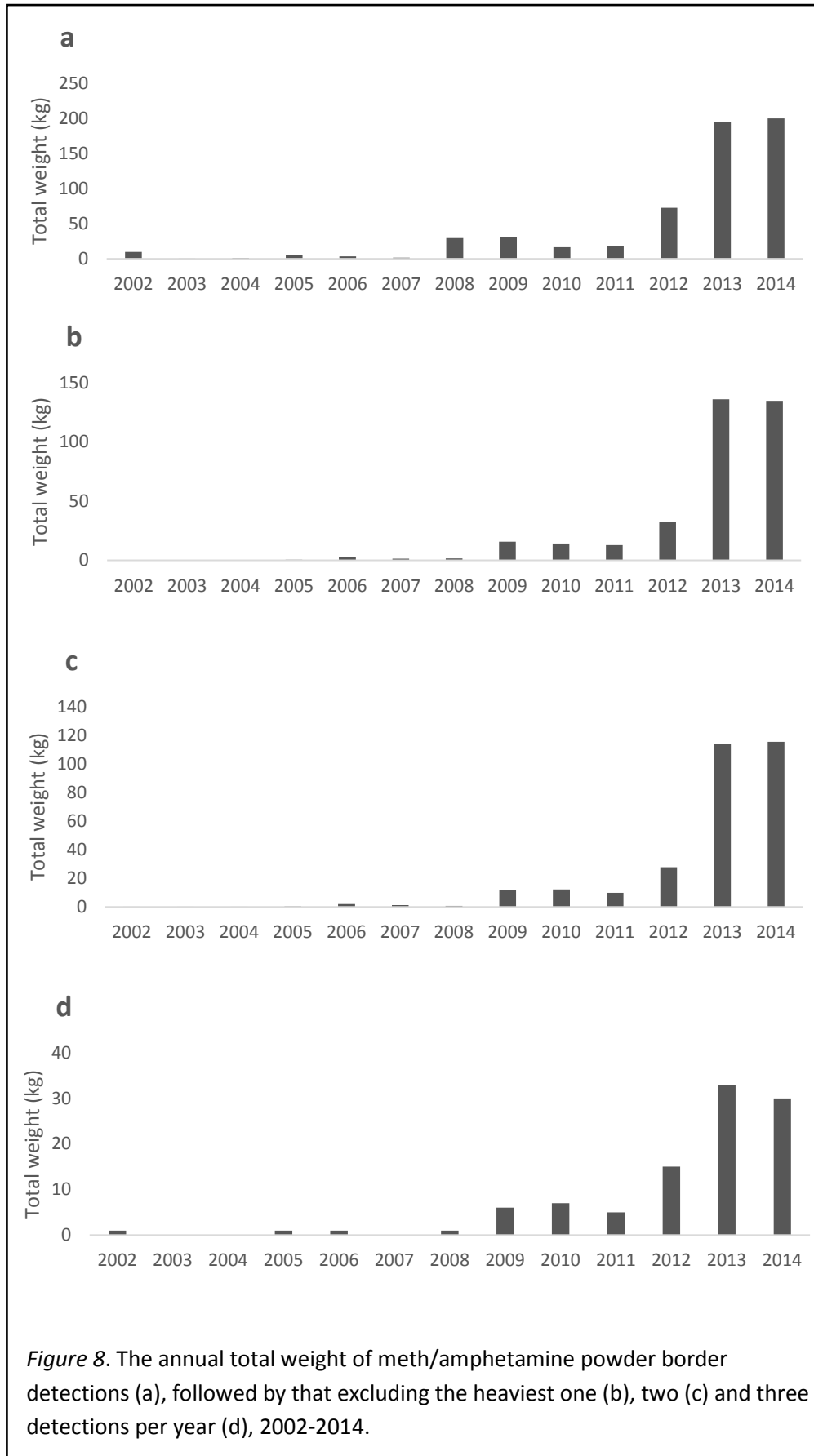
Figure 9 shows the two trends produced by each of the two methods to aggregate seizure number for the powder meth/amphetamine end-product border data. As per aggregate weight methods for powder meth/amphetamine border trends, each method to trends in aggregate number produced similar results. Both trends showed a general small increase over time until 2011, which then increased substantially from 2012.

Figure 9. The annual total number of meth/amphetamine powder border detections (a) and annual total number of meth/amphetamine powder border detections from the heaviest 100 group (b), 2002-2014.
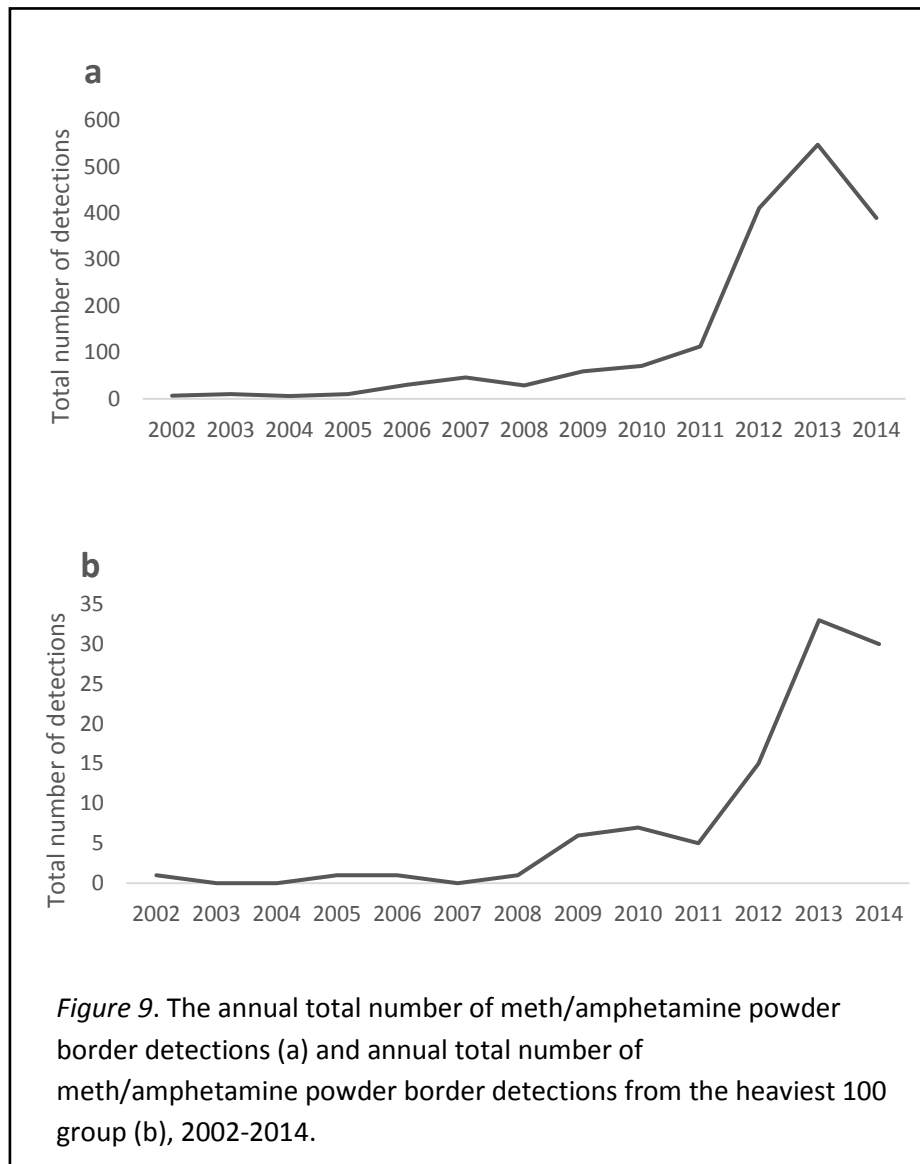
Figure 10 shows the EDRS and IDRS self-report trends to which the powder meth/amphetamine border detection trends were compared. Comparisons were tested using Pearson correlations and the results are given in Table 10. All four methods to aggregate seizure weight ('annual total weight', 'exclude heaviest 1', 'exclude heaviest 2', 'exclude heaviest 3') produced trends which significantly correlated with IDRS powder availability ($r =$

.66, *r* = .62, *r* = .62, *r* = .66 respectively) and IDRS powder purity (*r* = -.67, *r* = .68, *r* = .69, *r* = .87 respectively). Both methods to aggregate seizure number ('annual total number' and 'heaviest 100') significantly correlated with IDRS powder availability (r=.84 and r=.72 respectively), IDRS powder purity (*r* = .63 and *r* = .64 respectively) and EDRS powder purity (*r* = .72 and *r* = .60 respectively). Hence all methods to aggregate seizure weight and number for Australian powder meth/amphetamine border detections appear to be equally effective at indicating changes in powder meth/amphetamine supply.

Figure 10. The proportion of national EDRS and IDRS participants who said powder meth/amphetamine was 'easy' or 'very easy' to obtain (a) and that powder meth/amphetamine purity was 'high' (b), 2002-2014. Sources: Ecstasy and related Drugs Reporting System national reports, 2004-2015; Illicit Drug Reporting System national reports, 2003-2015.
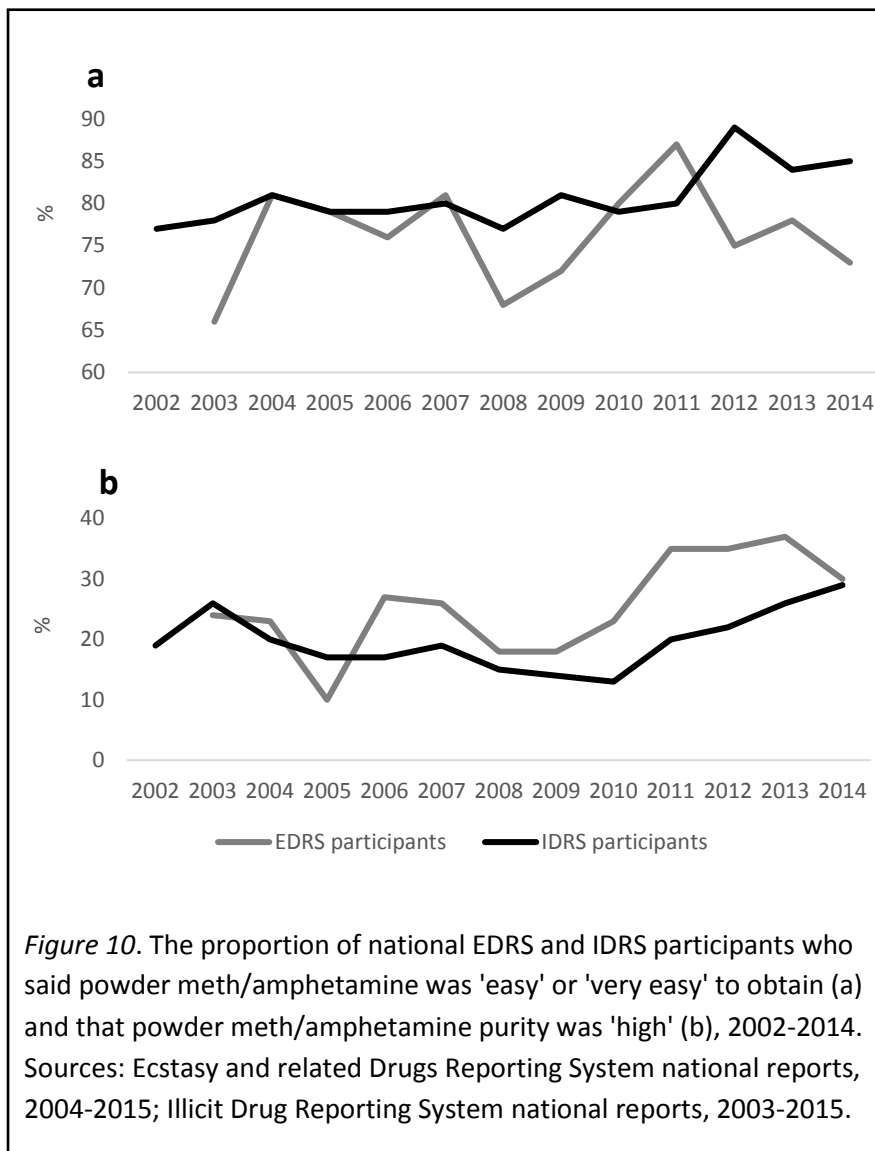
Table 10

Pearson correlations for the relationship between six alternative methods to analysis of Australian powder meth/amphetamine border detections and annual EDRS and IDRS perceptions of powder meth/amphetamine availability and purity.

Border method	Comparator trend			
	EDRS powder availability	IDRS powder availability	EDRS powder purity	IDRS powder purity
Aggregate powder weight				
Annual total weight	-.11	.66*	.54	-.67*
Exclude heaviest 1	-.05	.62*	.55	.68*
Exclude heaviest 2	-.05	.62*	.55	.69**
Exclude heaviest 3	-.21	.66*	.53	.87**
Aggregate powder number				
Annual total number	.02	.84***	.72**	.63*
Heaviest 100	-.02	.72**	.60*	.64*

Note. Comparisons with EDRS trends have 12 data points per trend (i.e. 12 years). Comparisons with IDRS trends have 13 data points per trend (i.e. 13 years).
*p < .05. **p < .01. ***p <.001

Figure 11 shows the four trends produced by each of the four methods to aggregate seizure weight for the crystal meth/amphetamine border detection data. As per powder meth/amphetamine, the four methods do not visually produce substantially different trends over time for crystal meth/amphetamine detections. All trends remained low and then increased substantially from 2012.
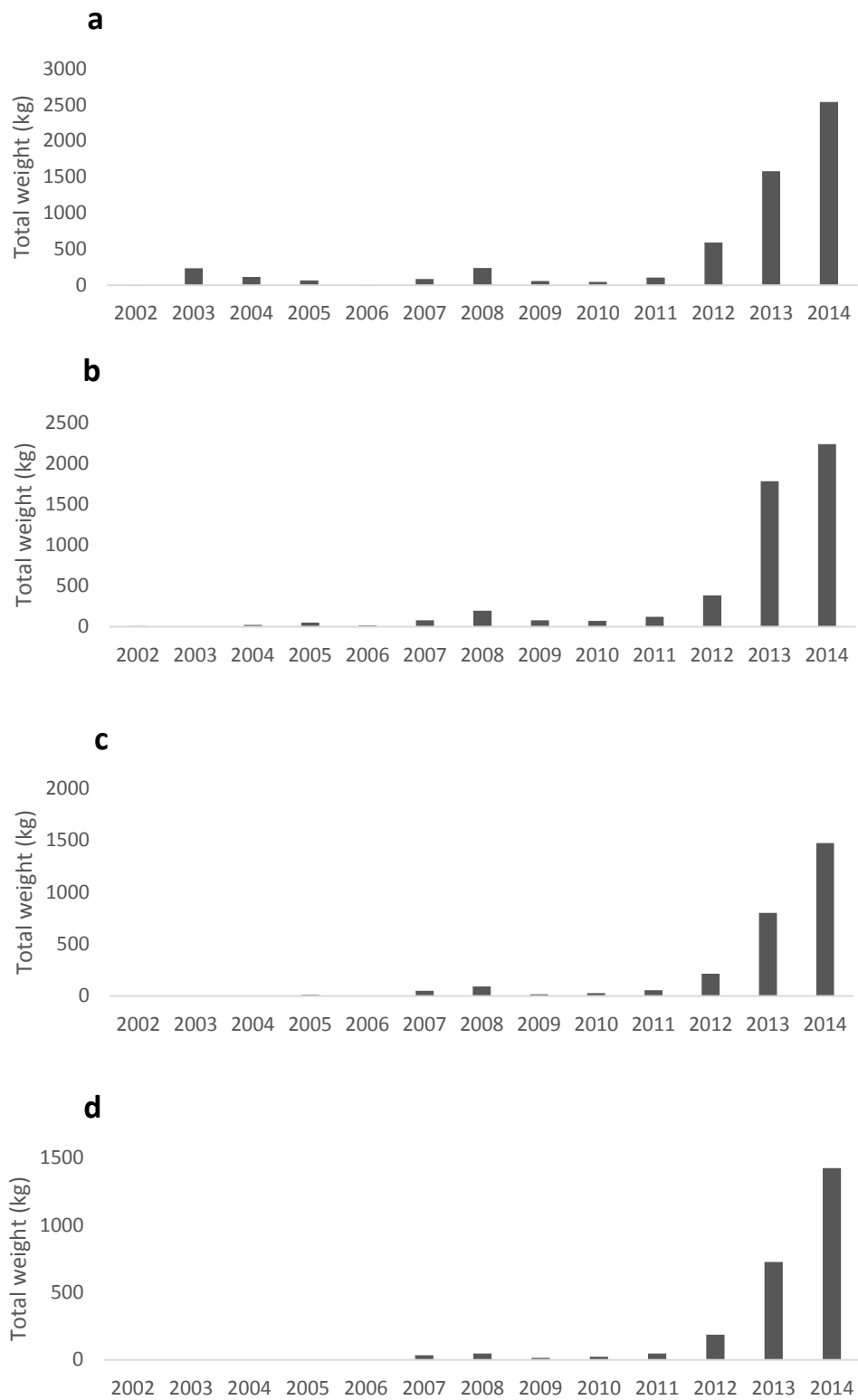
Figure 11. The annual total weight of meth/amphetamine crystal border detections (a), followed by that excluding the heaviest one (b), two (c) and three (d) detections per year 2002-2014.

Figure 12 shows the two trends produced by each of the two methods to aggregate seizure number for the crystal meth/amphetamine border detection data. Each method produced similar results. Both trends showed a general small increase over time until 2011, which then increased substantially from 2012.

Figure 12. The annual total number of meth/amphetamine crystal border detections (a) and the annual total number of meth/amphetamine crystal border detections from the heaviest 100 group (b), 2002-2014
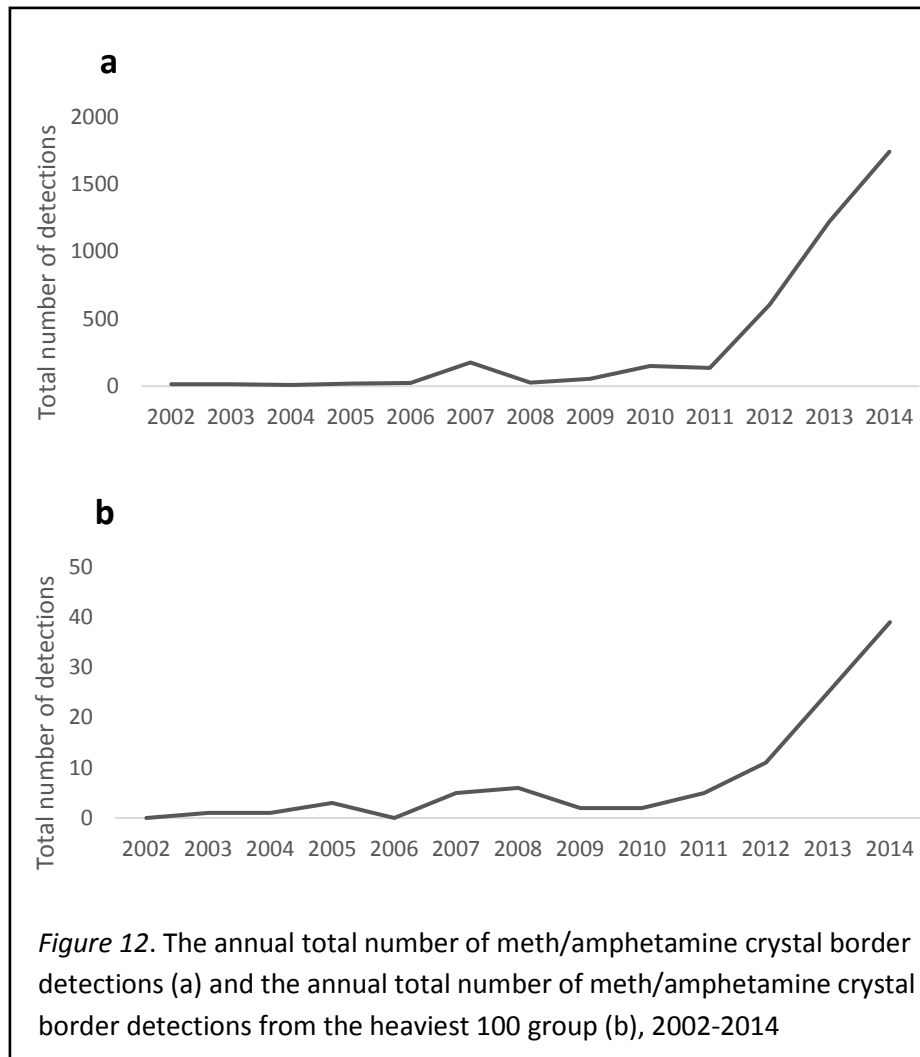
Figure 13 shows the EDRS and IDRS self-report trends to which the crystal meth/amphetamine border detection trends were compared. Comparisons were tested using Pearson correlations and the results are given in Table 11. All of the four aggregate weight analyses ('annual total weight', 'exclude heaviest 1', 'exclude heaviest 2', 'exclude heaviest 3') significantly correlated with IDRS crystal availability ($r = .61$, $r = .59$, $r = .57$, $r = .56$ respectively). 'Exclude heaviest 1' also significantly correlated with EDRS crystal availability ($r = .61$) and was the only weight analysis to do so. Both methods to aggregate number 'annual total number' and 'heaviest

100') significantly correlated with EDRS crystal availability (r = .68 and r = .63 respectively) and IDRS crystal availability (r = .61 and r = .63 respectively). Hence all methods to aggregate seizure weight and number appear to perform equally well as an indicator of changes in the quantity of crystal meth/amphetamine available at the Australian border, albeit with tentative evidence that 'exclude heaviest 1' may be a slightly better method to aggregate weight (as it correlated with one extra indicator).

Figure 13. The proportion of national EDRS and IDRS participants who said that crystal meth/amphetamine was 'easy' or 'very easy' to obtain (a) and that crystal meth/amphetamine purity was 'high' (b), 2002-2014. Sources: Ecstasy and related Drugs Reporting System national reports, 2004-2015; Illicit Drug Reporting System national reports, 2003-2015.
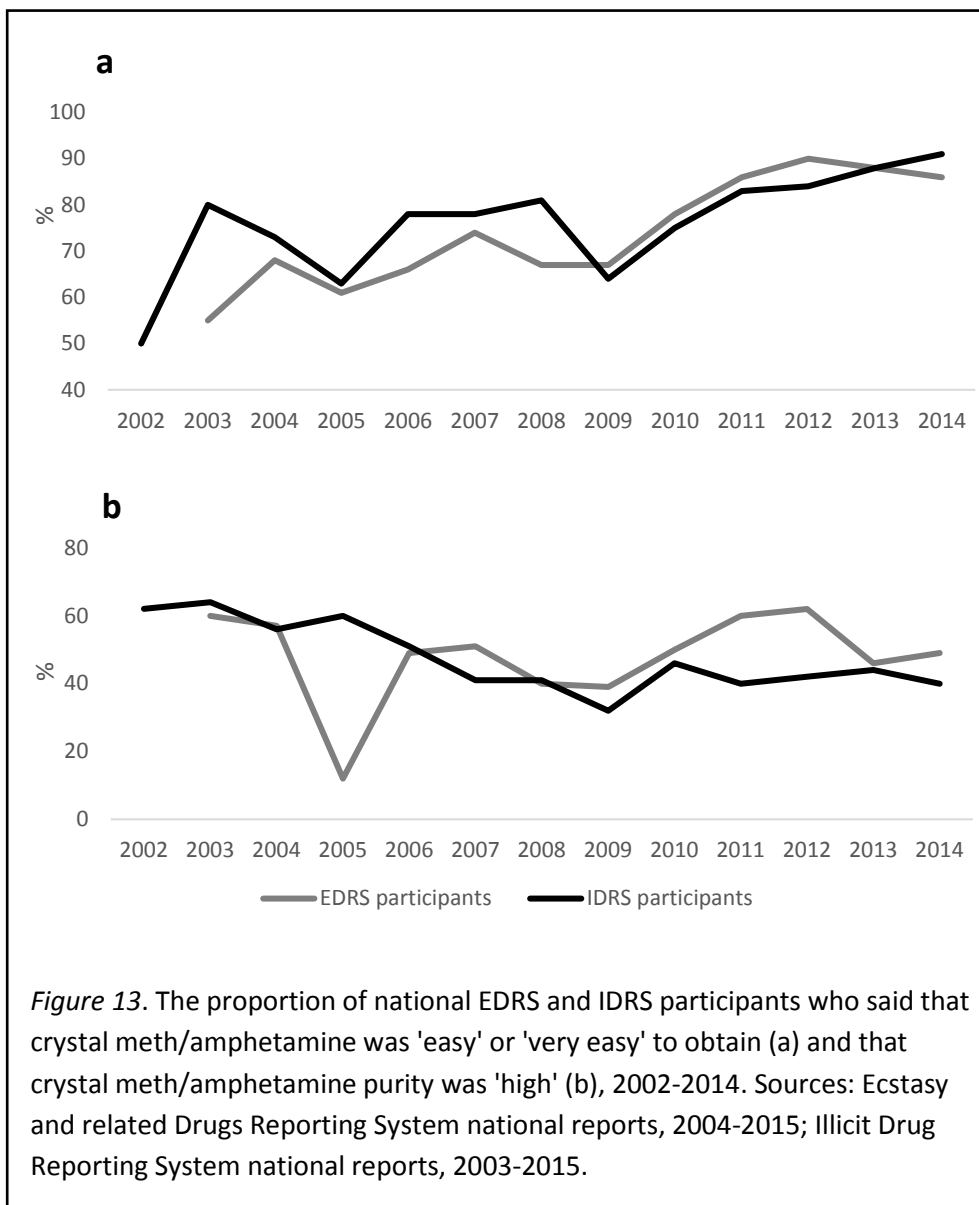
Table 11

Pearson correlations for the relationship between six alternative methods to analysis of Australian crystal meth/amphetamine border detections and annual EDRS and IDRS perceptions of crystal meth/amphetamine availability and purity

Border method	Comparator trend			
	EDRS crystal availability	IDRS crystal availability	EDRS crystal purity	IDRS crystal purity
Aggregate crystal weight				
Annual total weight	.56	.61*	.08	.29
Exclude heaviest 1	.61*	.59*	.02	.33
Exclude heaviest 2	.57	.57*	.04	.32
Exclude heaviest 3	.57	.56*	.05	.31
Aggregate crystal number				
Annual total number	.68*	.61*	.11	.36
Heaviest 100	.63*	.63*	.04	.38

Note. Comparisons with EDRS trends have 12 data points per trend (i.e. 12 years). Comparisons with IDRS trends have 13 data points per trend (i.e. 13 years).
*$p < .05$

Based on findings from part 1, which showed that 'exclude heaviest 1' was the best method to aggregate weight for indicating ecstasy supply changes, analyses in part 2 excluded the heaviest detection per year from all ecstasy border detection weight bin analyses. Meth/amphetamine border weight bins were analysed as normal (i.e. potential outliers were not excluded) given that there was no evidence to suggest that alternative methods to aggregate weight were better than 'annual total weight' for this drug type.

Part 2

Figure 14 shows the output produced by each of the four alternative weight bin methods for analysis of ecstasy border detection data (all forms). All methods produced at least one weight bin which had a substantially different trend to the others. The law method produced slight differences in trends between bins 1 and 2 (bin 2's trend was slightly higher between 2002 and 2012), and produced major differences between bin 3 and bins 1 and 2. Bin 3's trend peaked in the first half of the analysis period and declined to very low levels in the second half, which is in direct opposite to trends produced in bins 1 and 2. The research method produced the most variation in trends between bins with all three bins producing clearly different trends. Bin 1 was skewed to the left, bin 3 was skewed to the right, while bin 2 was more evenly distributed throughout. The third percentile method produced near identical trends for bins 1 and 2 but different for bin 3, and the quarter percentile method produced near identical trends for bins 1 to 3 but different again for bin 4.

Figure 14. Weight bin analyses of ecstasy border data (all forms) distinguishing the four alternative methods: law (a), research (b), third percentiles (c) and quarter percentiles (d).
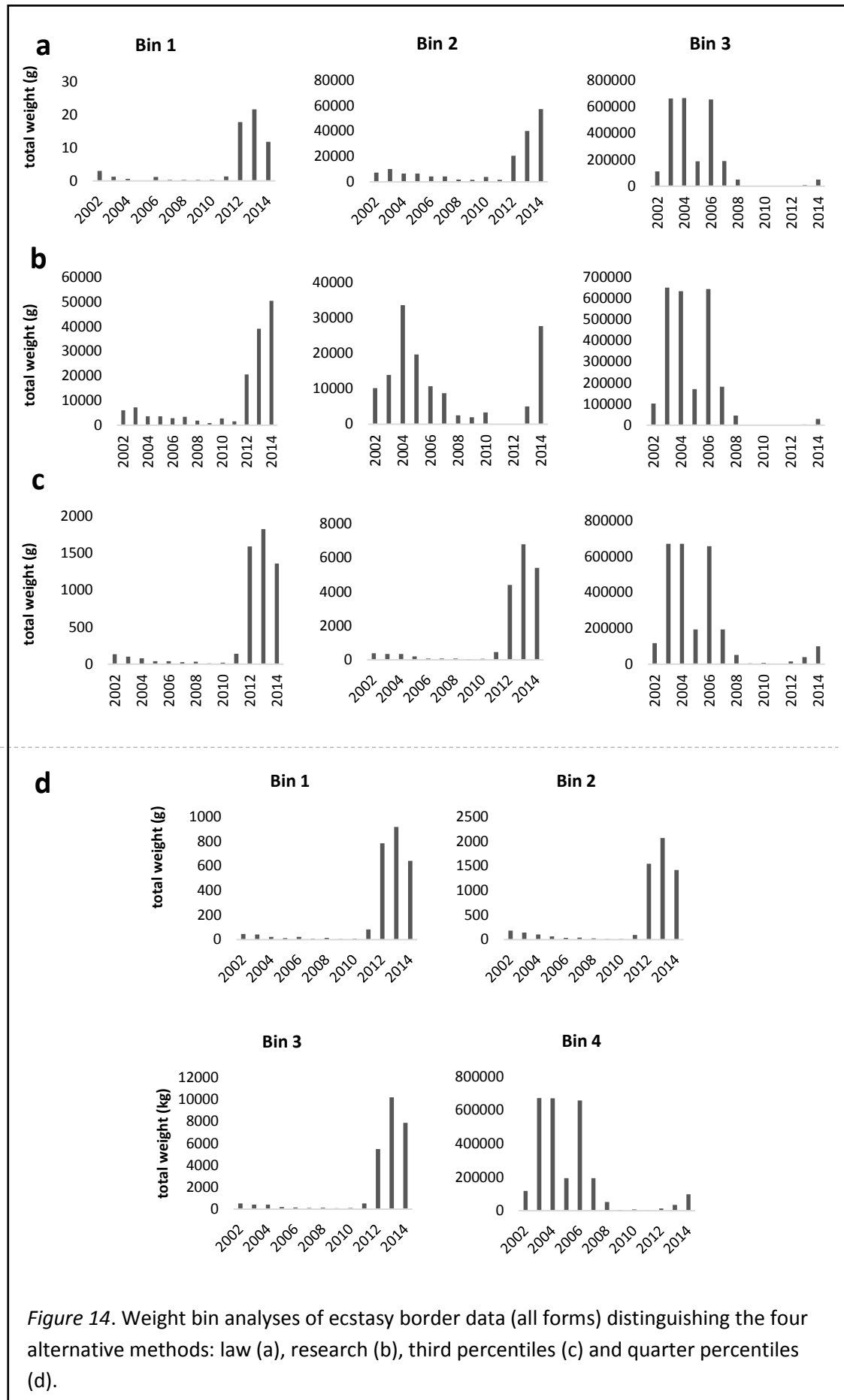
Figure 15 shows the output produced by each of the four alternative weight bin methods for analysis of meth/amphetamine border detection data (all forms). All methods produced at least one weight bin which had a substantially different trend to the others. The law method produced slight differences in trends between bins 2 and 3 and produced a very different trend in bin 1. The research method produced similar trends in bins 1 and 2 and different in bin 3. The third percentile method produced slightly different trends for bins 1 and 2 and a very different trend in bin 3. The quarter percentile method produced slightly different trends in bins 2 and 3 and very different trends in bins 1 and 4.

Figure 15. Weight bin analyses of meth/amphetamine border data (all forms) distinguishing the four alternative methods: law (a), research (b), third percentiles (c) and quarter percentiles (d).
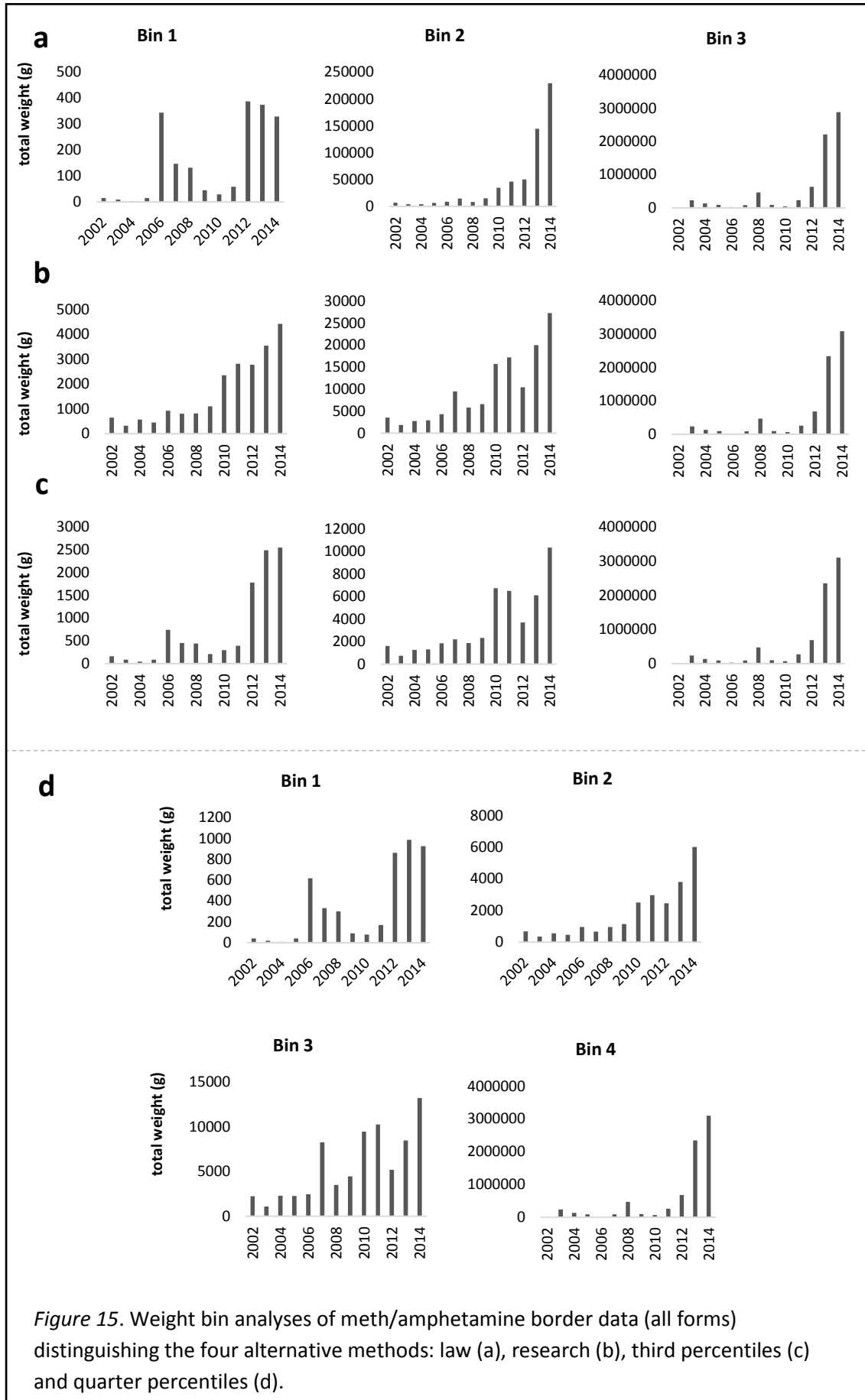
Figure 16 shows the output produced by each of the four alternative weight bin methods for analysis of the Vic purity ecstasy data (all forms). The law method produced slightly higher annual average purities for lightest bin (bin 1) relative to the second lightest bin (bin2). Bins 3 and 4 fluctuated over time, sometimes having average purities much higher than bins 1 and 2 (as expected) but sometimes having much lower average purities than bins 1 and 2 (contrary to expectations). The research method produced the highest average purity in bin 1 for most years which is inconsistent with expectations. The third percentile method produced bins that were in most years the complete opposite of market theory and expectations: the highest average purity in the lightest bin, the lowest average purity in the highest bin, and the middle bin had an average purity somewhere in between. But particularly from 2010 onwards, the lightest bin was much higher in purity than the heavier bins. A similar pattern emerged with the quarter percentile method.

Figure 66, Figure 67, and Figure 68 in Appendix A show the output produced by each of the four alternative weight bin methods for the tablet, powder and crystal ecstasy Vic purity data sets respectively. For all forms, the law method once again produced bins that were in some years consistent with market theory but in other years not. The remaining methods produced either varying degrees of consistencies between years (e.g. 'third percentiles' powder or 'quarter percentiles' crystal) the complete opposite of market theory (e.g. 'research' powder or 'third percentiles' tablet).

To conclude, no method stood out as being optimal for any Vic purity ecstasy dataset as none were entirely consistent with market theory. However, the 'law' method produced the biggest differences in average purities between bins for all form groups and was closest to that expected in market theory.

Figure 16. Weight bin analyses of ecstasy Vic purity data (all forms) distinguishing the four alternative methods: law (a), research (b), third percentiles (c), and quarter percentiles (d).
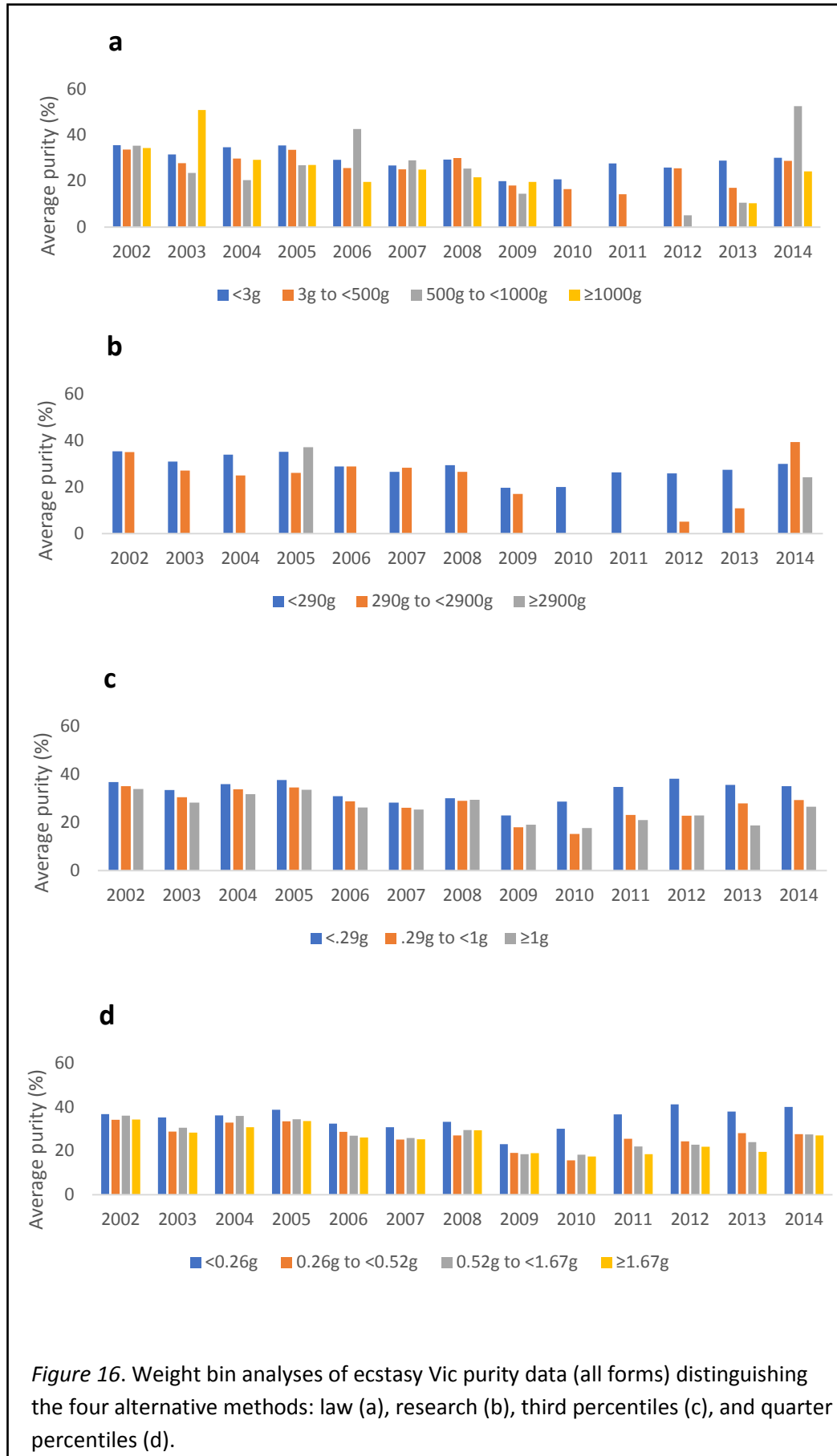
Figure 17 shows the output produced by each of the four alternative weight bin methods for analysis of the Vic purity meth/amphetamine data (all forms). Once more, none of the methods produced weight bins that were entirely consistent with market theory. The law method resulted in the two lightest weight bins (1 and 2) comprising similar annual average purities over time. Bins 3 and 4 on the other hand fluctuated over time, sometimes having average purities higher than bins 1 and 2 (as expected) but sometimes having lower average purities than bins 1 and 2 (contrary to expectations). The remaining methods produced weight bins with much less variation between them relative to the law method. The research method had almost no variance between bins (inconsistent with market theory). The third and quarter percentile methods produced a slightly higher average purity in the lowest bin relative to the others over the entire analysis period which is again inconsistent with market theory and expectations.

Figure 69, Figure 70, and Figure 71 in Appendix A show the output produced by each of the four alternative weight bin methods for the tablet, powder and crystal meth/amphetamine Vic purity data sets respectively. For the crystal dataset, the only methods to slightly resemble market theory were the 'law' and 'research' methods. Albeit the 'law' method produced larger differences between bins while the 'research' method produced only marginal differences between bins. For powder, the 'law' and 'research' methods also slightly resembled market theory but to a lesser extent than they did for crystal. All remaining methods and datasets failed to produce bins in line with market theory.

To conclude, as per the Vic purity ecstasy datasets, no method stood out as being optimal for any Vic purity meth/amphetamine dataset as none were entirely consistent with market theory.

Figure 17. Weight bin analyses of meth/amphetamine Vic purity data (all forms) distinguishing the four alternative methods: law (a), research (b), third percentiles (c) and quarter percentiles (d).
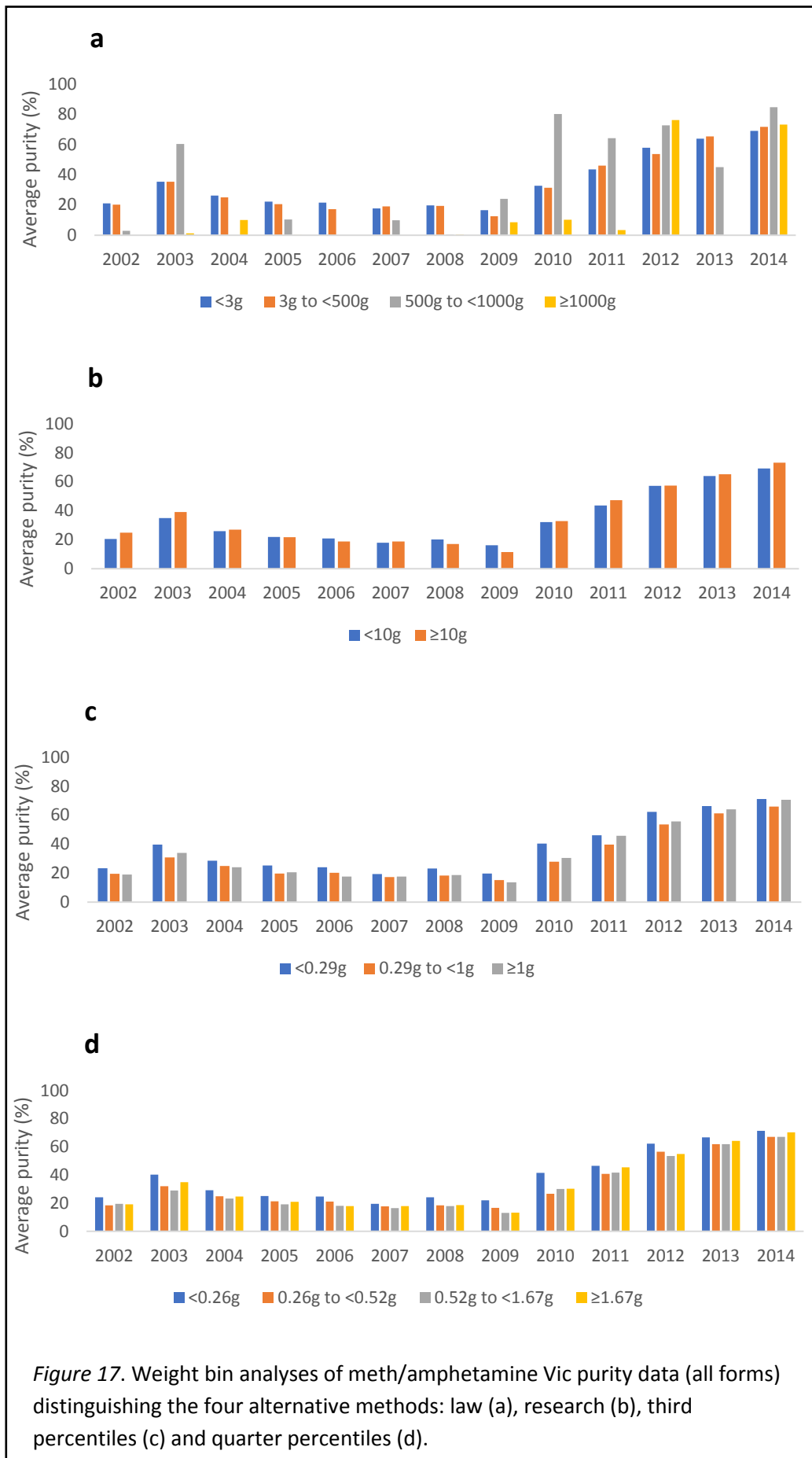
Discussion

This chapter sought to contribute to the international discussion on how to improve analysis of law enforcement seizure data (Singleton, Cunningham, Groshkova, Royuela, & Sedefov, 2018). It firstly examined whether two alternative methods to analysing Australian ecstasy and meth/amphetamine border detection data—excluding potential outliers and examining only large-scale seizures—are more indicative of changes in the quantity of ecstasy and meth/amphetamine available than the traditional annual total weight and number analysis. It secondly compared four different methods of defining weight bin thresholds to determine which thresholds are most optimal for analysis.

Methods to aggregate seizure weight and number

For the ecstasy border data (all forms), excluding potential outliers (specifically the heaviest detection per year) and the heaviest 100 analysis were the only methods to significantly correlate with both EDRS self-reports of ecstasy availability and purity (all forms). The traditional annual total weight and number analyses failed to correlate with EDRS perceptions of ecstasy availability or purity. Hence the findings suggest that supply trend analyses of Australian ecstasy border detection data are best undertaken using the 'exclude heaviest 1' analysis (for a trend by aggregate weight) and the 'heaviest 100' analysis (for a trend by aggregate number).

For both the powder and crystal meth/amphetamine border detection datasets, the alternative methods of analysis performed equally as well as the traditional methods: all methods produced trends that significantly correlated with two to three self-report indicator trends. This suggests that the alternative methods of analysis did not improve the analysis of the meth/amphetamine border data over and above the traditional analyses. It is, however, important to note that the traditional analyses did not result in trends that were less correlated with the other supply indicators.

The findings of this study show that the most optimal analysis of law enforcement seizure data to indicate changes in the quantity of drugs available is not universal and varies by drug type. This raises the question of why different drugs might require different analyses.

The geographic location of a drug relative to the primary region of manufacture is one variable that may cause differences that affect the size and frequency of seizures made. Take Australian ecstasy supply for example. Domestic ecstasy production in Australia is very limited (Australian Crime Commission, 2015; Fowler, Kinner, & Krenske, 2007). Because of this, traffickers may be

more likely to import more end-product at once to meet supply demands. In support of this hypothesis, Australia has been home to some of the world's largest seizures of ecstasy at the border. In 2005, the then world's largest seizure was 1.2 tonnes (Australian Crime Commission, 2006). This record was broken in 2007 by the now world's largest seizure of 4.4 tonnes (Australian Crime Commission, 2008). In 2014, the now second largest seizure of ecstasy was made—1.9 tonnes (Australian Crime Commission, 2016). In contrast, meth/amphetamine is manufactured in Australia in significant amounts (Ritter, Bright, & Gong, 2012). This may reduce the need for extremely large importations and hence reduce the likelihood of extreme outliers in the dataset of border meth/amphetamine detections. Whatever the reason might be, the Australian ecstasy border detection dataset contains some extreme outliers which the meth/amphetamine border dataset does not contain. This is one reason to explain why the alternative methods improved analysis of the ecstasy border data but not meth/amphetamine border data.

Methods to weight bin

The optimal method to define weight bin thresholds also varied by drug type and dataset. For the ecstasy border data the most optimal methods were found to be the 'law' and 'research' methods (which produced the most variation in trends between bins). Whereas for the meth/amphetamine border data, the 'law' and 'quarter percentile' methods were most optimal. On the contrary, the results suggest that the 'third percentile' or 'quarter percentile' methods should not be used to define weight bins for the Australian ecstasy border detection data set, and the 'research' and 'third percentile' methods should not be used to define weight bins for the Australian meth/amphetamine border detection dataset.

Hence the question remains: which of the two optimal methods is most optimal for each dataset? There are two reasons to argue in favour of the 'law' method for both datasets. First, the 'law' method was optimal across both drugs. Second, the 'law' method does not require extensive reading to find out the latest research methods in order to determine thresholds. While there are reasons to argue in favour of the 'law' method, there may still be some situations where researchers wish to use 'research' for ecstasy or 'quarter percentiles' for meth/amphetamine, which according to the present findings is also appropriate.

While the 'law' method appears to distinguish supply distribution levels well at the Australian border, research by Hughes, Ritter, Cowdery, and Phillips (2014) showed that Australian state and territory law thresholds may not always be fit for purpose (i.e. distinguish the distribution levels as accurately as they should). For example, Hughes et al. found that in all Australian

states, people who use ecstasy will often purchase, possess or use more than the threshold which constitutes what the law perceives as a 'less than traffickable' quantity of ecstasy. Although the efficacy of the Australian border thresholds was not examined in Hughes et al., their findings raise questions about the whether the current border thresholds set by law are fully optimised. The present research suggests that current border thresholds are good. However, future research could examine ways of improving current Australian border thresholds with respect to their ability to distinguish distribution levels. This could further improve the efficacy of weight bin analyses using the law method to define thresholds.

For the ecstasy and meth/amphetamine Vic purity datasets, none of the four tested weight bin methods were found to be optimal. This is because not one of the methods produced trends entirely in line with market theory. For instance, past research on heroin and cocaine markets has shown that purity decreases as it moves down the supply chain (Arkes, Pacula, Paddock, Caulkins, & Reuter, 2008; Caulkins et al., 2016; Day, Degenhardt, & Hall, 2006; Kilmer & Hoorens, 2010). But this was not evident in the present research on Australia's ecstasy and meth/amphetamine markets. Specifically, some weight bin methods produced bins with no systematic difference in average purities between bins, while others produced trends in direct opposition to market theory: with the lightest weight bin being systematically highest in average purity and the heaviest weight bin being systematically lowest in average purity.

It is not the first time that the Australian meth/amphetamine market has been shown to behave differently to market theory. Ritter, Bright, and Gong (2012) analysed judges' sentencing comments, published law enforcement reports and unit record meth/amphetamine Vic purity data in the 2006/07 financial year and found no systematic relationship between meth/amphetamine purity and the weight of the seizure. The present findings expand on this research by showing that the unusual market behaviour spans more than just 2006/07: at least between 2002 and 2014. This poses the question of why Australia's ecstasy and meth/amphetamine markets behave like this. It is not currently clear whether the contrasting findings are due to there being differences in market behaviour between synthetic drugs and plant-based drugs (i.e. cocaine and heroin), or for some other reason. This is something future research could examine. Either way, the present research did not find an optimal weight bin method for Vic purity data. As such, these datasets are perhaps best analysed only as a single aggregated group.

Limitations

For the analyses examining the aggregate total seizure weight methods and their associations with self-reported perceptions of the availability of ecstasy and meth/amphetamine, one limitation is that the comparison data, derived from the EDRS and IDRS, are solely at the retail level of the market. Whereas the border data are mostly derived from higher market levels. In theory, this should not matter because the analysis concerns which of the three methods of aggregate total weight best accord with other supply change indicators, which flow on to the retail-level of the market. Hence it is the pattern to the retail-level perceptions, compared to the pattern of the aggregate weight seizure methods. A second limitation is that a significant proportion of Australia's meth/amphetamine is manufactured in the country and this analysis examined border detections only (and not domestic seizures). A third limitation is the use of Pearson correlations as the statistical tests to compare trends. A more sophisticated method would be a comparison time series analyses, but this would require many more data points which were not available. This, however, is worth exploring in future research where possible.

For the analyses examining weight bins, the Vic purity data are mostly retail-level seizures. This would have affected the ability to identify an optimal method that produces systematic differences in purity between bins. A dataset that captures seizures more widely from all distribution levels (like the border data) may have been more appropriate. But purity data for this dataset is not available. Another limitation is the method of comparison which was visual only. A statistical comparison would have been more rigorous, but the lack of available data when broken down by form and per month meant that this was not possible with the present datasets.

Conclusion

The findings of this chapter contribute to the international discussion around improving methods of analysis for law enforcement seizure data (Singleton, Cunningham, Groshkova, Royuela, & Sedefov, 2018). Excluding potential outliers (for analysis of total weight) and examining changes in large-scale seizures only (for analysis of total number) were found to have potential to improve analysis of seizure data by producing trends that are more indicative of supply fluctuations than the traditional analyses. Future supply trend analyses may benefit from these methods. As noted earlier, these is no standard way to define outliers in a data series. A default approach could be to exclude the heaviest seizure per year from analyses of total weight.

Finally, although this research tested for the most optimal weight bin thresholds of Australian seizure data, it did not test the extent to which weight bins can improve the analysis over and above the aggregate trend alone. Whether the application of weight bins can identify supply changes that the aggregate trend cannot is examined in Chapters 5 and 6. In these chapters, supply changes in Australia's ecstasy and meth/amphetamine markets between 2002 and 2014 are examined respectively.

Chapter 5: Supply Changes in Australia's Ecstasy Market: 2002-2014

This chapter presents the first of the two supply trends studies and primarily aims to identify supply changes that have occurred in Australia's ecstasy market. The present chapter begins with a brief literature review of supply changes in the global ecstasy market, then proceeds to discuss what is known about supply changes in Australia's ecstasy market to-date, and then shows where the gaps in knowledge are.

Key Shifts in the International Ecstasy Market

Throughout the 1980s and 1990s Europe was understood as the global hub of ecstasy supply (Blickman, 2004; EMCDDA, 2016a; Massari, 2005; Vijlbrief, 2012): particularly in the Netherlands and Belgium where manufacturers massed produced ecstasy for export to other markets including Australia (Fowler, Kinner, & Krenske, 2007; UNODC, 2007; 2008). But from the early to mid-2000s ecstasy production (UNDOC, 2014; UNODC, 2008) and purity (Giné et al., 2016; Vogels et al., 2009) in North-Western Europe appeared to decline. During the European decline, significant production appeared to shift to North America and parts of Asia (UNODC, 2008; UNODC, 2011). By the late 2000s, ecstasy production and purity in Europe declined to significant lows which coincided with a perceived shortage of ecstasy in many countries, including Australia (Australian Crime Commission, 2013b; Giné et al., 2016; UNODC, 2011; Vijlbrief, 2012). During the shortage manufacturers adulterated tablets sold as ecstasy with new psychoactive substances (NPS) without ecstasy being present (Brunt, Poortman, Niesink, & van den Brink, 2011; Giné et al., 2016; Linsen et al., 2015). This led to ecstasy having a poor reputation amongst people who used it, along with a subsequent reduction in use in several world regions (Chalmers, Matthew-Simmons, & Hughes, 2013; Smith, Moore, & Measham, 2009; UNDOC, 2014; UNODC, 2012). Although significant production rose in non-European regions, its magnitude appeared not to be sufficient to supply other world regions as Europe once did. Ecstasy use continued to decline world-wide and evidence of exports from non-European regions was rare (UNODC, 2008; UNODC, 2011).

Several explanations have been put forward for the global ecstasy shortage, but the most common is due to the limited availability of the ecstasy precursor piperonyl methyl ketone or PMK (also known as 3,4-MDP-2-P), which was the most commonly sourced ecstasy precursor in Europe at the time (EMCDDA, 2016a; UNDOC, 2014; UNODC, 2012). Several events were

hypothesised to have contributed to the lack of PMK availability: (1) increased law enforcement presence targeting ecstasy precursor diversion (EMCDDA, 2016c; Vijlbrief, 2012); (2) improved precursor controls in China (the main source of illicit PMK at the time) implemented in both mid-2008 and 2009 (UNODC, 2010) (Vijlbrief, 2012); (3) an increased demand for PMK in regions other than Europe for the purpose of ecstasy manufacture (UNODC, 2010); and (4) improved controls in the Netherlands and Belgium in 2008 for the chemicals and equipment required to manufacture ecstasy (Vijlbrief, 2012).

In addition, three very large ecstasy precursor seizures in 2009 may have further contributed to the global ecstasy shortage (Global SMART Programme, 2012). In February 2009, 15 tons of seized safrole (another common ecstasy precursor) was disposed of in Cambodia (Global SMART Programme, 2010). There were a further 5.2 tons of safrole seized in Cambodia in June 2009 and 4.3 metric tonnes of piperonal seized in Mexico in March 2009 (Global SMART Programme, 2009). Those three seizures combined had the potential to produce nearly 17 metric tonnes of MDMA (using a yield estimate of 40% and 80% for piperonal and safrole respectively (UNODC, 2006)).

From 2010, new precursors were being used by ecstasy manufacturers around the globe. First, a 'pre-precursor' known as PMK-glycidate became available in China which is thought to have allowed ecstasy manufacture in Europe to re-establish (EMCDDA, 2013; EMCDDA, 2016a; UNODC, 2015). PMK-glycidate can be easily converted into PMK and is not under international control, making it difficult for law enforcement to police its illicit trade (EMCDDA, 2016a; UNDOC, 2014). Second, helional was first known to be used from 2011, with authorities seizing it in several clandestine laboratories in Australia and the USA (UNODC, 2014a). Reports of helional seizures again surfaced in Europe in 2014 (EMCDDA, 2016c) and in Canada in 2015 (International Narcotics Control Board, 2015).

According to law enforcement data, ecstasy production subsequently re-established in Europe from around 2011, and ecstasy laboratories in the Netherlands and Belgium became larger and more sophisticated than ever before (EMCDDA, 2016a). For example, some seized labs had custom built 750 litre reaction vessels (EMCDDA, 2016c). Moreover, ecstasy purity in the Europe rose to all-time highs and powder and crystal forms of the drug have since become widely available at the retail level for the first time (EMCDDA, 2016a; Giné et al., 2016). For example, Giné et al. (2016) analysed samples of ecstasy voluntarily submitted by people who used ecstasy which were collected at various nightlife places including clubs and raves in Spain between 2000 and 2014. They found that the average MDMA content of ecstasy tablets

dropped to its lowest point in 2009 (53mg) but by 2010 had already returned to 2002 levels (76mg vs 79mg) and continued to increase until reaching unprecedented levels of 114mg averages in 2014. Ecstasy crystal samples on the other hand remained relatively constant in average purity over the analysis period fluctuating between 68 and 78% which was very similar to crystal purity in Victoria. EMCDDA (2016a) presented forensic purity analyses of ecstasy samples analysed at drug checking services in the Netherlands which showed the annual proportion of ecstasy tablets containing <36mg increased from about 6% in 2003 to nearly 20% in 2009, but by 2010 had declined to <5%. Conversely the annual proportion of analysed tablets containing >106mg of MDMA increased from just 10% in 2009 to an unprecedented 41% in 2011 which further increased to 59% by 2014.

The Australian Ecstasy Market

Australia has one of the highest rates of consumption of the illicit stimulant ecstasy[4] per capita in the world (UNDOC, 2013). To-date, most research on the Australian ecstasy market has focussed on the use patterns of people who use ecstasy. As discussed in Chapter 3, the main systematic monitoring system which collects data on Australia's ecstasy market is the Ecstasy and related Drugs Reporting Survey (EDRS) (Black et al., 2008; Stafford et al., 2005). This is a study in which 600-800 people who regularly use stimulant drugs are interviewed annually in major cities around Australia. It primarily asks respondents about their use patterns and perceptions of ecstasy supply trends (such as whether they perceived any recent changes in availability and purity). The research provides an early warning system for potential market changes, including supply, use and harm changes. On top of presenting self-report data, the EDRS annual reports also present law enforcement seizure and purity data trends in aggregate form. These reports are amongst the most cited resources for trends in the Australian ecstasy market.

Research on Australian ecstasy supply changes specifically (as opposed to use and harms) has been limited, with most conducted before or during the global 'shortage'. Fowler, Kinner, and Krenske (2007) examined household surveys and EDRS interview data, as well as law enforcement seizure data and data from health organisations. They found that from the early 1990s up until 2004, Australia's ecstasy market showed clear signs of expansion. This was argued after finding steady increases in the total weight and number of border seizures, an increasing demand for ecstasy in Australia, and a stable retail price. The authors also reported

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[4] In this thesis ecstasy refers to the compounds '3,4-methylenedioxymethamphetamine (MDMA)', '3,4-methylenedioxy-N-ethylamphetamine (MDEA)' and '3,4-methylenedioxyamphetamine (MDA)'.

that sea cargo was the most common method of ecstasy importation and that Europe was the most common exporter of ecstasy to Australia of any world region during that period of time.

Since then, Scott and Burns (2011) examined EDRS trends between 2003 and 2010 as well as trends in aggregate Australian border detections of ecstasy between 1999/00 and 2008/09. They found declining rates of: EDRS participation, participants who reported ecstasy to be their drug of choice, the frequency of ecstasy use, price, subjective reports of purity and availability, and declines in the total weight and number of ecstasy border detections. The authors concluded that all indicators pointed to a declining availability of ecstasy in Australia along with use and demand. These trends coincide with much of the international literature and in particular with trends from Europe (see earlier discussion). However, the key difference between the findings of Scott and Burns (2011) and European indicators is that the Australian market appeared to continue to decline into 2010, whereas purity indicators in Europe pointed to a resurgence in 2010 (EMCDDA, 2016a; Giné et al., 2016).

Since 2010, more supply changes have been hypothesised in the Australian ecstasy market. In a 2011/12 annual report, Australian law enforcement stated that ecstasy was "now in its third year of shortage in the Australian illicit drug market" (Australian Customs and Border Protection Service, 2012, p. 47) implying that the 'shortage' period in Australia continued up until at least 2012. In a 2014/15 annual report, law enforcement hypothesised that, ecstasy had "made a resurgence in the Australian illicit drugs market, effectively ending a shortage observed in preceding years" (Australian Customs and Border Protection Service, 2015, p. 64). This hypothesis was made based on large increases in the total weight and number of border detections since 2013.

To the best of knowledge, there has been no Australian academic study to examine in detail ecstasy supply changes since the early 2000s, specifically addressing whether there has been a resurgence in supply since 2013 and the extent to which there have been form shifts over time. Further, there may have been other supply changes in the Australian ecstasy market which are not yet identified. As acknowledged by Fowler, Kinner, and Krenske (2007), a more sophisticated analysis of seizure data which distinguishes trends by seizure attributes like form, supply routes or mode of transport would enhance knowledge of ecstasy supply changes. But this is yet to be undertaken in the Australian context.

Research aims

This chapter has three aims:

1) to identify supply changes in Australia's ecstasy market between 2002 and 2014 noting when and where they happened;

2) to compare trends across four periods of time in order to:

   a. test whether those periods of market change hypothesised in the Australian literature are consistent with the evidence; and

   b. benchmark the scale of any resurgence in supply that may have occurred after the perceived 'shortage'; and

3) to examine whether the application of weight bin analysis can identify additional supply changes than are not detected by the corresponding aggregate trend.

In relation to the first aim, supply changes can be expressed in a number of market features. Five different kinds of supply change were examined herein: changes in the trend in quantity, purity, form, mode of transport and supply routes. In relation to the second aim, four periods of time were defined for the analysis, which are detailed in the methods. Trends over time in each of these aspects of supply were examined, with a view to providing detailed analysis of the ecstasy supply changes, including the extent to which the global ecstasy 'shortage' affected the Australian market and to what extent there has been a resurgence since the decline of ecstasy supply in Australia. The third aim focussed on a methodological issue. As noted in Chapter 4, weight bins are becoming a standard approach to supply trend analysis (Singleton, Cunningham, Groshkova, Royuela, & Sedefov, 2018). This research examines the utility of including weight bin analysis.

Method

Building on methods used by Hughes, Chalmers, Bright, Matthew-Simmons, & Sindicich (2012) and Kilmer and Hoorens (2010) (who examined changes in cocaine and heroin supply respectively), and methods developed in Chapter 4, this research examined five kinds of supply changes in Australia's ecstasy end-product and precursor supply between 2002 and 2014. Seven datasets were used to examine supply changes. The first three were datasets analysed previously in Chapter 4: ecstasy end-product border data 2002-2014 (from Department of Immigration and Border Protection), ecstasy end-product Vic purity data 2002-2014 (from the Drug Sciences Group, Victoria Police Forensic Services Department) and subjective purity and availability reports by EDRS participants from the national EDRS reports (2003-2015) (Breen et al., 2004; Sindicich & Burns, 2015). The remaining four datasets analysed in this chapter were

the following. The first was a unit-record dataset from Department of Immigration and Border Protection on ecstasy precursor detections made between 2002 and 2014. The second and third were the annual total number of ecstasy supplier arrests in Victoria (2005-2014) and New South Wales (2002-2014), retrieved from the Crime Statistics Agency and the Bureau of Crime Statistics and Research respectively (Victoria data for 2002-2004 are currently unavailable). Arrest data were retrieved from two states only because New South Wales and Victoria were the only jurisdictions to provide publicly available data on trends in ecstasy supplier arrests specifically. At the time of the research all national arrest data were reported under the umbrella of amphetamine-type-stimulants and did not distinguish ecstasy arrests from arrests for other synthetic stimulant drugs. The final dataset was the annual total number of ecstasy clandestine laboratory detections made within Australia, retrieved from the Illicit Drug Data Reports (data from 2004/05-2013/14) and from Fowler, Kinner, and Krenske (2007), (data in 2003/04 only). See Table 12 for an overview of the supply changes examined, analyses, rationale and limitations. This research was approved by the University of New South Wales Human Research Ethics Advisory Panel: HC16265.

Table 12

The five supply change kinds examined, analyses, data sources, rationales and limitations

Supply change kind examined	Border or domestic supply?	Analyses conducted to identify changes over time	Data source	Rationale	Limitations
Quantity	Border	Annual total weight of ecstasy border detections excluding the heaviest detection made per year.	Border	Changes in total detection quantities depend partly on changes in the total quantity of drugs imported into Australia. The exclusion of the heaviest detection per year was shown in Chapter 4 to be the optimal approach to this analysis.	Changes in detection quantities also depend on changes in law enforcement activity and the ability of traffickers to conceal drugs, albeit potential outliers were excluded to reduce the impact of outliers on trends.
		Annual total number of ecstasy border detections from the 'heaviest 100' group: end-product and precursors.	Border	This was shown in Chapter 4 to be an optimal method to indicate changes in the quantity of ecstasy available.	As above.
	Domestic	Annual proportion of EDRS participants who reported ecstasy to be 'easy' or 'very easy' to obtain.	EDRS	Indicates changes in perceived ecstasy availability at the low-level, which depends on changes in availability at the high-level.	EDRS participants are a sentinel sample and from Australian capital cities only.
		Annual total weight of ecstasy precursor border detections excluding the heaviest detection made per year.	Border	Changes in total detection quantities depend partly on changes in the total quantity of precursors imported into Australia. Changes in the amount of precursors imported indicate changes in the scale/magnitude of domestic manufacture, which in turn indicates changes in the quantity of ecstasy available domestically.	Changes in detection quantities also depend on changes in law enforcement activity and the ability of traffickers to conceal drugs, albeit outliers were excluded to reduce the impact of outliers on trends.

Supply change kind examined	Border or domestic supply?	Analyses conducted to identify changes over time	Data source	Rationale	Limitations
		Annual total number of ecstasy precursor border detections from the 'heaviest 100' group: end-product and precursors.	Border	As above.	As above.
		Annual total number of ecstasy clandestine laboratory detections	IDDR / Fowler et al. (2007)	Changes in the number of laboratory detections indicates potential changes in the scale of domestic ecstasy manufacture and hence the quantity of ecstasy available domestically.	Data does not contain information on the size of laboratories, whether they were active or inactive at the time of detection, or how often they were in operation prior to detection.
		Annual total number of ecstasy supplier arrests in NSW and VIC	BOCSAR and CSA	Changes in the number of supplier arrests are assumed to be related to the size of the market. If there is more supply, it is assumed that more arrests will be made because more people will be trafficking and/or because existing traffickers will be more active.	Changes in arrest numbers are also dependent on changes in law enforcement activity and the ability of traffickers to conceal drugs.
					Arrest data only publicly exists in two states: NSW and VIC. Trends may not necessarily reflect trends in other Australian states and territories.
					Arrest data does not distinguish between different forms of ecstasy.
Form	Border	Proportion of border end-product annual total weight by form (excluding the heaviest detection made per year).	Border	Changes in the form of the drug may indicate changes in market actors, supply origin or supply routes.	Imported form may be converted into another form on arrival in Australia, albeit this would require extra processing. Hence changes in border form may not necessarily translate to low-level markets.
	Domestic	Annual proportion of the total weight of ecstasy seizures in Victoria by form.	Vic Purity	Changes in form may indicate changes in market actors, supply origin or supply routes	Data are from one state only. The form of ecstasy seized in Victoria may differ to other states and territories in Australia.

Supply change kind examined	Border or domestic supply?	Analyses conducted to identify changes over time	Data source	Rationale	Limitations
Supply routes to Australia	Border	Annual total weight of end-product as a proportion by world region of embarkation (excluding the heaviest detection made per year).	Border	The region of embarkation is where the detected drugs were last known to be trafficked from. It is indicative of where the drugs were sourced from and if there have been changes in trafficking routes to Australia. Countries were grouped into five world regions: Asia, Europe, Africa, Oceania and the Americas. Regions were defined using United Nations Statistics Division definitions (United Nations Office Statistics Division, 2013).	The country/region of embarkation is the last point in what may have been a more complex supply route to Australia. This analysis is not able to detect changes in more complex supply routes prior to the last region of embarkation. For example, ecstasy may have travelled via two or three regions before being exported to Australia. This analysis only identifies changes in the last region of embarkation prior to being exported to Australia.
Mode of transport	Border	Proportion of border end-product annual total weight by mode of transport (excluding the heaviest detection made per year)	Border	Mode of detection is indicative of how the drugs entered Australia as well as the sophistication of trafficking operations, with air/sea cargo indicative of high-level planned/non-opportunistic trafficking. Detections were categorised into one of three transport modes: air/sea cargo; air/sea passengers and crew; and international post.	Assumes that highly planned and sophisticated trafficking operations use air or sea cargo for transport.
Purity	Domestic	Average purity of ecstasy seizures in Victoria distinguishing form: tablet (aggregated monthly), powder (quarterly) and crystal (annually).	Vic purity	Changes in purity indicate the presence of market disruptions (i.e. purity declines or drops) or market resurgence (i.e. purity increases).	May be a biased estimate of average purity of total market. The purity of discovered drugs may be systematically different to the purity of drugs not discovered. Data are from one state only. The purity of ecstasy in Victoria may differ to other states and territories in Australia.

Supply change kind examined	Border or domestic supply?	Analyses conducted to identify changes over time	Data source	Rationale	Limitations
		Annual proportion of EDRS participants who reported ecstasy purity to be 'high'.	EDRS	Indicates changes in perceived ecstasy purity at the retail-level, which is assumed to mirror changes in purity at the high-level, indicative of market disruptions.	EDRS participants are a sentinel sample and from Australian capital cities only.

Unit-record data overview

As the ecstasy end-product border data and ecstasy Vic purity data were already outlined in Chapter 4, their overviews are not repeated here. To reiterate the main point, the Vic purity data do not match the border data in terms of their distributions by weight, which is indicative that (as expected) border detections were on average made at higher distribution levels than the Vic purity seizures. Most seizures in the Vic purity dataset were made at the low-level.

The ecstasy precursor border dataset comprised 68 detections made between 2002 and 2014. Three precursor detections (4% of the total) were excluded from analysis due to missing/unknown weight values, leaving a final sample of 65 detections. See Table 13 for the annual total number of precursor border detections distinguishing type. Compared to end-product (which ranged from annual totals of 38 to 3,385), there were very small annual numbers of precursor detections made (<15 in all years).

Department of Immigration and Border Protection advised that their data are subject to change when new information becomes available. All findings from these analyses are therefore indicative only. Data presented here reflected the best available when provided in February 2015.

Table 13

Annual total number of ecstasy precursor border detections in Australia, distinguishing precursor type, 2002-2014

Year	Type				
	Isosafrole	3,4-mdp-2-p	Piperonal	Safrole	Total
2002				1	1
2003				1	1
2004		1	1		2
2005			2		2
2006	3		1	3	7
2007	4	1	2		7
2008	2				2
2009		1			1
2010	1		1		2
2011	1		1	5	7
2012	1	8		1	10
2013			1	6	7
2014	1	4	4	5	14
Total	13	15	13	22	63

Analysis plan

There were three different types of analyses, each of which are outlined below.

Broad trends over time (2002-2014)

The first analysis examined broad trends over time ('2002 to 2014'). All border analyses were examined descriptively at the annual aggregate level. A statistical analysis such as time series is more rigorous, but would require at least quarterly aggregated data over the 13 year period to be run. When the border data were analysed at the quarter level many quarters had no data given there were too few detections made in some years. For example, there were just 38 end-product detections made in the whole of 2009. The data became even more sparse when segregated by form, mode of transport and supply routes. Changes in the average purity of tablet and powder domestic seizures were examined using a monthly and quarter-yearly aggregated time series analysis respectively. For tablets, there was significant autocorrelation at lag 8 ($d=2.35$, $p < .05$), meaning that each purity value in the series was predicted by the

eighth value that preceded it. The ARIMA method was used to correct for the autocorrelation and an AR(8) model was used to model the series. For powder, there was significant autocorrelation at lag 9 (d=0.97, p <. 05) and the ARIMA method corrected for the autocorrelation using an AR(9) model. Both time series analyses were conducted in R Studio using the *strucchange* package to detect structural breakpoints. Similar to the border data, there were too few crystal seizures made in Victoria to perform a time series. Hence, the crystal purity data was aggregated annually and the trend was analysed descriptively.

Testing hypotheses of periods of market change

The second analysis tested whether there was evidence to support periods of change in the Australian ecstasy market that have been hypothesised in the Australian literature. The four periods of time defined for this analysis were derived from the Australian literature. To summarise, ecstasy supply was perceived to be rising steadily from the early 1990s up until 2004 in the wake of increased ecstasy border seizures and demand but stable price (Fowler, Kinner, & Krenske, 2007). Supply was then perceived to have gradually declined over the mid-2000s, based on declining quantities of ecstasy detected at the border and perceptions from regular ecstasy users who reported a declining availability and purity of ecstasy during this time (Scott & Burns, 2011). Periods 1 and 2 were thus defined as '2002 to 2004' and '2005 to 2007' respectively to represent these two apparent stages of the market. Australian law enforcement referred to the years between 2008 and 2012 years as an ecstasy 'shortage' (Australian Customs and Border Protection Service, 2012). This was hypothesised by law enforcement based on negligible amounts of ecstasy detected at the border during that time. Period 3 was therefore defined as '2008 to 2012'. Finally, from 2013 law enforcement hypothesised that the ecstasy shortage in Australia had ended based on marked increases in the total weight of ecstasy border detections (Australian Customs and Border Protection Service, 2015). In addition, people who regularly use stimulants in Australia (EDRS participants) were reporting rising availability and purity of ecstasy and coupled with increased use of non-tablet forms. In 2013 specifically, EDRS participants were asked by researchers for the first time about the extent to which they used ecstasy in crystal form (as this was raised by a small number of participants in 2012 as an emerging form (Sindicich & Burns, 2015). Period 4 was therefore defined as '2013 to 2014' (the hypothesised resurgence and shifts in form). Trends across all four periods were firstly compared to test the extent to which Australian ecstasy supply changed in line with the periods of market change hypothesised in the Australian literature. Secondly, the two periods of perceived heightened supply (1 and 4) were compared to benchmark the scale of any resurgence in supply that may have occurred after the

perceived 'shortage'. This method was specifically derived from Hughes et al. (2012), who made comparisons between peak periods of Australian cocaine supply in order to benchmark the scale of shifts.

Application of a weight bin method

The third analysis examined whether analysis by weight bin can provide more insight about supply trend changes at different market levels than aggregate trends alone. As argued in Chapter 4, the 'law' method of defining weight bins was optimal for the analysis of Australian ecstasy border data and was used here to define weight bin thresholds: weight bin 1 ('<0.5g'), weight bin 2 ('0.5g to <500g'), weight bin 3 ('≥500g'). The law thresholds were obtained from Schedule Four—border controlled drugs (Criminal Code Regulations, 2002). Weight bin trends for the border data were compared to the corresponding aggregate trends. As shown in Chapter 4, Vic purity data were best analysed as an aggregate trend given there were no systematic differences in average purities between weight bins when analysed using any of the four tested methods to define weight bins. Hence no weight bin analysis was conducted for Vic purity data.

Results

Quantity changes

Figure 18 shows the annual total weight and number of end-product border detections between 2002 and 2014. Total weight peaked in the early 2000s (e.g. approximately 670kg detected in 2003, 2004 and 2005) and then declined to negligible amounts in the late 2000s (e.g. <8kg detected annually between 2009 and 2011). Total weight increased slightly from 2012 but as of 2014 (107kg) was still far lower than previous peak levels. Total number also peaked in the early 2000s, increasing from 12 in 2002 to a peak of 19 in 2004 before declining to just 1 in 2010. It remained 1 in 2011 and 2012, and then increased to 10 in 2014 (i.e. a level only half of the previous peak in 2004).

Analysis by period showed that period 4's average annual total weight (78kg) was slightly higher than period 3 (18kg) but substantially lower than it was in period 1 (488kg) and 2 (349kg). The average total number of detections per period showed a similar trend, with period 4's annual average number (7) being higher than period 3 (2), but still less than periods 1 (16) and 2 (11). In comparison between periods of concern, the average annual total weight of detections in period 4 was 6 times lower than in period 1 and the annual average number of detections in period 4 was 2 times lower than in period 1. Taken together, these trends

suggest that the quantity of ecstasy available at the border saw a substantial decline over periods 2 and 3, and then resurged slightly in period 4 but to levels much lower than the previous peak in period 1.

Figure 18. The annual total weight of end-product border detections excluding the heaviest detection per year and the annual total number of end-product detections from the heaviest 100 group, 2002-2014.
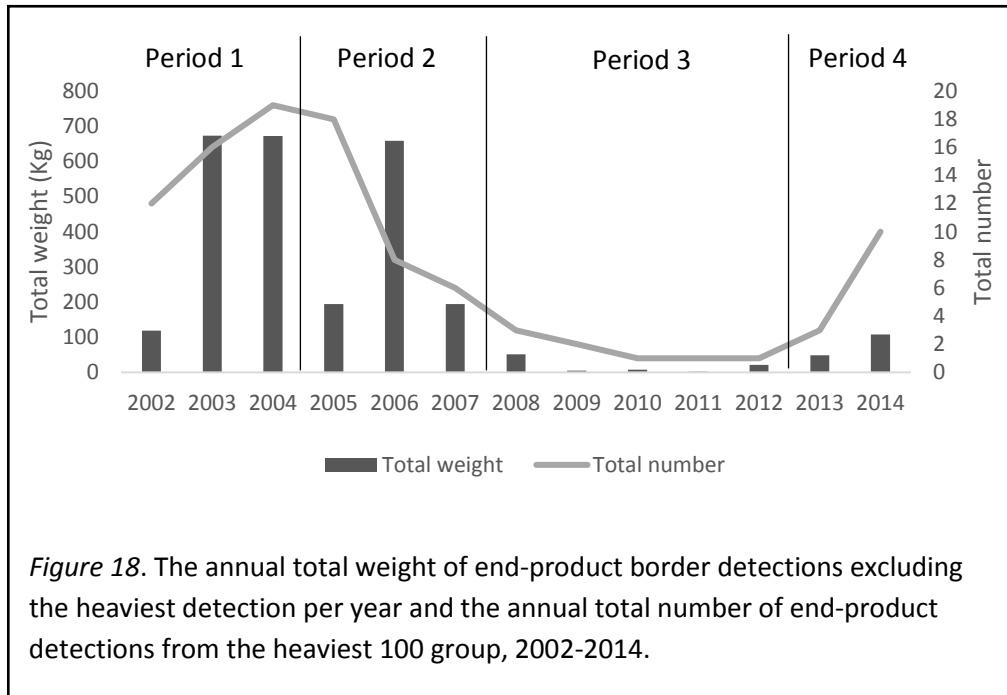
Figure 19 shows the annual proportion of national EDRS participants who reported ecstasy to be 'easy' or 'very easy' to obtain in Australian capital cities between 2003 and 2014. The annual proportion declined from peaks of 96% in 2003 and 2005 to its lowest point of 74% in 2010 before increasing again until 89% in 2014. This trend is consistent with the border data and shows that two major quantity changes happened over the analysis period.

Figure 19. Annual proportion of the national sample of EDRS participants who reported ecstasy to be 'easy' or 'very easy' to obtain, 2003 to 2014. Source: Ecstasy and related Drugs Reporting System 2004 to 2015.
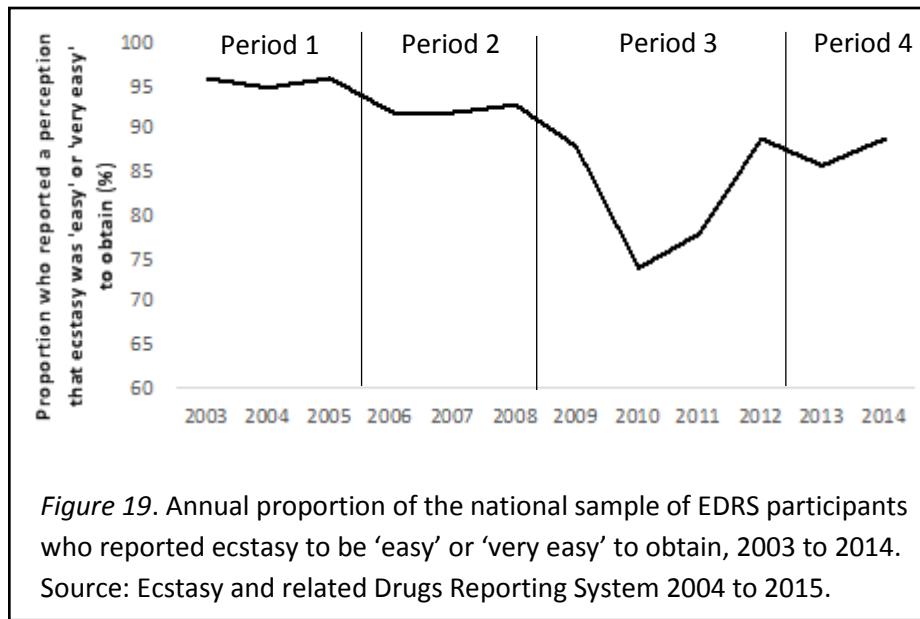
Figure 20a shows the annual total weight and number of ecstasy precursor border detections between 2002 and 2014. Figure 20b shows the annual total number of ecstasy clandestine laboratory detections made in Australia over time. Both precursor and clandestine laboratory detections were very low over the analysis period. For instance, there were far greater quantities of end-product detected over time than precursors (compare Figure 18 to Figure 20a) and ecstasy clandestine laboratory detections comprised only a small fraction in comparison to meth/amphetamine laboratory detections over the same time period which saw hundreds of detections per year (which is outlined in Chapter 6). This indicates that domestic manufacture of ecstasy occurred only in low amounts over the analysis period and that most ecstasy supply was imported. The low number of detections for both ecstasy precursors and laboratories makes it difficult to interpret the trends, both of which fluctuated greatly. But domestic manufacture appears to have increased slightly during times of low or declining border quantity, as indicated by higher quantities of precursors and laboratories detected in periods 1 and three relative to other periods. Increased domestic manufacture during periods 2 and three may explain why the decline of domestic ecstasy quantity appeared to take longer to reach its lowest point (and was less prolonged) than it seemed at the border. It was difficult to compare period 1 to 4 and reach a conclusion on which likely had more domestic manufacture. Period 1 had virtually no precursors detected but a higher number of laboratories detected. In comparison, period 4 had more precursor detections by weight and number, but less laboratory detections. Hence the evidence surrounding whether manufacture was greater in period 4 than 1 is inconclusive.

Figure 20. The annual total weight of precursor border detections excluding the heaviest detection per year and the annual total number of precursor detections from the heaviest 100 group between 2002 and 2014 (a), and the annual total number of ecstasy clandestine laboratories seized in Australia between 2003/04 and 2014/15 (b). Source of clandestine laboratory data: Illicit drug data reports 2006 – 2016; Fowler, Stuart & Leigh (2007).

Figure 21 shows the total number of ecstasy supply arrests in New South Wales (2002-2014) and Victoria (2005-2014). In New South Wales, arrests remained relatively low between 2002 and 2004 (approximately 300 annually) before seeing a general increase to 518 in 2009, a decline to 291 in 2011, then an increase to 591 in 2014. The Victorian trend increased from 364 in 2005 to 467 in 2007, then declined to 171 in 2011, before increasing to 401 in 2014. Hence both trends showed a steep decline in 2010 and 2011 indicating a potential shock to the

ecstasy market in 2010, before re-increasing from 2012, which is consistent with a supply resurgence from 2012.

Figure 21. Annual total number of arrests in New South Wales (NSW) and Victoria (VIC) associated with ecstasy 'supply' offences. Source: Bureau of Crime Statistics and Research, and Crime Statistics Agency.
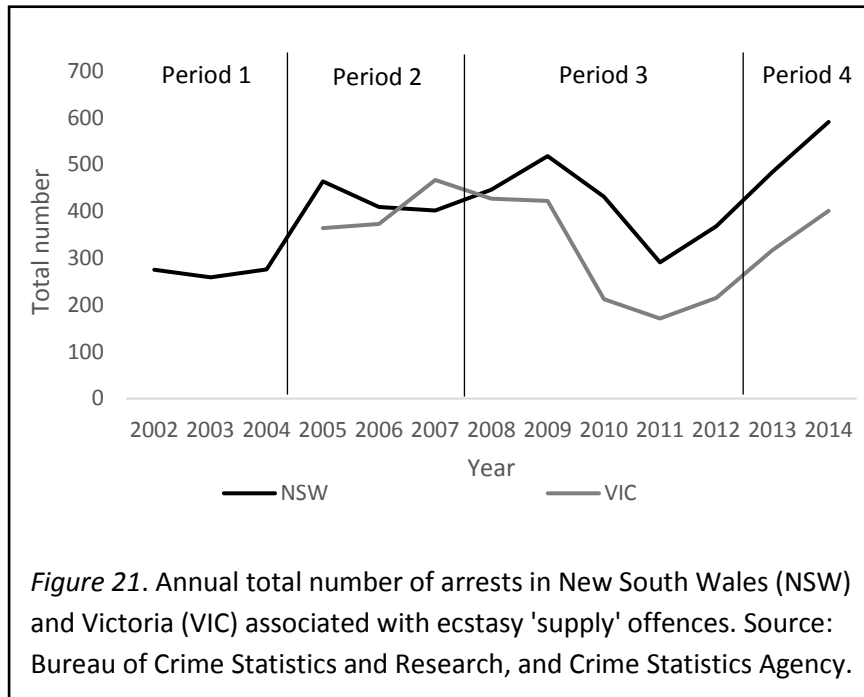
Form changes

Figure 22 shows the annual proportion of border end-product total weight by form. There were two major form shifts identified. The first was a shift from tablet to non-tablet forms (mostly powder) over the first half of the analysis period. For instance, the total weight of border detections in tablet form decreased from 99% in 2002 to just 18% and 10% in 2007 and 2008. Conversely, the proportion of detections in powder form increased from just 0.3% in 2002 to 82% and 88% in 2007 and 2008 respectively. Non-tablet forms remained the most prominent detected by weight each year for the remainder of the analysis period. But between 2008 and 2014 there was a gradual decline in the proportion of detections in powder form and an increase in the proportion of detections in crystal form, hence the second major form shift at the border. By 2014, crystal accounted for the greatest proportion of total weight relative to any other form (49%).

In period 1, the most prominent form detected by weight at the border was tablet (accounting for 63% of detections in that period by weight), followed by unknown (24%), and then powder (13%). In period 2, the most prominent form detected was tablet (58%) followed by liquid (23%) and powder (18%). In period 3, the most prominent form detected had shifted to

powder (68%) followed by tablet (21%) and then crystal (9%). In period 4, the most prominent form detected shifted to crystal (42%) followed by powder (24%), tablet (13%) and then liquid (10%). Hence in period 1, the vast majority of total weight was in tablet form, but in period four the vast majority of weight was in non-tablet form most notably crystal and powder.

Figure 22. The proportion of the annual total weight of Australian ecstasy end-product border detections excluding the heaviest detection per year by form, 2002 to 2014.
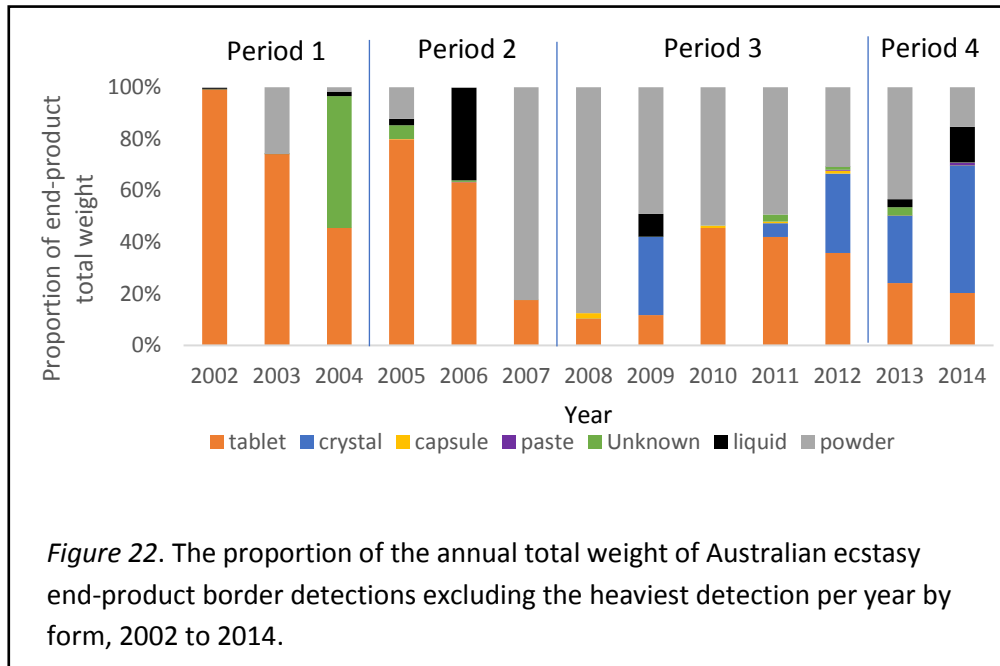
Figure 23 shows the proportion of ecstasy seizures in Victoria by weight, form and year. Tablet was by far the most common form by weight seized in Victoria throughout the analysis period, accounting for more than 78% of seizure by weight in all years, albeit there was a very small shift to more crystal from 2012. Crystal seizures accounted for 1% or less of total weight in all years prior to 2012, and then in 2012 this increased to 2.8% and by 2014 it reached 7.6%. Powder accounted for low annual proportions of total weight over time, fluctuating between 1% and 21% annually. Therefore there was no evidence of any major shift from tablet to non-tablet forms in Victoria as was found at the border. This suggests that imported non-tablet forms were mostly converted to tablets before being sold on the retail market.

In period 1, the most prominent form by weight was tablet (accounting for 94% of seizures by weight in that period), followed by powder (5%). In period 2, the most prominent form by weight was tablet (90%) followed by powder (10%). In period 3, the most prominent form by weight was tablet (83%) followed by powder (21%). In period 4, the most prominent form by weight was tablet (91%) followed by crystal (6%) and then powder (3%). Therefore there was

no major form shift between periods 1 and four (of which the bulk of seizures remained in tablet form). There was, however, a notable albeit small increase in the amount of crystal seized in period four compared to period 1.

Figure 23. Annual total weight of ecstasy seizures in Victoria as a proportion by form.
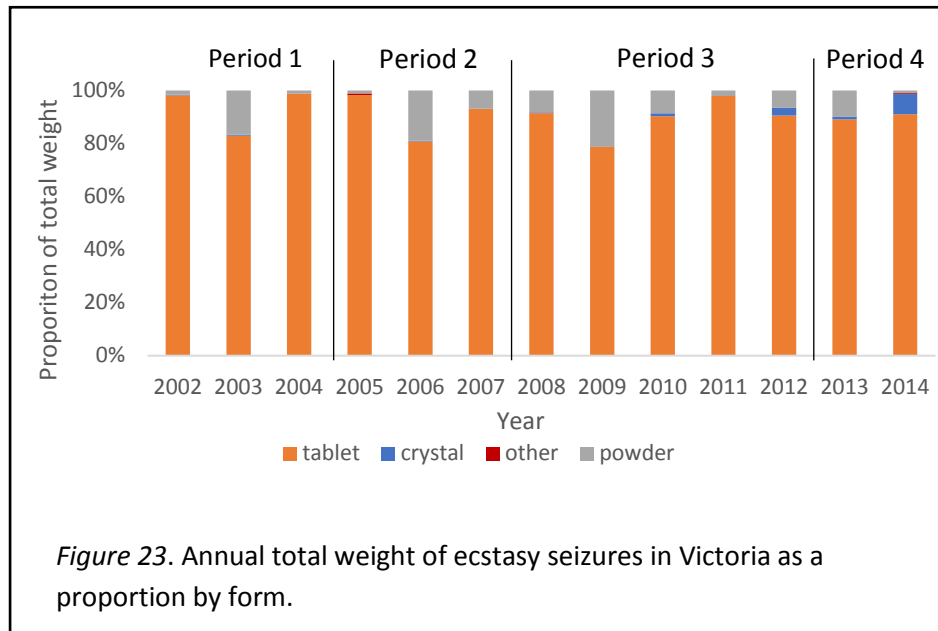
Supply route changes

Figure 24 shows the annual proportion of the border end-product total weight by region of embarkation, 2002 to 2014. There was a shift in the most prominent region of embarkation from Europe (2002-2005) to the Americas and Asia (2006-2010) which then shifted back to Europe (2011-2014). Hence there were two major supply route shifts identified over the analysis period. The decline in quantity and form shift at the border coincided with a shift away from Europe to other world regions. Similarly, the quantity increase at the border in the early 2010s coincided with a shift back to Europe as the prominent region of embarkation.

In period 1, the most prominent region of embarkation of end-product detections by weight was Europe (accounting for 86% of detections by weight in this period), followed by Asia (13%). In period 2, Europe and the Americas both accounted for equal highest proportions of total weight (41% each) followed by Asia (14%). In period 3, unknown accounted for the greatest proportion (51%) followed by Europe (29%), the Americas (14%), then Asia (6%). In period 4, Europe accounted for the vast majority (81%) followed by the Americas (11%) and then Asia (8%). Hence Europe accounted for the vast majority of detections by weight in both periods 1 and 4.

Figure 24. Annual proportion of end-product total weight excluding the heaviest detection per year by region of embarkation, 2002 to 2014.
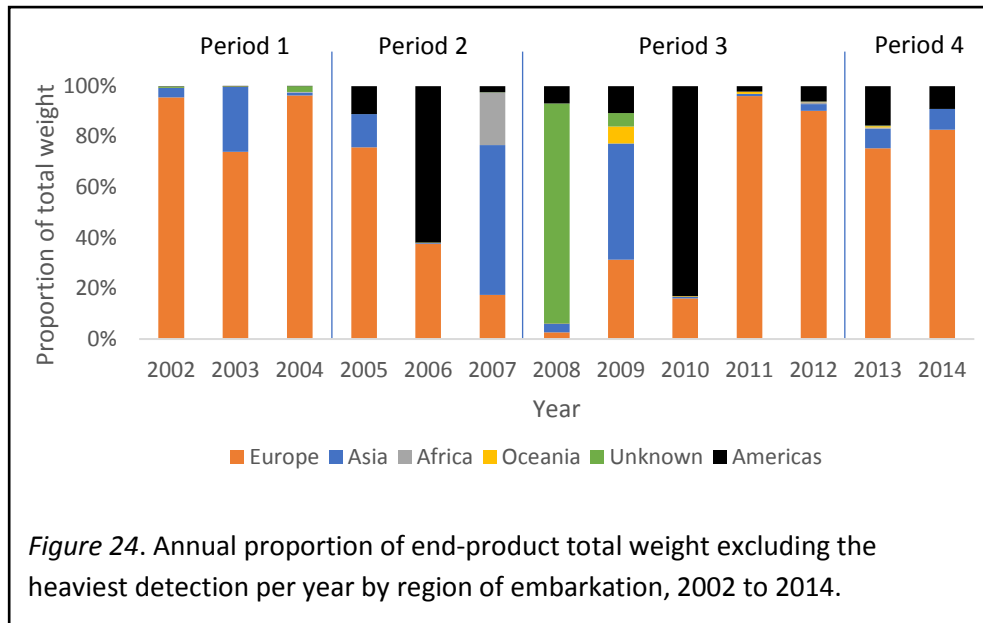
Mode of transport changes

Figure 25 shows the annual proportion of the border end-product total weight by mode of transport, 2002 to 2014. There were two major shifts identified. The first was a shift from mostly air/sea passengers and crew in 2002 (accounting for 56% of detections by weight) to air/sea cargo in 2003 (93%). Air/sea cargo remained most prominent mode by weight until 2009 in which a shift to post began. Between 2010 and 2013, post accounted for the vast majority of total weight (accounting for >93% of detections by weight annually). There was a slight shift in the mode of transport back to air/sea cargo in 2014, albeit post still remained most prominent (accounting for 66% of detections by weight).

In period 1, the most prominent mode of end-product detections by weight was air/sea cargo (accounting for 87% of detections by weight in this period), followed by air/sea passengers and crew (8%) then post (3%). In period 2, air/sea cargo accounted for the greatest proportion (84%) followed by air/sea passengers and crew (10%) then post (5%). In period 3, air/sea cargo accounted for the greatest proportion (54%) followed by post (42%), and then air/sea passengers and crew (4%). In period 4, post accounted for the majority (75%) followed by air/sea cargo (19%) and then air/sea passengers and crew (7%). There was a clear shift in the prominent mode of transport between periods 1 and 4 from air/sea cargo to post.

Figure 25. Annual proportion of end-product total weight excluding the heaviest detection per year by mode of transport, 2002 to 2014.
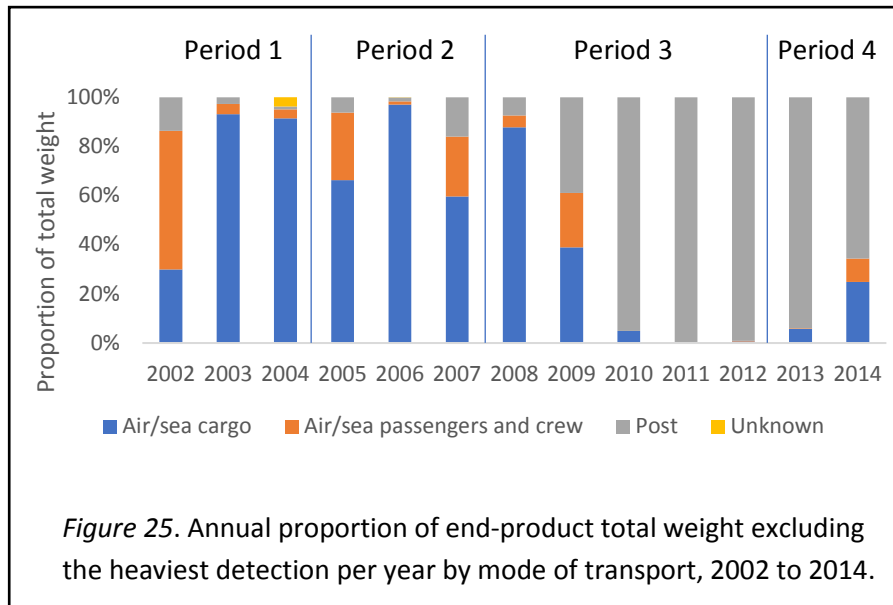
Purity changes

Figure 26 shows the monthly average purity time series for domestic tablet seizures, 2002-2014. Three structural breakpoints were deemed to be most optimal for analysis. From January 2002 the series increased by 0.05% per month although this upward trend was not significant, $p > .05$. In January 2006 there was a significant level drop in purity of -5.9%, $p = .001$, 95% CI [-9.4, -2.4]. The series then declined by -0.17% per month but again the slope was not significant, $p > .05$. In March 2008 there was a significant level increase in average purity by 8.5%, $p < .0001$, [4.7, 12.4]. The series then declined by -0.81% per month–this slope was significant, $p < .001$, [-0.95, -0.66]–and continued to decline until reaching its lowest point of the analysis period in August 2010. The following month in September 2010 there was a significant level increase in average purity by 11.0%, $p < .0001$, [7.9, 14.1]. The series then declined by -0.02% per month, but the slope was not significant, $p > .05$. As of 2014, average tablet purity had not returned to prior peak levels seen at the beginning of the analysis period. Although the average purity in period four (20%) had resurged since its lowest point in period 3, average purity was still much lower than the average purity in period 1 (33%), again suggesting only a partial resurgence had occurred.

The periods of change in ecstasy tablet purity are reasonably in line with periods of market change hypothesised in the Australian literature for periods 1 and 2: average purity was highest in period 1 and dropped slightly in period 2. However, hypothesised periods 3 and 4 are not consistent with this series. While period 3 was clearly the lowest point, the lowest

point was not as prolonged as hypothesised. This series suggests that period 4 (the
resurgence) began much earlier than 2013: about late 2010.

Figure 26. Monthly average purity of ecstasy tablet seizures in Victoria, 2002-
2014.
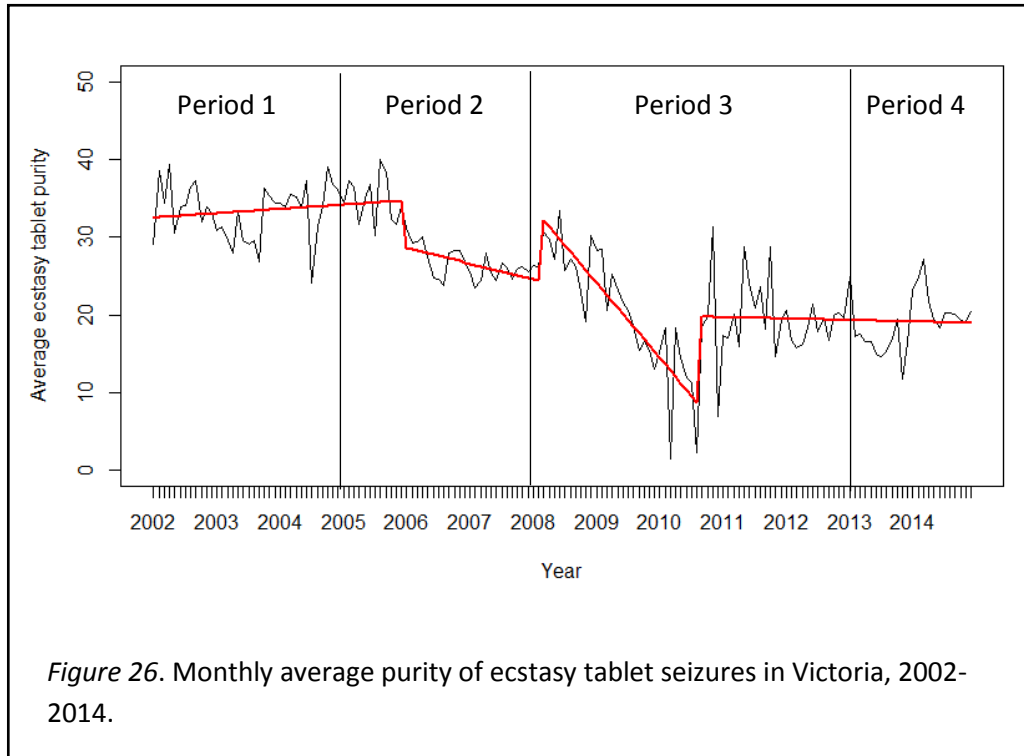
Figure 27 shows the quarterly average purity time series for domestic powder seizures, 2002-
2014. From 2002-quarter-1, average powder purity significantly declined at the rate of -0.22%
per quarter, $p < .0001$, 95% CI [-0.31, -0.13]. In 2008-quarter-1, average purity then
significantly declined at the increased rate of -2.4% per quarter, $p < .001$, [-3.26, -1.53]. In 2010-
quarter-1 there was a significant increase in purity level by 12.2%, $p < .0001$, [8.1, 16.4]. The
series then significantly increased by 0.33% per quarter for the remainder of the analysis
period, $p < .0001$, [0.20, 0.46]. By 2014, average powder purity had returned to pre-peak levels
seen at the beginning of the analysis period. The average purity in period four was identical to
average purity in period 1 (36%).

As per the tablet purity series, the hypothesised periods of market change suggested in the
Australian literature are in line with that suggested by the powder series for periods 1 and 2.
But again periods 3 and 4 in the powder series are inconsistent with the Australian literature.

Although the lowest point was in period 3, this series also suggests that period 3 was much shorter and hence period four began much earlier: here it shows that a supply resurgence happened at the beginning of 2010 (not 2013).

Figure 27. Quarterly average purity of ecstasy powder seizures in Victoria, 2002-2014.
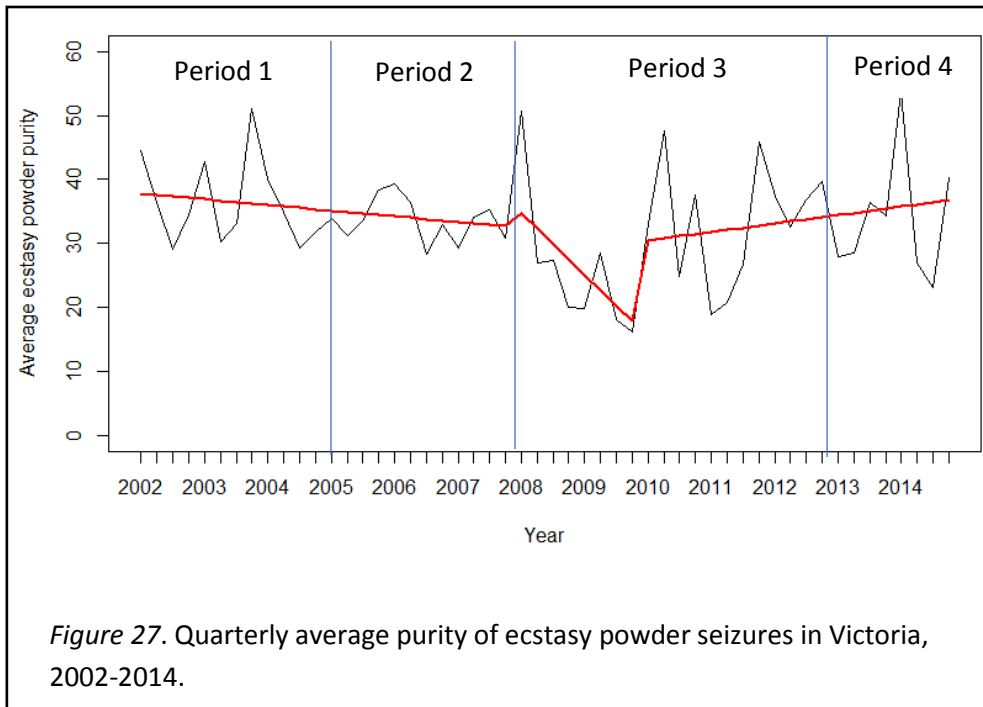
Figure 28 shows the annual average purity time series for domestic crystal seizures, 2002-2014. When compared to powder and tablet, crystal had a much higher average purity over time. In all years except 2004 and 2009, the average purity of crystal remained fairly consistent and high (fluctuating between 62% and 79%). Caution is advised interpreting this trend due to the very low sample sizes prior to 2012, which comprised 13 annual seizures or less.

Figure 28. Annual average purity of ecstasy crystal seizures in Victoria, 2002-2014.
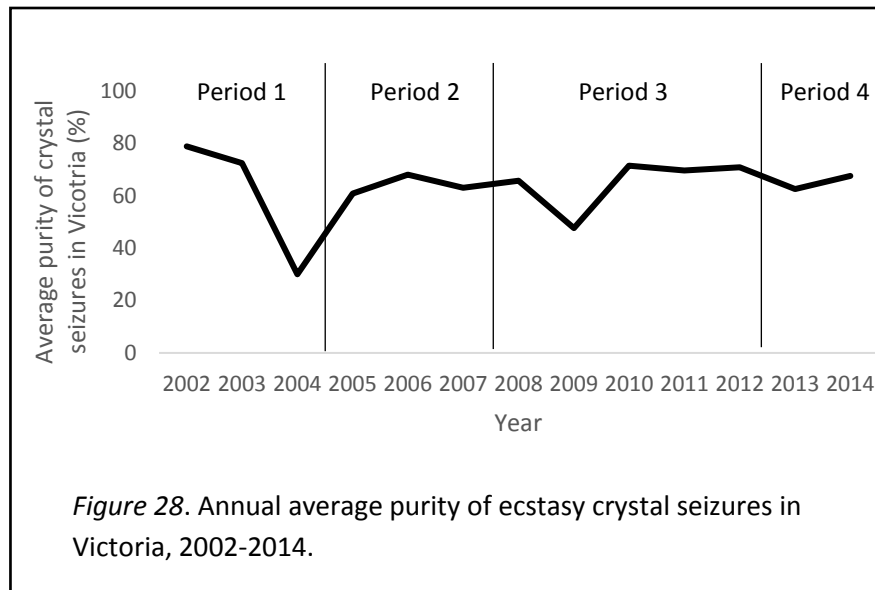
Figure 29 shows the annual proportion of the national sample of EDRS participants who reported ecstasy purity irrespective of form to be 'high', 2003 to 2014. The annual proportion increased from 21% in 2003 to a peak of 32% in 2004, declined to its lowest point of 6% in 2010, then re-increased until in 2014 but to a point still lower than the previous peak (19%).

As per forensic purity analyses, the EDRS purity trend in periods 1 and 2 is consistent with literature hypotheses, but here the resurgence began from 2011, suggesting that the lowest supply period was probably much shorter than hypothesised.

Figure 29. Annual proportion of the national sample of EDRS participants who reported ecstasy purity to be 'high', 2003 to 2014. Source: Ecstasy and related Drugs Reporting System 2004 to 2015.
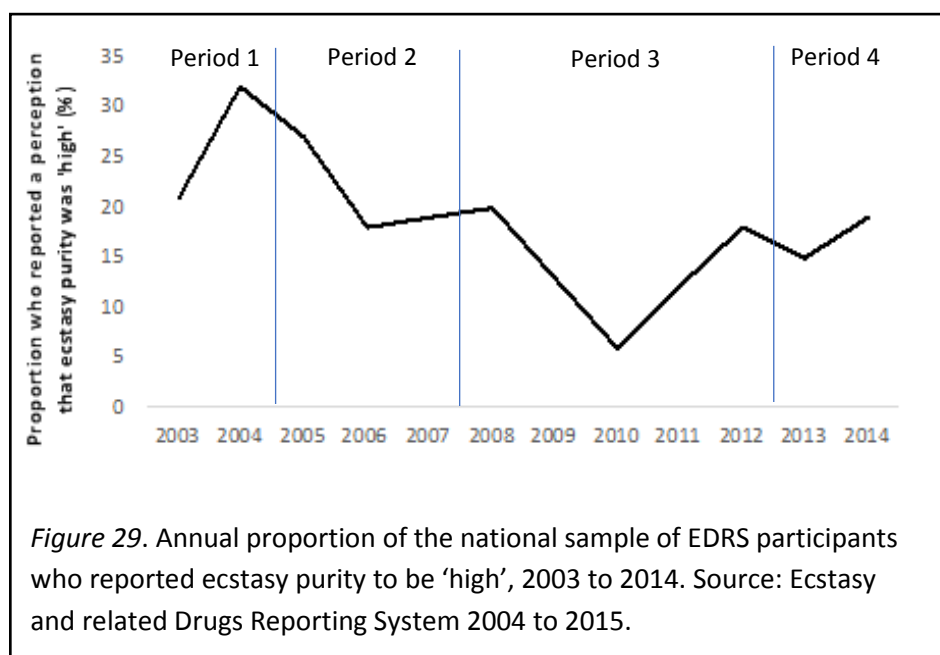
Analysis by weight bin

Figure 30 shows the annual total weight and number of detections compared to the analysis by weight bin. Both the total number and weight of detections in bin 3 were more similar to that of the aggregate trend. This suggests that the aggregate trend is being driven by the >500g trend (i.e. bin 3). The total weight and number trends for bins 1 and 2 are very different to bin 3 and suggest supply changes happened at different times in lower distribution levels. In particular, bins 1 and 2 show a large quantity increase from 2012 to 2014. Whereas the peak quantity in bin 3 occurred in the early to mid-2000s. Hence the aggregate trend failed to detect supply changes in smaller weight bins which peaked at different times to the high distribution level.

Figure 31 shows the annual total weight of detections by form compared to the analysis of the same data by weight bin. Once more, bin 3 was more similar to the aggregate trend and bins 1 and 2 were more dissimilar. Hence the aggregate trend failed to detect form changes at lower distribution levels which occurred at different times to the high-level. In particular, the weight bin analysis shows that the form shift to non-tablet forms began at the high-level but took time to translate down to the lower levels. The form shift to non-tablet forms happened most prominently in bin 3 from 2007 onwards and it was almost a complete shift. Bin 2 shows that the form shift was less prominent at the mid-level and took longer to see a prominent shift (not seeing any notable shift until 2008). Bin 1 shows that the lower-level took even longer to shift form, not showing any evidence of a form shift beginning until 2012. Bin 1, which is indicative of low-level trends, is consistent with the Vic purity data which are also indicative of the low-level market and show that the form shift to crystal did not happen until later in the analysis period relative to the higher level border data (see Figure 23).

Figure 32 shows the annual total weight of detections by region of embarkation compared to the analysis of the same data with weight bins applied. Once more, this showed that shifts in supply routes were not consistent across all three distribution levels. The weight bin analysis shows that the shift in supply routes away from Europe to other world regions was more prominent at the high-level than lower levels.

Figure 33 shows the annual total weight of detections by mode of transport compared to an analysis of the same data by weight bin. Once again, the aggregate trend failed to detect changes at lower market levels which differ in significant ways to the high-level. The lowest level (bin 1) shows that in the first half of the analysis period, traffickers were importing using mostly air/sea passengers and crew which then shifted to post most predominantly form 2011.

Bin 2 shows that mid-level traffickers were using the post as the most predominant method in all years except 2009 (which was air/sea cargo). While bin 3 shows that the high-level was mostly using air/sea cargo at the beginning of the analysis period which then shifted to mostly post from 2010.
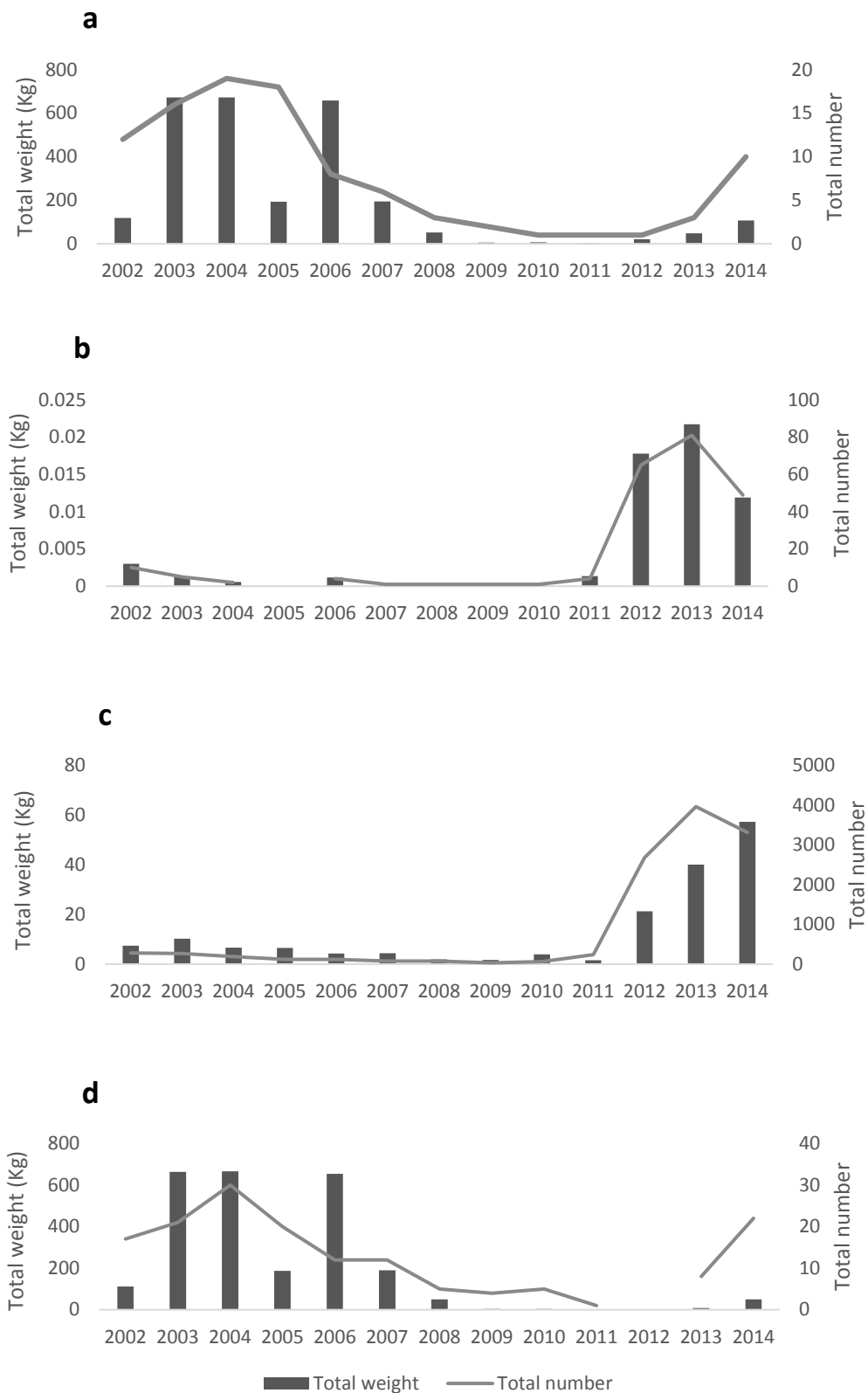
Figure 30. Aggregate total weight and number trends of end-product border detections (a) compared to the same data analysed by weight bin (law method) in bins 1 (b), 2 (c) and 3 (d).
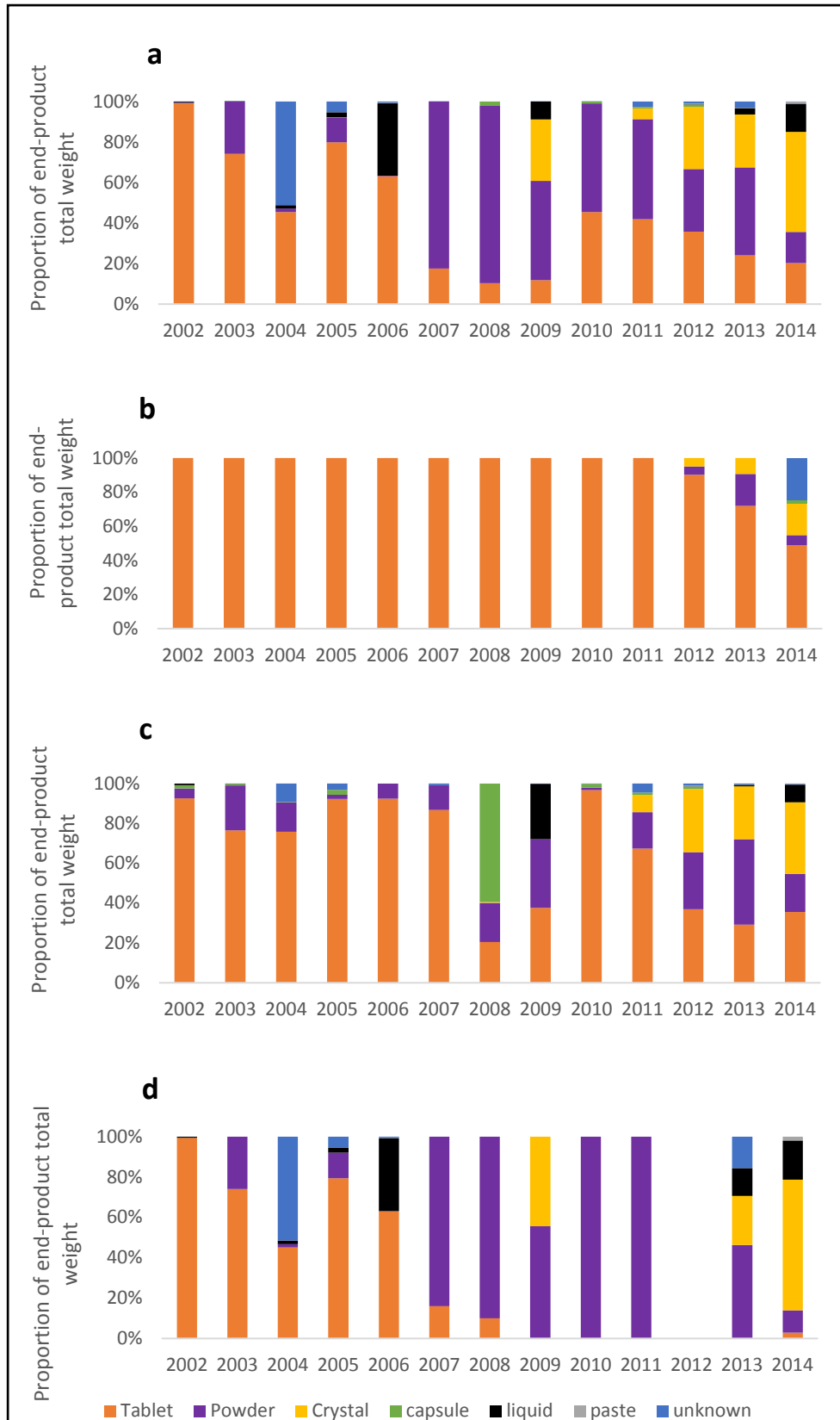
Figure 31. Aggregate total weight of end-product border detections as a proportion by form (a) compared to the same data analysed by weight bin (law method) in bins 1 (b), 2 (c) and 3 (d).

Figure 32. Aggregate total weight of end-product border detections as a proportion by country of embarkation (a) compared to the same data analysed by weight bin (law method) in bins 1 (b), 2 (c) and 3 (d).
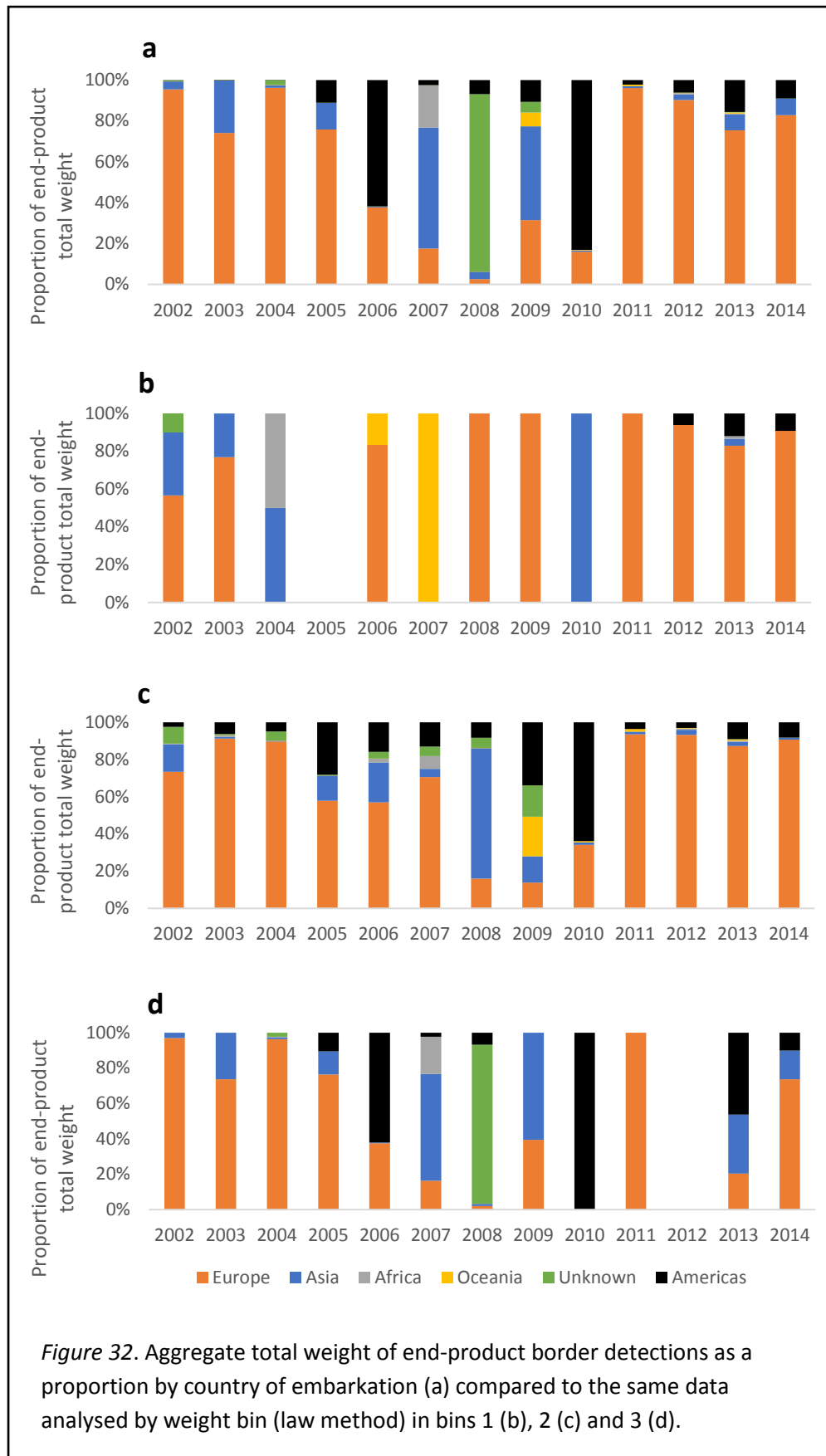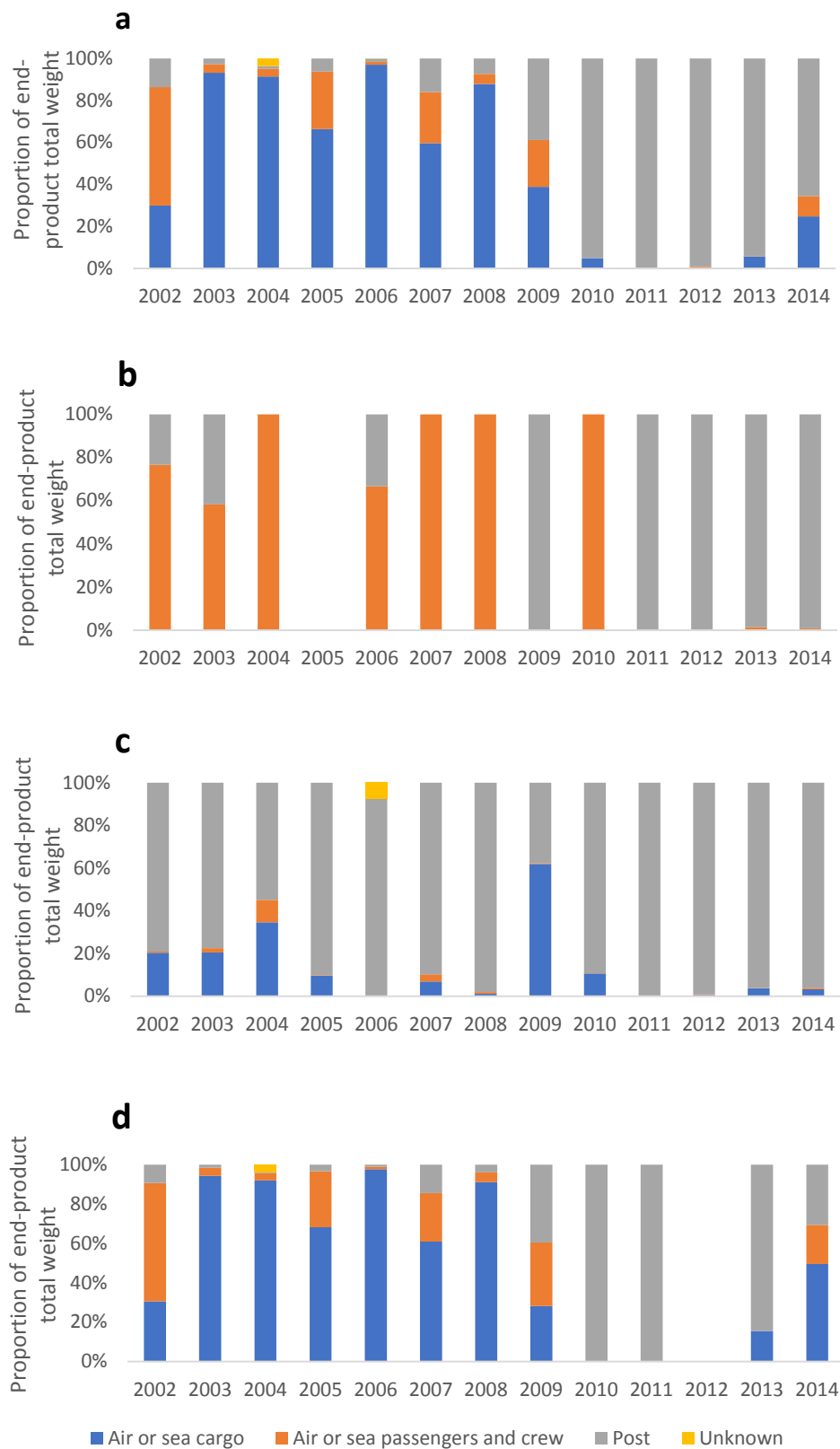
Figure 33. Aggregate total weight of end-product border detections as a proportion by mode of transport (a) compared to the same data analysed by weight bin (law method) in bins 1 (b), 2 (c) and 3 (d).

Discussion

This research aimed to do three things: to identify supply changes in Australia's ecstasy market between 2002 and 2014 noting when and where they happened; to compare trends across four periods to test whether those periods of market change hypothesised in the Australian literature are consistent with the evidence; and to examine trends at different distribution levels by applying weight bin analysis and comparing them to their corresponding aggregate trends to see whether any new insights about supply changes can be gained.

Between 2002 and 2014, the analysis identified two major quantity changes, two major form changes at the border, one minor form change in Victoria, three major purity changes in Victoria for both tablet and powder forms, two major changes in border supply routes and two major changes in border mode of transport. As hypothesised, many more supply changes in Australia's ecstasy market were identified in this research than previously known.

The quantity of ecstasy available at the border peaked at the beginning of the analysis period and then appeared to decline from around 2005. Coinciding with this decline was a decline in the tablet form and shift to powder form, a shift away from Europe as the most prominent exporter of ecstasy to Australia to other world regions (most notably the Americas and Asia), and also a decline in both tablet and powder purity in Victoria. This is consistent with data in the world drug reports suggesting that significant ecstasy production shifted away from Europe to Asia and North America in the mid 2000s (UNODC, 2008; UNODC, 2011). The present border quantity indicators further suggest that in 2008 quantity began to reach its lowest point of the analysis period, which coincided with a more rapid significant decline of both tablet and powder purity, a shift away from air/sea cargo as the most prominent mode of transport to post, and a potential small rise in domestic manufacture of ecstasy. This is consistent with the European literature which suggests ecstasy trafficking at all levels is increasingly shifting to postal methods (EMCDDA, 2016c).

Both tablet and powder purity reached their lowest average purity in 2010 as indicated by the Vic purity time series analyses, which coincided with the lowest total weight and number of border detections and the lowest proportion of EDRS participants who said purity was high and that ecstasy was easy or very easy to obtain. Taken together, these indicators strongly suggest that 2010 was the time of lowest ecstasy supply in Australia. However, by 2011 both powder and tablet purity in Victoria had partially resurged and the proportion of EDRS participants who said purity was high and ecstasy was easy or very easy to obtain also increased by a notable amount. After the partial resurgence in 2011, average tablet purity

remained unchanged for the remainder of the analysis period (sitting at around 20%), whereas powder purity continued to significantly increase and by 2014 had returned to pre-peak levels (68%). In contrast, the average purity of crystal seizures in Victoria was consistently very high throughout the analysis period. In all years except 2004, average crystal purity was >60%.

The partial resurgence from 2011 coincided with four other supply changes: a shift in supply routes from the Americas and Asia back to Europe as the most prominent exporter of ecstasy to Australia (which remained most prominent through to 2014), a gradual shift to crystal and a decline in powder at the border, a small albeit notable increase in crystal in Victoria, and then a small quantity increase of ecstasy at the border which occurred a short time later from 2013. By 2014, crystal accounted for about half of all ecstasy detected at the border and about 8% of seizures in Victoria.

Taken together, these findings suggest that the resurgence of Australian ecstasy supply may have occurred earlier than hypothesised by law enforcement groups (in 2011 not in 2013) (Australian Customs and Border Protection Service, 2015) and that the form shift away from tablets to non-tablet forms may also have commenced earlier than first identified by EDRS participants (in 2007 and not in 2012), (Entwistle & Burns, 2014). In particular, crystal ecstasy first emerged at the border from 2008 and was even seized in Victoria as early as 2002 albeit in very small quantities at that stage. This means that the findings presented here are not consistent with the periods of market change hypothesised in the Australian literature.

The present findings also suggest that Australia's ecstasy low point happened in 2010 which is one year after Europe, and that Australia's ecstasy supply followed a different trajectory to Europe after the global "shortage" where purity continued to increase to unprecedented highs in subsequent years (EMCDDA, 2016a; Giné et al., 2016; Mounteney et al., 2018). For example, tablets analysed at drug checking facilities in the Netherlands found that the proportion of all analysed tablets containing >106mg of MDMA increased from just 10% in 2009 to an unprecedented 41% in 2011 which further increased to 59% by 2014 (EMCDDA, 2016a). This raises the question of why Australia's ecstasy supply has not followed suit with Europe and increased to unprecedented highs, despite the shift back to Europe as the most prominent exporter of ecstasy to Australia from 2011.

Prior to 2007, most ecstasy border detections by weight were in tablet form, suggesting that most tablets in Australia were pressed overseas and therefore accorded to the manufacturing trends of Europe. After 2007 there was a shift to non-tablet forms at the border but the low-level appeared to remain mostly tablets. This indicates that most tablets in circulation in

Australia since then were pressed in Australia from non-tablet forms imported. This helps to explain why Australia might no longer follow Europe's trend in terms of tablet purity, because it appears that traffickers in Australia now mostly set their own purity of tablets regardless of what is happening in Europe. It's not clear why traffickers here are not increasing the purity in response to increasing quantity. How traffickers adapt to purity changes is examined in Chapters 7 and 8.

The period of resurgence in Australia had very different supply characteristics compared to the previous peak period in the early 2000s. Between these periods of heightened supply, there was a shift to non-tablet forms which became much higher in average purity than tablets, a lower quantity of ecstasy available overall, and finally there was a shift to post from air/sea cargo as the most prominent mode of transport. The one aspect of supply that was constant between periods of heightened supply was that Europe was the main exporter of ecstasy to Australia. It is no surprise that Europe returned as the prominent exporter of ecstasy to Australia following the global shortage given that Europe is known for producing the highest quality ecstasy compared to anywhere else in the world (EMCDDA, 2016a).

Weight bins

The analysis by weight bin of the border data identified supply changes at different distribution levels that aggregate trends alone could not detect. For example, weight bin analysis by total weight and number showed that a major quantity decline occurred at the high-level around the middle of the analysis period, whereas this was not evident at the mid or low-level. In contrast, there was a major quantity increase in the mid and low-levels at the end of the analysis period, which was not evident at the high level. The aggregate trend on the other hand showed a major quantity decline around the middle of the analysis period and then a small quantity increase towards the end. This supports past research which demonstrates the value of weight bin analysis as more supply changes can be detected over and above the aggregate trend alone (Kilmer & Hoorens, 2010; Singleton, Cunningham, Groshkova, Royuela, & Sedefov, 2018).

Limitations

As outlined in Chapter 3, all drug supply indicator data have limitations. The primary concern with using law enforcement data to indicate supply changes is that changes in seizure quantities may be more indicative of changes in law enforcement activity than supply. However, biases with the use of law enforcement data were arguably reduced by using

methods of analysis shown to be more indicative of supply fluctuations in Chapter 4 along with data triangulation methods. A second limitation was the use of descriptive methods of analysis for the border data. An inferential statistics procedure such as time series analysis would have strengthened the analysis and findings, but this was not possible given there were insufficient sample sizes per data point. A third limitation was the purity analysis being of data from the state of Victoria only. Ecstasy purity in Victoria is not indicative of ecstasy purity at the border, nor is it necessarily consistent with ecstasy purity in other Australian states or territories.

Conclusion

This research identified five kinds of supply changes that occurred several times in Australia's ecstasy market between 2002 and 2014. It showed that the Australian ecstasy 'shortage' was probably less prolonged than hypothesised in the literature and occurred one year later than Europe's ecstasy 'shortage'. It showed that Australia's ecstasy market resurged after the global shortage but probably to a level lower than the previous Australian peak in the early 2000s. Finally, it showed the value of weight bin analysis which identified more supply changes in Australia's ecstasy market over and above the aggregate trends alone. The following chapter, Chapter 6, examines supply changes in Australia's meth/amphetamine market between 2002 and 2014.

Chapter 6: Supply Changes in Australia's Meth/Amphetamine Market: 2002-2014

As per the previous chapter on ecstasy supply changes, this chapter examines supply changes in Australia's meth/amphetamine market and follows the same format and aims (only centred around meth/amphetamine supply). Once again, the chapter begins with a brief literature review of the international market, followed by the Australian market and gaps in knowledge.

The international meth/amphetamine market

From the late 1990s, meth/amphetamine was believed to have been primarily manufactured in East and South East Asia in tablet or crystal form and in the early 2000s this region was referred to as the global hub of production and trafficking (McKetin et al., 2008). This was argued based on large increases in meth/amphetamine seizures, clandestine laboratory detections and related arrests over that time up until the mid-2000s in the East and South East Asia region. In 2003, UNODC used indirect methods to estimate that about half of all global production of meth/amphetamine was in East and South East Asia, with a third originating in North America and 15% in Europe (UNODC, 2005). The main producer of meth/amphetamine in Asia in the early 2000s was believed to be China (UNODC, 2005). Notable production was also present in the Oceania region during this time (specifically Australia and New Zealand), although there was no evidence that exports from this region occurred in any great quantities to other parts of the world (UNODC, 2007).

In response to the uprise of global meth/amphetamine manufacture during the 1990s and 2000s, many countries began to implement stricter controls around the two main meth/amphetamine precursors—ephedrine and pseudoephedrine (Stoneberg, Shukla, & Magness, 2017). These substances are primarily manufactured for the medical industry for use in cold and flu medicines and were traditionally available to the public over the counter in pharmacies/drug stores. But a common trend was to divert packets of cold and flu medicines containing these precursors into illicit meth/amphetamine manufacture, which prompted the move to implement stricter controls in some countries.

In Australia, stricter pseudoephedrine controls began rolling out across the country from 2005 via Project STOP (Devaney, Ferris, & Mazerolle, 2015). Pharmacies participating in Project STOP recorded public purchases of pseudoephedrine products for each individual and restricted the amount which could be purchased. This was done to prevent 'pseudo runners' travelling from

pharmacy to pharmacy and purchasing large quantities of medicines containing pseudoephedrine for diversion into illicit meth/amphetamine manufacture. In 2008, pseudoephedrine and ephedrine was no longer sold to the public in Mexico and was only used in hospitals (Rebecca, Rachel, Bright, & Melissa, 2011; Stoneberg, Shukla, & Magness, 2017). Similar controls were expanded into China in 2012 (Australian Crime Commission, 2015b) and again in Europe in 2013 (Stoneberg, Shukla, & Magness, 2017). Several more controls were implemented in North America between 2003 and 2008 (Rebecca, Rachel, Bright, & Melissa, 2011).

Despite the implementation of stricter precursor controls in many countries, law enforcement data suggest that the international meth/amphetamine market continued to expand over time as evidenced by continuing increases in the annual total weight of meth/amphetamine global seizures, arrests and clandestine laboratory detections (UNODC, 2014). For instance, in 2005 approximately 55 tonnes of amphetamine-type-stimulants were seized (UNODC, 2011), by 2010 approximately 70 tonnes were seized and by 2015 nearly 200 tonnes were seized. From around 2010 onwards, seizures of amphetamine-type-stimulants began to overtake that of heroin for the first time and by 2015 seizures were approximately double that of heroin (UNODC, 2017), which further highlights the significant growth of global meth/amphetamine supply.

Over the past decade there have been two notable shifts in supply origin and form. First, significant meth/amphetamine manufacture has expanded to new areas. While the largest proportions of global meth/amphetamine appears to still be manufactured in East and South East Asia and North America (based primarily on trends in law enforcement data), significant production appears to have expanded to Africa and central Asia and includes countries such as "Guatemala, the Islamic Republic of Iran, Kenya, Nigeria and South Africa" (UNODC, 2014, p. 3). Second, there has been a major form change in many countries from mostly powders or tablets to mostly crystal. This is evidenced by shifts in the form of seized meth/amphetamine. For example, the total weight of seizures in crystal form in East and South East Asia doubled from approximately 7,000kg in 2009 to approximately 14,000kg in 2013 with China accounting for the largest proportion of crystal seizures by weight in the Asia region over that time; and there was a 78% increase in crystal seizures in Europe between 2012 and 2013 (UNODC, 2015b).

The Australian meth/amphetamine market

Most research on Australia's meth/amphetamine market has focussed on use or harms (Australian Institute of Health and Welfare, 2014; Degenhardt et al., 2016; Degenhardt et al., 2008; Degenhardt et al., 2016; Heilbronn et al., 2013; Kinner & Degenhardt, 2008; McKetin, Kelly, & McLaren, 2006; Tscharke, Chen, Gerber, & White, 2015) or on low level supply (Chalmers & Bradford, 2013; McKetin, McLaren, Kelly, & Chalmers, 2009; Scott, Caulkins, Ritter, Quinn, & Dietze, 2015). Traditionally, meth/amphetamine in Australia was primarily manufactured locally and existed primarily in powder form as reported by people who use drugs (Topp, Degenhardt, Kaye, & Darke, 2002). This contrasts with South East and East Asia (the global hub of supply) in which the primary form of meth/amphetamine prior to the 2000s was tablet and to a lesser extent crystal (McKetin et al., 2008).

Research on supply changes in the Australian meth/amphetamine market has been limited. McKetin, McLaren, and Kelly (2005) analysed seizure data from New South Wales and found that the form of seizures was slowly shifting to crystal in the early 2000s. Specifically, they found that 8% of seizures by weight in 2001 were in crystal form and this rose to 17% in 2003. This coincided with reports from people who use drugs who reported the first notable increases in the use of meth/amphetamine in crystal form in the early 2000s (Topp, Degenhardt, Kaye, & Darke, 2002). By the mid-2000s powder was still the most common form reportedly used by people who use drugs but there were indications that crystal use was continuing to overtake that of other forms (Kinner & Degenhardt, 2008). This was a concerning trend given that crystal meth/amphetamine use is associated with greater health risks than meth/amphetamine use in other forms (Kinner & Degenhardt, 2008). Coinciding with the first increases in crystal use were perceived steady increases in meth/amphetamine related harms between the late 1990s and the mid-2000s as evidenced by increases in national meth/amphetamine related psychosis incidents, emergency department presentations and crime (Fulde & Wodak, 2007).

From 2006, crystal meth/amphetamine was subjected to a significant increase in attention by Australian media, government and the alcohol and other drugs sector (Hughes, 2016). This was fuelled in part by the apparent rise in crystal meth/amphetamine use and meth/amphetamine related harms in Australia. For a few years there were numerous media reports hypothesising major changes in the Australian meth/amphetamine market and referred to this new era as the 'ice age' (Hughes, 2016).

Media and government attention subsided from around 2009, but by 2013 attention had shifted back to meth/amphetamine and in particular crystal meth/amphetamine for the same reasons as before (Australian Crime Commission, 2014b; Department of the Prime Minister and Cabinet, 2015). This time, however, there were potential signs of further unprecedented rises in harms and crystal meth/amphetamine use as well as unprecedented increases in supply.

For instance, Scott, Caulkins, Ritter, Quinn, and Dietze (2015) estimated the price per pure gram of meth/amphetamine in Victoria using forensic purity data of seizures and price estimates from people who use drugs. They found a significant decrease in the estimated price per pure gram of meth/amphetamine at the retail level in Victoria between 2008 and 2013. This is strong evidence of a surging market prior to 2013. Consistent with this, by 2012/13, law enforcement data published in the Australian Illicit Drug Data Report showed unprecedented annual increases in the number and weight of meth/amphetamine detections at the Australia border in 2012/13 and 2013/14, particularly in crystal form (Australian Crime Commission, 2015). There was also a rise in national meth/amphetamine seizures from less than 5000 kg per year in 2011/12 or prior, to between approximately 14,000kg and 30,000kg per year between 2012/13 and 2014/15 (Australian Crime Commission, 2017). That is a three to six-fold increase.

Evidence for further unprecedented increases in crystal meth/amphetamine availability come from self-report and health data. The best estimates of meth/amphetamine use patterns in Australia are from the population based National Drug Strategy Household Survey (NDSHS). This paper-based survey which samples people from households around Australia is run every three years and asks respondents questions about their attitudes towards drugs, whether they use drugs and if so what their use patterns are. Despite showing declining rates in the proportion of people who recently used meth/amphetamine (i.e. within the past year of the survey) from 3.2% in 2004 to 2.1% in 2010 to just 1.4 % in 2016, the survey showed that the proportion of 'recent meth/amphetamine users' who reported using crystal as their main form has been rising (from 27% in 2007 to more than 50% in 2013 and 2016) and that there was a slight increase over time in the frequency of use amongst those reporting crystal as their main form (weekly or more use rose from 24.3% in 2007 to 31.9% in 2016) (Australian Institute of Health and Welfare, 2017).

However, caution is advised interpreting the decreased prevalence of recent meth/amphetamine use as indicated by the NDSHS. First, the NDSHS excludes the homeless

population, some of whom are people who regularly use meth/amphetamine (Stafford & Burns, 2012; Stafford & Burns, 2015). Second, meth/amphetamine use has received increased stigmatisation over time which may have affected reporting of use patterns. A recent study analysed trends in media reporting, public attitudes towards meth/amphetamine and self-reports of meth/amphetamine use patterns over time as reported by NDSHS (Chalmers, Lancaster, & Hughes, 2016). The study found that over time there was a substantial increase in the stigmatisation of meth/amphetamine use as portrayed by the media and public attitudes. This coincided with the decline in the proportion of NDSHS respondents stating that they had recently used meth/amphetamine. The authors cautioned that increased stigmatisation may have led to an increased under-reporting of meth/amphetamine use in the NDSHS.

In addition, several studies have reported perceived increases in meth/amphetamine related harms in Australia since 2013. For instance, since 2013 there have been increases in meth/amphetamine-related ambulance attendances, hospitalisations, fatal overdoses and treatment seeking (Degenhardt et al., 2016; Department of the Prime Minister and Cabinet, 2015; Heilbronn et al., 2013; Westmore, Van Vught, Thomson, Griffiths, & Ryan, 2014). Though the caveat with these studies is that they were confined to selected areas in Victoria only (i.e. not Australia-wide). Finally, Degenhardt et al. (2016) applied indirect estimation techniques to health data such as meth/amphetamine counselling, rehabilitation and hospital admissions to estimate the number of regular and dependent meth/amphetamine users in Australia. Following a decline between 2007/08 and 2009/10, they estimated a large increase in the number of regular and dependent meth/amphetamine users which reached unprecedented levels in 2012/13 and again in 2013/14. However, the rigour of the methods used to obtain these estimates has been questioned by some (Dietze, Quinn, & Hughes, 2016).

To summarise, there has been considerable debate over the past decade around what is happening with Australia's meth/amphetamine market including with use patterns and with supply. There is tentative evidence to suggest form and quantity changes in Australia's meth/amphetamine market over time, but there has been no detailed analysis of supply changes to date. For instance, has there been a real increase in supply since 2013? And to what extent was the 'ice age' a peak supply period and how did supply in that period compare to the most recent period of concern post 2013? To what extent has there been a shift to crystal meth/amphetamine supply over time? There may have also been more supply changes than previously known, such as changes in supply routes or mode of transport: an analysis that has yet to be undertaken on Australian meth/amphetamine supply indicator data.

Research aims

There are three aims in this chapter:

1) to identify supply changes in Australia's meth/amphetamine market between 2002 and 2014 noting when and where they happened;

2) to compare trends across four periods of time in order to:

   a. test whether those periods of market change hypothesised by the Australian media are consistent with the evidence; and

   b. benchmark the scale of any shift in supply that may have occurred since 2013; and

3) to examine trends at different distribution levels by applying weight bin analysis and comparing them to their corresponding aggregate trends to see whether any new insights about supply changes can be gained.

In relation to the first aim, supply changes can be expressed in a number of market features. Six different kinds of supply change were examined herein: changes in the trend in quantity, purity, form, precursor type, mode of transport and supply routes. In relation to the second aim, four periods of time were defined for the analysis, which are detailed in the methods section. Trends over time in each of these aspects of supply were examined, with a view to providing detailed analysis of the meth/amphetamine supply changes. The third aim focussed on a methodological issue. As noted in Chapter 4, weight bins are becoming a standard approach to supply trend analysis (Singleton, Cunningham, Groshkova, Royuela, & Sedefov, 2018). This research examines the value of including weight bin analysis.

Method

Building on methods used by Hughes, Chalmers, Bright, Matthew-Simmons, & Sindicich (2012) and Kilmer and Hoorens (2010) (who examined changes in cocaine and heroin supply respectively), and methods developed in Chapter 4, this research examined six kinds of supply changes in Australia's meth/amphetamine end-product and precursor supply between 2002 and 2014. Eight datasets were used to examine supply changes. The first four were datasets analysed previously in Chapter 4: meth/amphetamine end-product border data 2002-2014 (from Department of Immigration and Border Protection), meth/amphetamine end-product Vic purity data 2002-2014 (from the Drug Sciences Group, Victoria Police Forensic Services

Department) and subjective purity and availability reports by EDRS (2003-2014) and IDRS (2002-2014) participants from the national EDRS reports (Breen et al., 2004; Sindicich & Burns, 2015) and the national IDRS reports (Stafford & Burns, 2014; Stafford et al., 2005). The remaining four datasets analysed in this chapter were the following. The first was a unit-record dataset from Department of Immigration and Border Protection on meth/amphetamine precursor detections made between 2002 and 2014. The second and third were the annual total number of meth/amphetamine supplier arrests in Victoria (2005-2014) and New South Wales (2002-2014), retrieved from Crime Statistics Agency and Bureau of Crime Statistics and Research respectively (Victoria data for 2002-2004 are currently unavailable). Arrest data were retrieved from two states only because New South Wales and Victoria are the only jurisdictions to make available trends for meth/amphetamine supplier arrests specifically. All national arrest data are reported under the umbrella of amphetamine-type-stimulants and do not distinguish meth/amphetamine arrests from other synthetic stimulant drugs. The final dataset was the annual total number of meth/amphetamine clandestine laboratory detections made within Australia, retrieved from the Illicit Drug Data Reports (2004/05-2013/14). See Table 14 for an overview of the six supply change kinds examined, analyses, rationale and limitations. This research was approved by the University of New South Wales Human Research Ethics Advisory Panel: HC16265.

Table 14

The six supply change kinds examined, analyses, data sources, rationales and limitations

Supply change kind examined	Border or domestic supply?	Analyses conducted to identify changes over time	Data source	Rationale	Limitations
Quantity	Border	Annual total weight of meth/amphetamine border detections.	Border	Changes in total detection quantities depend partly on changes in the total quantity of drugs imported into Australia.	Changes in detection quantities also depend on changes in law enforcement activity and the ability of traffickers to conceal drugs.
		Annual total number of meth/amphetamine border detections.	Border	As above.	As above.
	Domestic	Annual proportion of EDRS and IDRS participants who reported meth/amphetamine to be 'easy' or 'very easy' to obtain.	EDRS/IDRS	Indicates changes in meth/amphetamine availability at the retail-level, which reflects changes in availability at the high-level.	EDRS and IDRS participants are a sentinel sample and from Australian capital cities only.
		Annual total weight of meth/amphetamine precursor border detections.	Border	Changes in total detection quantities depend partly on changes in the total quantity of precursors imported into Australia. Changes in the amount of precursors imported indicate changes in the scale/magnitude of domestic manufacture, which in turn indicates changes in the quantity of meth/amphetamine available domestically.	Changes in detection quantities also depend on changes in law enforcement activity and the ability of traffickers to conceal drugs.
		Annual total number of meth/amphetamine precursor border detections.		As above.	As above.
		Annual total number of meth/amphetamine clandestine laboratory detections	IDDR	Changes in the number of laboratory detections indicates potential changes in the scale of domestic meth/amphetamine manufacture and hence the quantity of meth/amphetamine available domestically.	Data does not contain information on the size of laboratories, whether they were active or inactive at the time of detection, or how often they were in operation prior to detection.

Supply change kind examined	Border or domestic supply?	Analyses conducted to identify changes over time	Data source	Rationale	Limitations
		Annual total number of meth/amphetamine supplier arrests in NSW and VIC	BOCSAR and CSA	Arrest numbers depend partly on meth/amphetamine availability. If more supply is around, it is assumed that more arrests will be made because more people will be trafficking and/or because existing traffickers will be more active.	Changes in arrest numbers are also dependent on changes in law enforcement activity and the ability of traffickers to conceal drugs. Arrest data only publicly exists in two states. NSW and VIC trends may not necessarily reflect trends in other Australian states and territories. Arrest data does not distinguish between different forms or types of meth/amphetamine.
Form	Border	The annual total weight of end-product detections by type and form; the annual total weight of precursor detections by type.	Border	Changes in end-product type or form may indicate changes in market actors, supply origin or supply routes. Changes in precursor type may indicate changes in manufacturing methods.	Imported form may be converted into another form on arrival in Australia, albeit this would require extra processing. Hence changes in border form may not necessarily translate to retail-level markets.
	Domestic	Annual proportion of the total weight of meth/amphetamine seizures in Victoria by form.	Vic Purity	Changes in form may indicate changes in market actors, supply origin or supply routes	Data are from one state only. The form of meth/amphetamine seized in Victoria may differ to other states and territories in Australia.
Supply routes to Australia	Border	Annual total weight of border detections as a proportion by world region of embarkation, separately for end-product and precursors. (end-product analysis was of crystal detections only given crystal has been the focus of attention in more recent years).	Border	The country/region of embarkation is where the detected drugs were last known to be trafficked from. It is indicative of where the drugs were sourced from and if there have been changes in trafficking routes to Australia. Countries were grouped into five world regions: Asia, Europe, Africa, Oceania and the Americas. Regions were defined using United Nations Statistics Division definitions (United Nations Office Statistics Division, 2013).	The country/region of embarkation is the last point in what may have been a more complex supply route to Australia. This analysis is not able to detect changes in more complex supply routes prior to the last region of embarkation. For example, meth/amphetamine may have travelled via two or three regions before being exported to Australia. This analysis only identifies

Supply change kind examined	Border or domestic supply?	Analyses conducted to identify changes over time	Data source	Rationale	Limitations
					changes in the last region of embarkation prior to being exported to Australia.
Mode of transport		Annual total weight of border detections as a proportion by mode of transport, separately for end-product and precursors. (end-product analysis was of crystal detections only given crystal has been the focus of attention in more recent years).	Border	Mode of detection is indicative of how the drugs entered Australia as well as the sophistication of trafficking operations, with air/sea cargo indicative of high-level planned/non-opportunistic trafficking. Detections were categorised into one of three transport modes: air/sea cargo; air/sea passengers and crew; and international post.	Assumes that highly planned and sophisticated trafficking operations use air or sea cargo for transport.
Purity	Domestic	Average purity of meth/amphetamine seizures in Victoria distinguishing form: crystal (aggregated monthly), powder (monthly) and tablet (annually).	Vic purity	Changes in purity indicate the presence of market disruptions (i.e. purity declines or drops) or market resurgence (i.e. purity increases).	May be a biased estimate of average purity of total market. The purity of discovered drugs may be systematically different to the purity of drugs not discovered.
					Data are from one state only. The purity of meth/amphetamine in Victoria may differ to other states and territories in Australia.
		Annual proportion of EDRS and IDRS participants who reported meth/amphetamine purity to be 'high': separately for powder and crystal.	EDRS and IDRS	As above	EDRS and IDRS participants are a sentinel sample and from Australian capital cities only.

Unit record data overview

Table 15 shows the distribution of the 10,291 meth/amphetamine precursor border detections distinguishing precursor type. Most detections over the analysis period were pseudoephedrine (n = 4,702), ephedrine (n = 3,104) or ma huang/ephedra (n = 2,183). There were comparatively few P2P, (n = 17) phenylacetic acid (n = 33) and norephedrine (n = 252) detections made over time.

Table 15

Annual total number of meth/amphetamine precursor border detections in Australia, distinguishing form, 2002-2014

Year	EPHEDRINE	MA HUANG / EPHEDRA	PHENYL-2-PROPANONE (P-2-P)	PHENYLAC ETIC ACID	PHENYL-PROPANOLAMINE /NOREPHEDRINE	PSEUDOEPHEDRINE	Total
2002	316	1173	0	0	60	278	1827
2003	238	586	0	0	33	251	1108
2004	111	152	0	0	20	148	431
2005	116	39	0	1	12	204	372
2006	213	110	2	2	30	280	637
2007	241	42	0	1	22	274	580
2008	113	46	2	3	18	196	378
2009	103	30	6	1	15	243	398
2010	183	0	1	0	11	507	702
2011	233	4	4	10	6	707	964
2012	289	0	0	6	13	511	819
2013	634	0	1	5	7	582	1229
2014	314	1	1	4	5	521	846
Total	3104	2183	17	33	252	4702	10291

As the meth/amphetamine end-product border data and meth/amphetamine Vic purity data were already outlined in Chapter 4, their overviews are not repeated again here. It is, however, important to repeat one point here for clarity. That is the Vic purity data do not match the end-product border data in terms of their distributions by weight. The distribution of Vic purity seizures by weight was largely positively skewed, with the 75th percentiles for tablet, powder and crystal being just 3.5g, 2.6g and 1.8g respectively. This indicates that most seizures of all forms happened at the retail-level. Although, there were some seizures made towards the upper level of the market with the maximum weight seized for tablet, powder and crystal being 2.4kg, 7.4kg and 2.0kg respectively. On the other hand, the border data were less

skewed than the Vic purity data. In comparison, the 75th percentiles for tablet, powder and crystal by weight were higher: 26.1g, 26.5g and 500g respectively; and so were the maximums: 1.8kg, 65kg and 879kg for tablet, powder and crystal respectively. Hence the end-product border data are indicative of higher distribution levels than the Vic purity seizures.

Analysis plan

All analyses outlined in Table 1 were analysed in three steps, of which are outlined below.

Trends over time

The first analysis examined broad trends over time ('2002 to 2014'). All border analyses were examined descriptively at the annual aggregate level. A statistical analysis such as time series is more rigorous, but would require at least quarterly aggregated data over the 13 year period to be run. When the border data were analysed at the quarter level many quarters had no data given there were too few detections made in some years. For example, there were <190 annual end-product detections made in 2003 and 2004 which when broken down into quarter-years and then segregated by form, mode of transport or supply routes resulted in a series with several quarters having no data. Changes in the purity of crystal and powder domestic seizures were examined using a monthly time series analysis. For crystal, there was significant autocorrelation at lag 9 ($d = 1.75$, $p = .034$), meaning that each purity value in the series was predicted by the ninth value that preceded it. Hence an AR(9) model was used to correct for the autocorrelation. For powder, there was significant autocorrelation at lag 9 ($d = 1.75$, $p = .030$) and the autocorrelation was also corrected for using an AR(9) model. Both time series analyses were conducted in R Studio using the *strucchange* package to detect structural breakpoints. There were too few tablet seizures made in Victoria to perform a monthly or quarterly time series. Hence, like all border analyses, the tablet purity data was aggregated annually and the trend was analysed descriptively.

Testing hypotheses of periods of market change

The second analysis tested whether there was evidence to support periods of market change hypothesised by the media. Australian media loosely defined two periods which they perceived to be heightened periods of meth/amphetamine supply in Australia. First, '2006 to 2008', which was a period termed the "Ice Age", and secondly '2013 to 2014', which is defined herein as the most recent period of concern (Hughes, 2015; Lancaster, Ritter, & Colebatch, 2014). These were portrayed as peak periods by the media due to perceived increases in crystal meth/amphetamine use and related harms in Australia (Hughes, 2016). Hence the

following periods were defined for the time periods analysis: period 1 ('2002 to 2005'), period 2 ('2006 to 2008'), period 3 ('2009 to 2012') and period 4 ('2013 to 2014'). Trends across all four periods were firstly compared to test the extent to which Australian meth/amphetamine supply changed in line with the periods of market change hypothesised by the media. Secondly, the two periods of perceived heightened supply (2 and 4) were compared to benchmark the scale of any apparent shifts. This method was specifically derived from Hughes et al. (2012), who made comparisons between peak periods of Australian cocaine supply in order to benchmark the scale of shifts.

Analysis by weight bin

The third analysis examined whether analysis by weight bin can provide more insight about supply trend changes at different market levels than aggregate trends alone. As argued in Chapter 4, the 'law' method of defining weight bins was optimal for the analysis of Australian meth/amphetamine border data and was used here to define weight bin thresholds: weight bin 1 ('<2g'), weight bin 2 ('2g to <750g'), weight bin 3 ('≥750g'). The law thresholds were obtained from Schedule Four—border controlled drugs (Criminal Code Regulations, 2002). Weight bin trends for the border data were compared to the corresponding aggregate trends. As shown in Chapter 4, Vic purity data were best analysed as an aggregate trend given there were no systematic differences in average purities between weight bins when analysed using any of the four tested methods to define weight bins. Hence no weight bin analysis was conducted for Vic purity data.

Results

Quantity changes

Figure 34 shows the annual total weight of meth/amphetamine end-product border detections between 2002 and 2014. Apart from two minor peaks in 2003 (238kg) and 2008 (475kg), total weight remained relatively low between 2002 and 2010 (<98kg in all other years). Then total weight steadily increased from 278kg in 2011 to an unprecedented 2,360kg and 3,118kg in 2013 and 2014. The total number of detections increased steadily and substantially over time from 241 in 2002 to 3,176 in 2014.

Analysis by period showed that period 2's average annual total weight (200kg) was higher than period 1 (122kg), but was less than period 3 (287kg), and far less than period 4 (2,739kg). The average total number of detections per period showed a similar trend, with period 2's annual average number (583) being higher than period 1 (190), but less than period 3 (962) and far

less than period 4 (2725). In comparison between periods of concern, the average annual total weight of detections in period 4 was 22 times higher than in period 2 and the annual average number of detections in period 1 was 14 times higher than in period 2. Taken together, these analyses suggest that the quantity of meth/amphetamine end-product available at the border increased substantially over the analysis period and that border quantity was far greater in period 4 than it was in period 2.

Figure 34. The annual total weight and number of end-product border detections, 2002 - 2014.
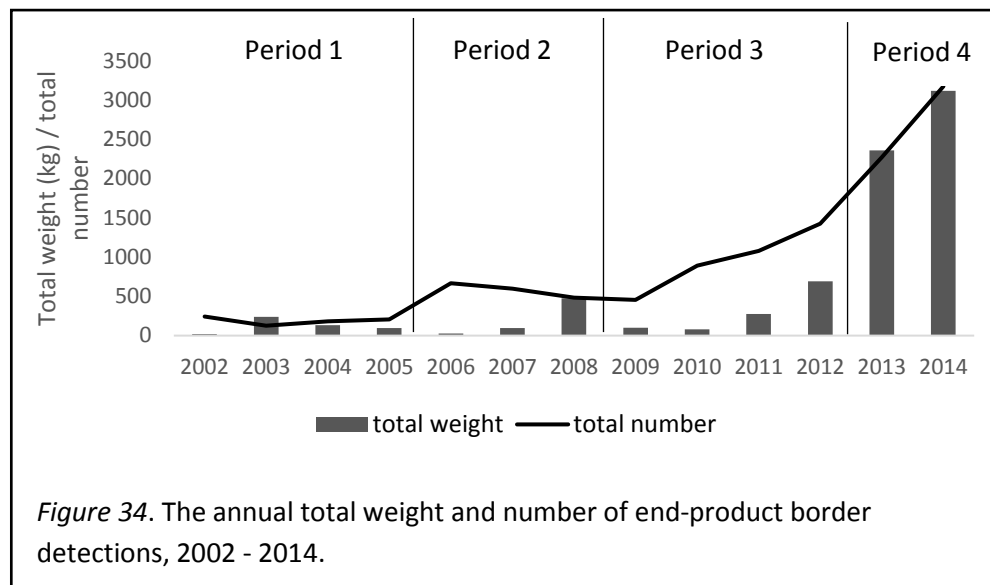
Figure 35 shows the annual proportion national EDRS and IDRS participants who commented on the availability of crystal and powder meth/amphetamine in Australia and said that it was either 'easy' or 'very easy' to obtain. Crystal ratings generally increased over time for both IDRS and EDRS. For example, the EDRS proportion for crystal rose from 55% in 2003 to 86% in 2014, and the IDRS proportion for crystal rose from 50% in 2002 to 91% in 2014. The average EDRS proportion for crystal was lowest in period 1 (61%), higher in period 2 (69%), higher again in period 3 (80%) and highest in period 4 (87%). The average IDRS proportion for crystal was lowest in period 1 (67%), higher in period 2 (79%), slightly lower in period 3 albeit very similar (77%) and highest in period 4 (90%). Trends from both EDRS and IDRS participants suggest that crystal availability in Australia was higher in period 4 than it was in period 2.

The proportion of IDRS and EDRS participants reporting powder to be 'easy' or 'very easy' to obtain remained high and relatively stable over time. The average IDRS proportion was the same in periods 1 and 2 (79%) and increased only very slightly in periods 3 (82%) and 4 (85%).

The average EDRS proportion was also identical in periods 1 and 2 (75%) and remained very similar in periods 3 (79%) and 4 (76%). These trends suggest that the quantity of meth/amphetamine powder available in Australia remained fairly constant over time and in particular periods 2 and 4 were very similar in this respect. There appeared to only be a notable rise in the quantity of crystal meth/amphetamine available.

Figure 35. Annual proportion national EDRS and IDRS participants who commented on the availability of (a) crystal and (b) powder meth/amphetamine in Australia and said that it was either 'easy' or 'very easy' to obtain.
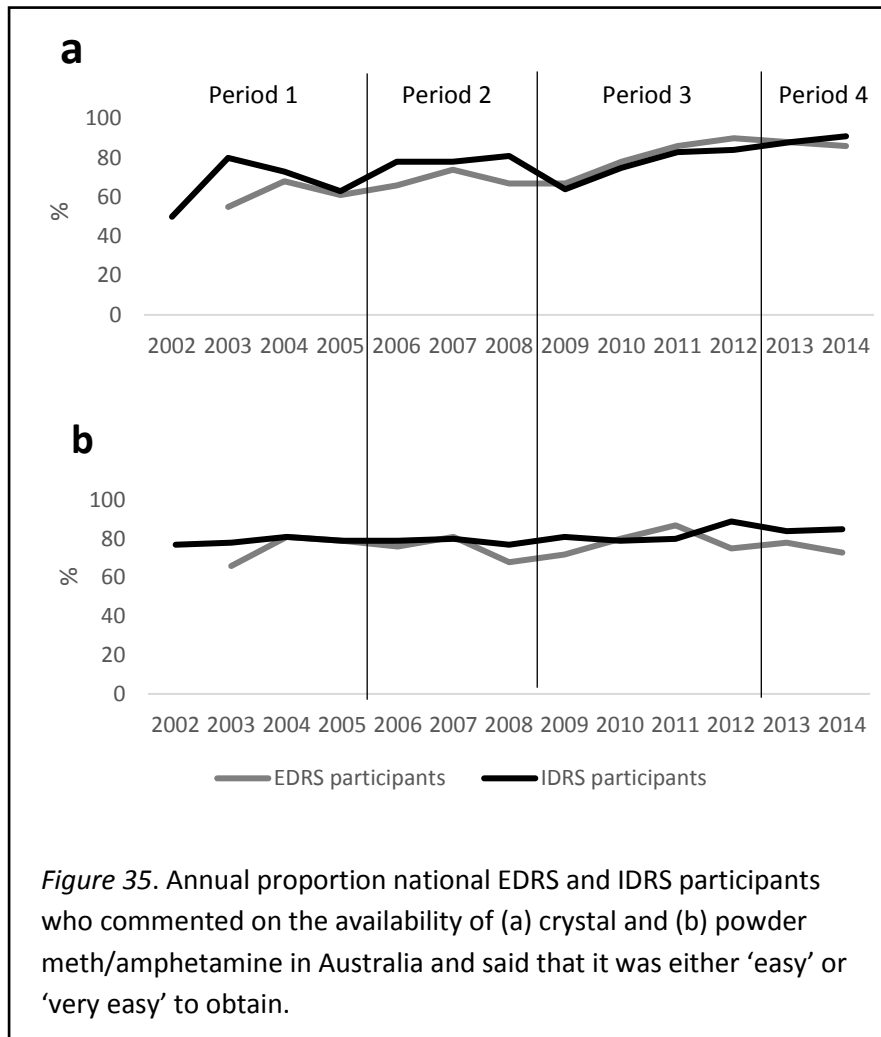
Figure 36a shows the annual total weight of precursor border detections between 2002 and 2014, while Figure 36b shows the annual number of meth/amphetamine clandestine laboratory detections between 2004/05 and 2013/14. Between 2002 and 2005, the total weight of precursors fluctuated quite substantially, from lows of 151kg and 55kg in 2002 and 2004 to highs of 856kg and 859kg in 2003 and 2005. From 2006 onwards, there was a general increase from 197kg in 2006 to 2,109kg in 2013, before decreasing to 762kg in 2014, albeit there was an apparent outlier in 2008 of 2,607kg. The total number of precursor detections

declined from a peak of 1,827 in 2002 to 372 in 2005, before generally increasing for the remainder of the analysis period to the second highest number of 1,229 in 2013, and then slightly decreasing to 846 in 2014. The total number of clandestine laboratory detections remained relatively stable between 2004/05 and 2008/09 at just under 300 per year, but from 2009/10 doubled to just under 600 per year and remained at a similar level up to and including 2013/14. Taken together, these trends suggest that domestic manufacture may have seen a slight decline between 2002 and 2004, but has since then steadily increased over time. Whilst the extent of the increase is not entirely clear from the clandestine laboratory data alone (as data on the size of the seized laboratories was not available), the concurrent increase in precursor detections means there can be more confidence that there was an increase in the scale of domestic manufacture over time. It is worth noting that since the work of this thesis was completed, Australian law enforcement agencies have been reporting data on the size of seized laboratories (Australian Crime Commission, 2017). This will undoubtedly improve analysis in the future.

The average annual total weight of precursor detections was lowest in period 1 (481kg), higher in periods 2 (1,051kg) and 3 (1,028kg), and highest in period 4 (1,038kg). The average annual number of detections was higher in period 1 (935) than it was in either period 2 or 3 (721) and highest in period 4 (1,038). There were many more laboratory detections in period 4 (an average of approximately 600 per year) than in 2 (an average of approximately 300 per year). Taken together, these analyses suggest that local manufacture of meth/amphetamine was probably much greater in period 4 than it was in period 2 given there were indications of greater quantities of precursor importations and more laboratories detected during this time.

Figure 36. Annual total weight and number of meth/amphetamine precursors border detections (2002-2014) (a), and annual total number of meth/amphetamine clandestine laboratory detections in Australia (2004/05-2013/14) (b).
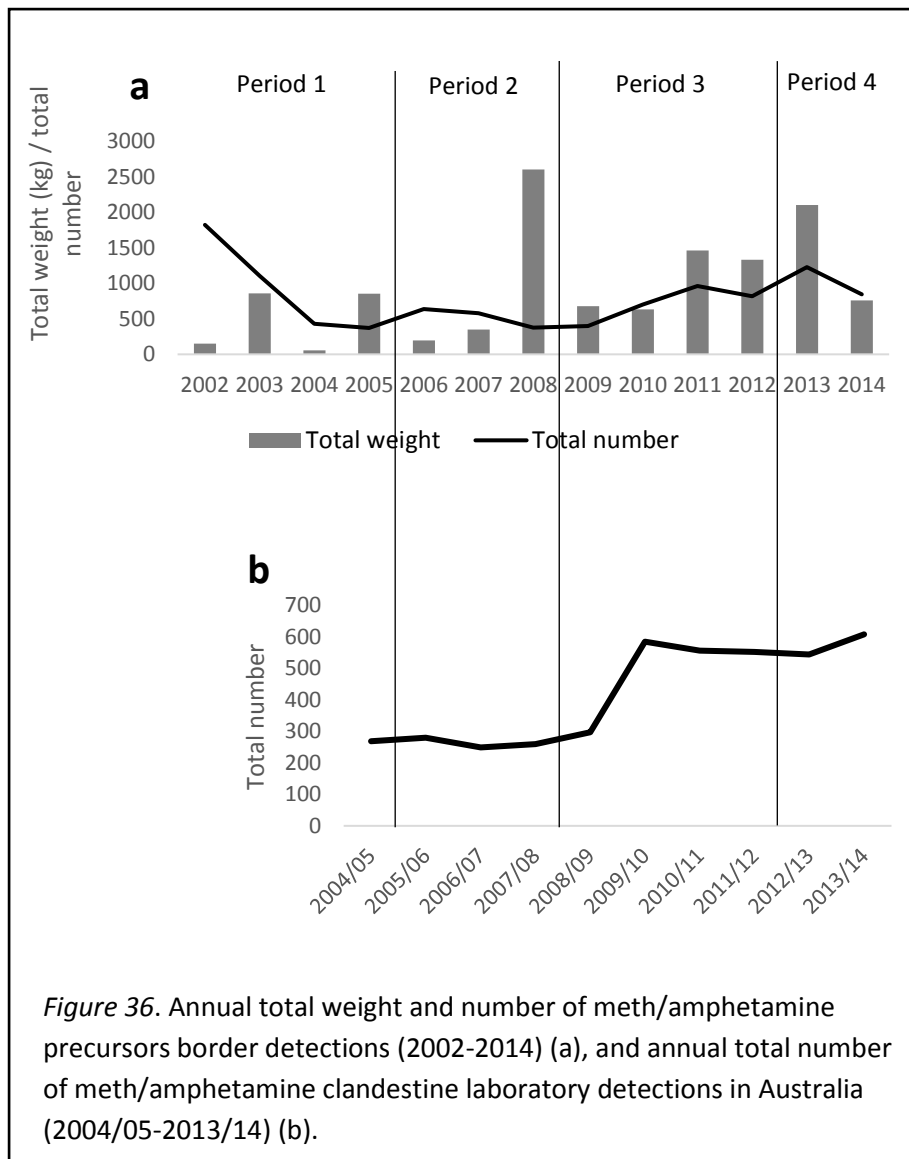
Figure 37 shows the annual total number of arrests for meth/amphetamine supply offences in both Victoria and New South Wales. Both trends were both consistent with border detection trends, showing general upward trends over time. New South Wales arrests increased from 683 in 2002 to 2,184 in 2014. Victoria increased from 558 in 2005 to 2,084 in 2014.

The average number of arrests in both NSW and VIC for period 4 (1890 and 2018 respectively) was approximately 2 times higher than the average number of arrests in periods 2 (814 and 1002 respectively) or 3 (963 and 1006 respectively). This suggests that supply was much higher in period 4 than 2.

Figure 37. Annual total number of meth/amphetamine supplier arrests in New South Wales (2002-2014) and Victoria (2005-2014).
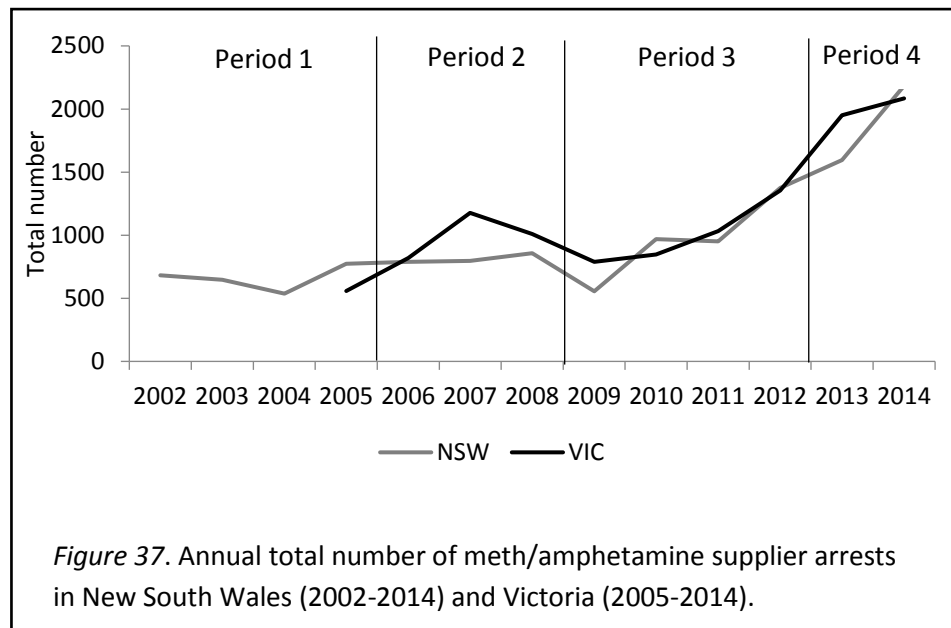
Form and type changes

Figure 38 shows the annual total weight of end-product and precursor border detections as a proportion, distinguishing between end-product form and precursor type between 2002 and 2014. For end-product detections by form, no discernible trend emerged, but by weight, crystal was the most prominent end-product form detected at the border over time followed by liquid and then powder. This suggests that the amount of crystal meth/amphetamine imported into the country increased steadily over time when viewed in the context of increases in the total weight and number of meth/amphetamine border detections over time (see Figure 34).In period 1, crystal accounted for the largest proportion of total weight (86%) followed by liquid (6%), powder (3%) and then tablet (2%). In period 2, the most prominent form by weight was crystal (54%) followed by liquid (35%), powder (6%) and then tablet (2%). In period 3, the most prominent form by weight was crystal (70%) followed by liquid (13%), powder (12%) and then tablet (3%). In period 4, the most prominent form by weight was again crystal (75%) followed by liquid (16%) and then powder (7%). There was a greater proportion of detections by weight in crystal form (75%) in period 4 relative to period 2 (54%). This coupled with a far greater total weight of detections in period 4 relative to period 2 (see Figure 34) suggests that there was a far greater amount of crystal meth/amphetamine being imported into the country in period 4.

The most prominent precursor types detected over time by weight shifted from mostly ephedrine and ma huang / ephedra between 2002 and 2005 to pseudoephedrine and ephedrine from 2006 onwards. By 2009 most detections by weight were pseudoephedrine and then this gradually shifted to mostly ephedrine over the following years until 2013 in which ephedrine accounted for the largest proportion of total weight.

The most prominent type detected by weight in period 1 was ephedrine (69%) followed by ma huang / ephedra (26%). In period 2, pseudoephedrine became most prominent (58%), followed by ephedrine (41%). In period 3, pseudoephedrine remained most prominent (73%) followed by ephedrine (24%). In period 4, there was a shift back to ephedrine as the most prominent type detected by weight (72%) with pseudoephedrine being next most prominent (28%). Hence the shift in type between periods 2 and 4 indicated a shift in manufacturing method between the two periods of concern.

Given that crystal meth/amphetamine has been the focus of attention in recent years, and that this form comprised the majority of detected border weight in all but three years, the remaining end-product border analyses focussed on crystal meth/amphetamine trends only.

Figure 38. Annual total weight of meth/amphetamine end-product border detections as a proportion by form (a) and annual total weight of meth/amphetamine precursor border detections as a proportion by precursor type (b), 2002 to 2014.
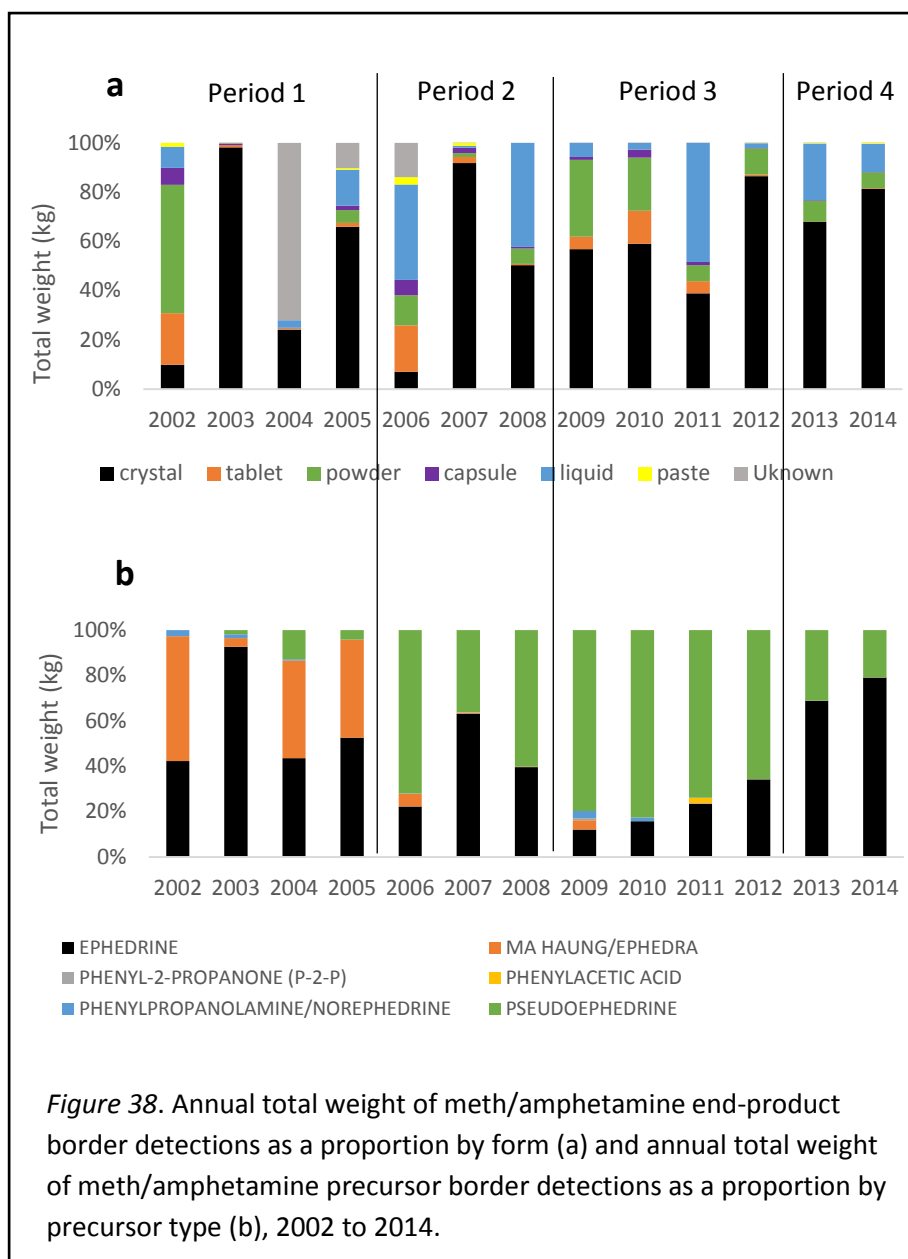
Figure 39 shows the annual total weight of meth/amphetamine seizures in Victoria as a proportion by form between 2002 and 2014. There was a clear shift in the most prominent form seized over time from powder to crystal. This was evidenced by a decline over time in the proportion of seizures by weight that were in powder form from 84.4% in 2002 to just 11.4% in 2014, and a corresponding increase over time in the proportion of domestic seizures by weight that were in crystal form from just 4.1% in 2002 to 79.1% in 2014. Tablet seizures also saw a decrease in prevalence over time from 11.1% in 2002 to just 0.1% in 2014.

In period 1, powder accounted for the largest proportion of seizures by weight (77%) followed by tablet (15%) and then crystal (8%). In period 2, the most prominent form seized by weight was powder (62%) followed by crystal (34%) and then tablet (4%). In period 3, the most

prominent form seized by weight shifted to crystal (58%) followed by powder (40%), and then tablet (2%). In period 4, the most prominent form seized by weight was largely crystal (82%) followed by powder (12%) and then other (6%). The proportion of total seizure weight that was crystal in period 4 was more than double than it was in period 2, which is consistent with the border data showing large increases in crystal meth/amphetamine importations in period 4 relative to period 2.

Figure 39. Annual total weight of meth/amphetamine seizures in Victoria as a proportion by form, 2002 to 2014.
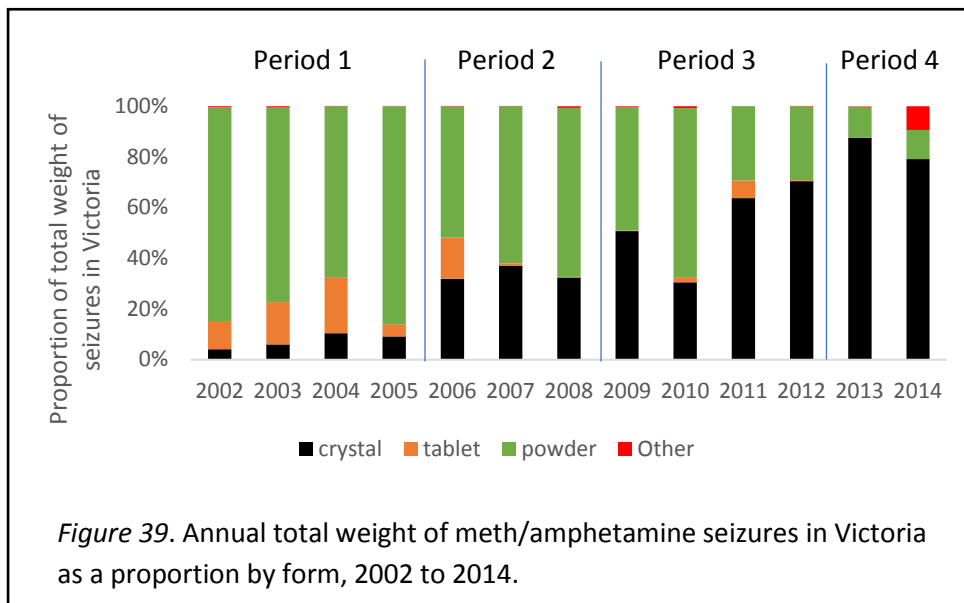
Supply route changes

Figure 40a shows the total weight of crystal meth/amphetamine detections as a proportion by region of embarkation, between 2002 and 2014. Prominent regions of embarkation for crystal meth/amphetamine detections by weight were observed worldwide: Asia, the Americas, Africa and Europe. There were shifts in regional prominence over time. From 2002 to 2004 the most prominent region by weight was largely Asia (mostly China/Hong Kong), which then shifted to the Americas (mostly Canada) as the most prominent region from 2005 until 2007. From 2008 a gradual shift back to Asia began and by 2012 Asia (mostly China/Hong Kong) became the most prominent region by weight once more.

More specifically, in period 1 the most prominent country of embarkation for crystal meth/amphetamine detections was China/Hong Kong (accounting for 86.1% of total weight) followed by Canada (11.1%). In period 2 the most prominent country by weight shifted to

Canada (58.6%) followed by China/Hong Kong (39.2%). In period 3 there was a shift back to the Asia region, with the most prominent countries by weight being Thailand (39.1%) followed by China/Hong Kong (34.6%), Canada (10.3%), and then South Africa (5.6%). In period 4, there was a shift back to China/Hong Kong which accounted for the majority of total weight (63.4%) followed by Germany (21.4%).

Figure 40b shows the total weight of meth/amphetamine precursor detections as a proportion by region of embarkation, between 2002 and 2014. Prominent regions by weight were confined to mostly Asia, The Americas and Africa, but in all years bar 2002, 2004 and 2005, Asia accounted for the >79% of precursor weight.

There were shifts in the prominent country of embarkation for meth/amphetamine precursors within Asia over time. In period 1, the most prominent country of embarkation by weight was Thailand (accounting for 41.1% of total weight) followed by Vietnam (20.9%) and the USA (6.5%). In period 2, the most prominent country remained Thailand (49.6%) followed by China/Hong Kong (19.4%), South Korea (10.1%) and Vietnam (5.4%). In period 3, the most prominent country shifted to China/Hong Kong (45.7%) followed by Vietnam (23.7%) and then Thailand (5.8%). In period 4, the most prominent country remained China/Hong Kong (59.3%) followed by India (13.9%) and then Vietnam (10.9%). Hence between periods of concern, there was a shift from Thailand and Vietnam to China/Hong Kong and India as the most prominent countries of embarkation. In particular, China/Hong Kong became the most prominent country of embarkation for both crystal meth/amphetamine and meth/amphetamine precursors.

Figure 40. Annual total weight of border detections as a proportion by region of embarkation for meth/amphetamine end-product (a) and meth/amphetamine precursors (b), 2002 to 2014.
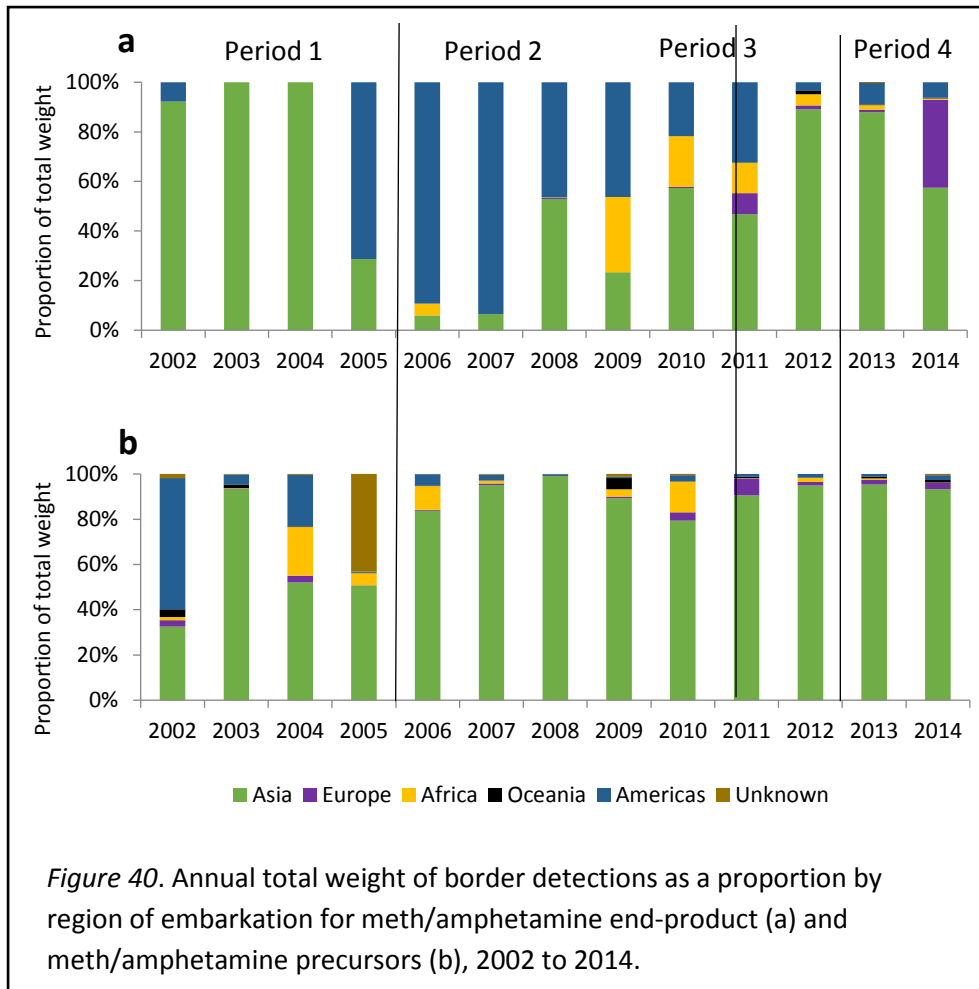
Mode of transport changes

Figure 41a shows the mode of crystal meth/amphetamine detections by weight between 2002 and 2014. The vast majority of detected crystal weight was detected on air/sea cargo (accounting for more than 60% of detected weight in all years except 2002). Post and air/sea passengers and crew were only of minor importance throughout the analysis period apart from 2002 where air/sea passengers and crew accounted for >90% of detections by weight.

In period 1, air/sea cargo accounted for the majority of precursor total weight (94%) followed by air/sea passengers and crew (3%) and then post (2%). In period 2, air/sea cargo accounted for the majority weight (94%) followed by air/sea passengers and crew (3%) and post (3%). In period 3, air/sea cargo accounted for the majority of precursor total weight (81%) followed by post (11%) and then air/sea passengers and crew (8%). In period 4, air/sea cargo accounted for the majority of precursor total weight (82%) followed by post (14%) and then air/sea passengers and crew (5%). This analysis shows a small shift to more postal importations in

periods 3 and 4. Finally, air/sea cargo was the prominent method of importation in both periods 2 and 4, albeit period 4 had a small increase in postal importance.

Figure 41b shows the mode of meth/amphetamine precursor detections by weight. The majority of detected precursor weight was also detected on air/sea cargo which accounted for more than 50% of weight in all years except 2002 and 2004 (where post was most prominent). There was a minor increasing importance of post between 2006 and 2009, which then gradually decreased in importance over the remainder of the analysis period.

In period 1, air/sea cargo accounted for the majority of precursor total weight (86%) followed by post (11%) and then air/sea passengers and crew (3%). In period 2, air/sea cargo accounted for the majority weight (93%) followed by post (7%) and then air/sea passengers and crew (1%). In period 3, air/sea cargo still accounted for the majority albeit smaller proportion of precursor total weight but (53%) followed by post (34%) and then air/sea passengers and crew (13%). In period 4, air/sea cargo accounted for the majority of precursor total weight once more (69%) followed by post (22%) and then air/sea passengers and crew (9%). This analysis mirrored that of crystal above and showed a small shift to more postal importations in periods 3 and 4. Air/sea cargo remained the prominent method of importation between periods 2 and 4, albeit period 4 had a greater presence of postal importations.

Figure 41. Annual total weight of border detections as a proportion by mode of transport for meth/amphetamine end-product (a) and meth/amphetamine precursors (b), 2002 to 2014.
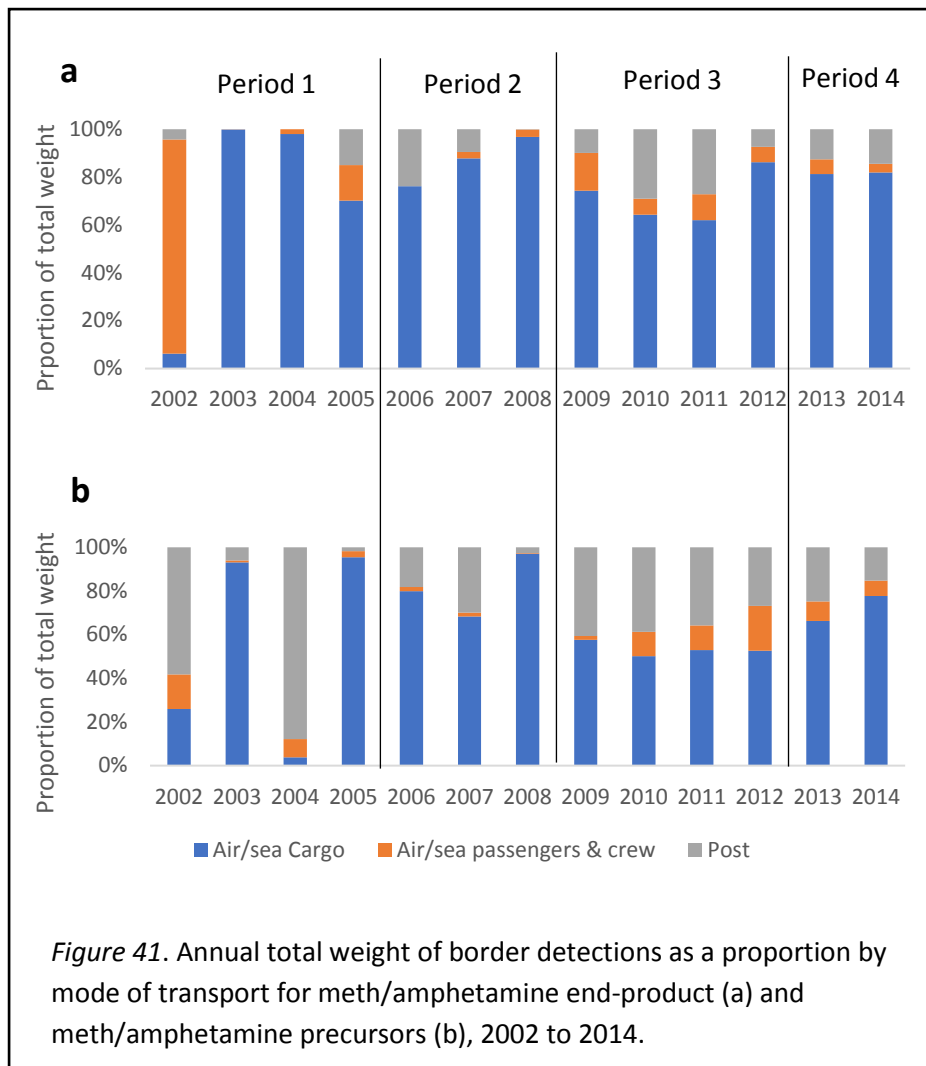
Purity changes

Figure 42 shows the monthly average purity of meth/amphetamine crystal seizures in Victoria. Four structural breakpoints were deemed to be most optimal for analysis. From January 2002, crystal purity significantly increased by 2% per month, $p < .0001$, 95% CI [1.42, 2.58]. In December 2003, there was a significant drop in purity by -16%, $p = .0029$, [-26.40, -5.70] and then the series declined by -0.37% per month but this slope was not significant, $p > .05$, and nor was the drop of -6.3% in February 2006 significant, $p > .05$. The series then significantly declined by -0.47% per month, $p < .0001$, [-0.65, -0.29]. In November 2009, there was a significant level increase in average crystal purity by 14.21%, $p < .0001$, [6.25, 22.18], and then the series significantly increased by 1% per month, $p < .0001$, [0.66, 1.35]. From May 2012 the series increased at the rate of 0.29% per month but this slope was not significant, $p > .05$.

Average crystal purity was lower in period 2 (28%) than it was in periods 1 (51%) or 3 (49%) and highest in period 4 (70%). This is evidence to suggest that period 2 was not a peak period but period 4 was.

Figure 42. Monthly average purity of crystal meth/amphetamine seizures in Victoria, 2002-2014.
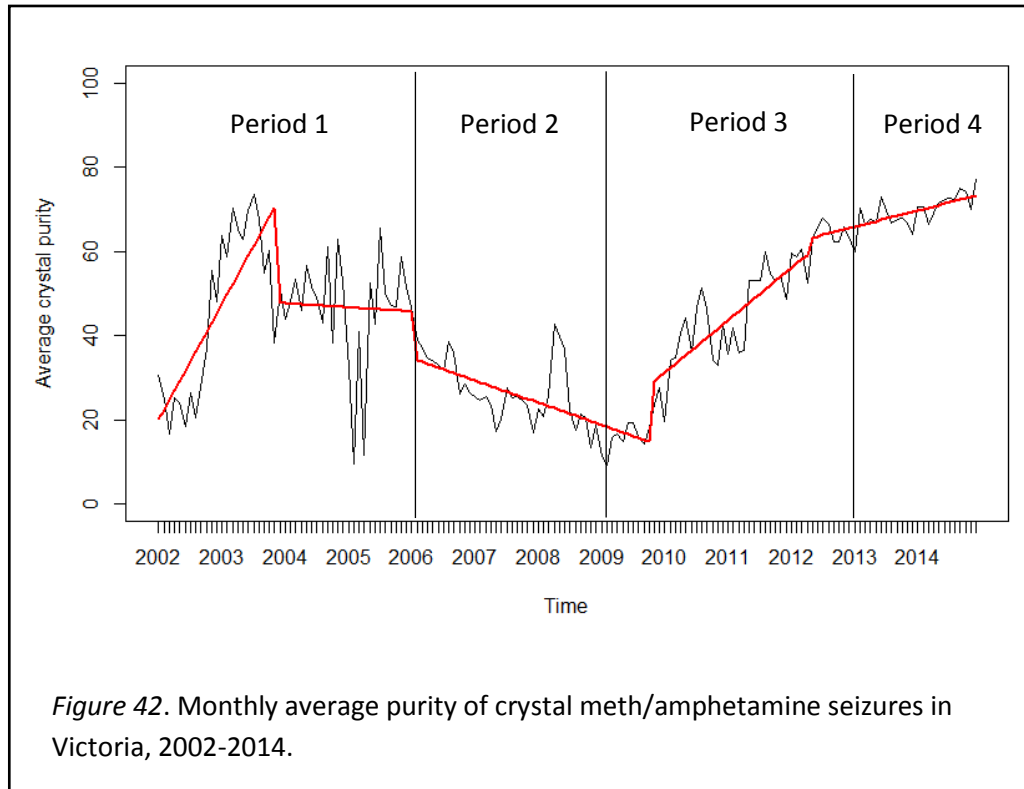
Figure 43 shows the monthly average purity of meth/amphetamine powder seizures in Victoria. Two structural breakpoints were deemed to be most optimal for analysis. From January 2002, powder purity significantly increased by 0.6% per month, *p* = .0002, 95% CI [0.29, 0.91]. In December 2003, there was a significant level drop in purity by -9.35%, *p* = .0002, [-14.07, -4.63], and then the series significantly declined by -0.2% per month, *p* < .0001, [-0.27, -0.13]. From December 2008, average purity significantly increased by 0.45% per month, *p* < .0001, [0.40, 0.50], and continued to do so for the remainder of the analysis period. Hence the series followed a similar trajectory to crystal only much lower in purity in comparison.

Average powder purity was lower in period 2 (14%) than it was in periods 1 (22%) or 3 (18%) and highest in period 4 (36%). This is further evidence to suggest that period 2 was not a peak, but period 4 was.

Figure 43. Monthly average purity of powder meth/amphetamine seizures in Victoria, 2002-2014.
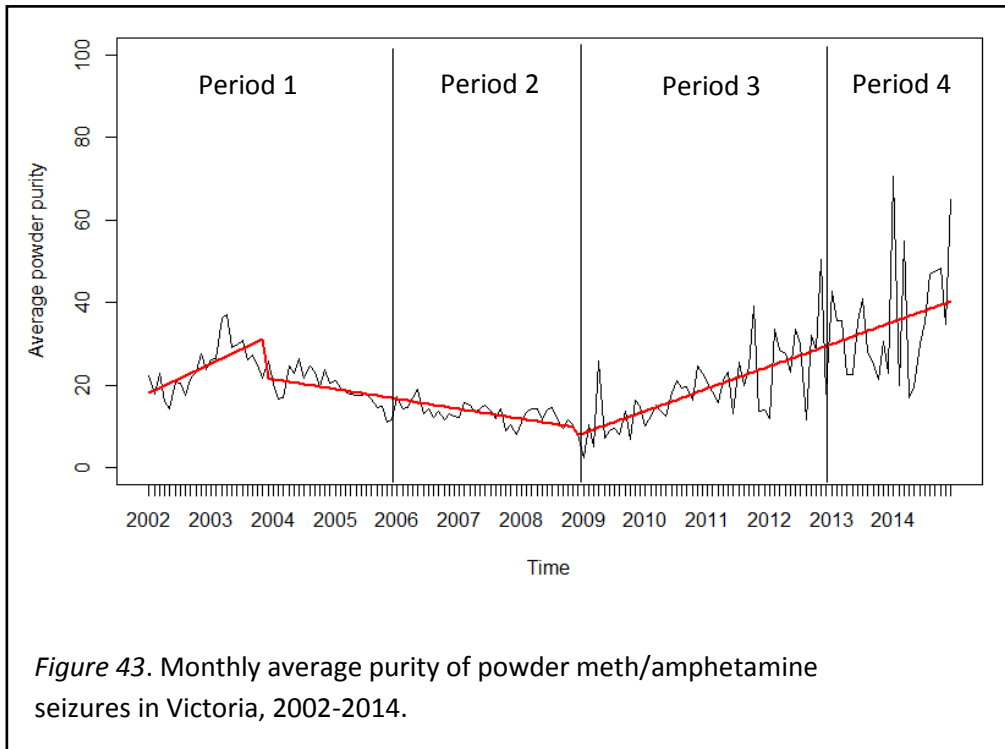
Average tablet purity remained consistently low over the analysis period, fluctuating between 2.5 and 6.1 % (see Figure 44). There was no major difference in average tablet purity between periods 1 to 4: 5%, 3%, 3% and 4% respectively. This shows there was no difference in tablet purity between the two periods of concern.

Figure 44. Annual average purity of meth/amphetamine tablets seized in Victoria, 2002-2014.
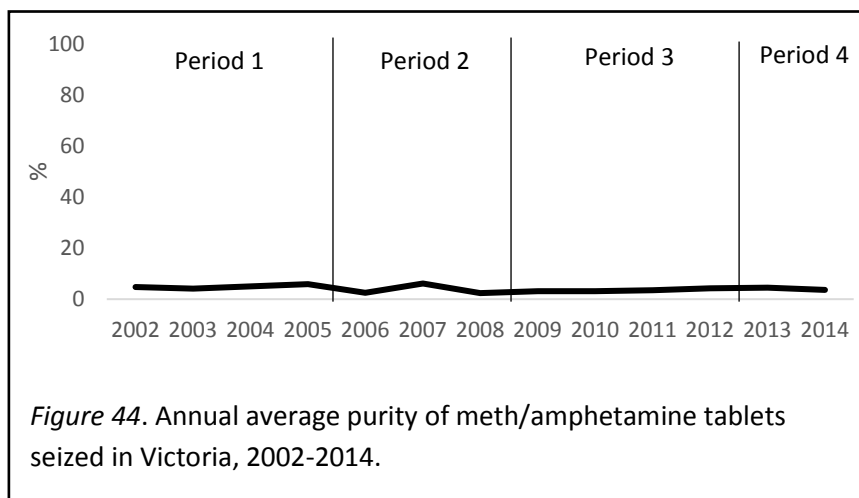
Figure 45a shows the annual proportion of national EDRS and IDRS participants who reported the purity of crystal meth/amphetamine to be high. The proportion of IDRS participants reporting that, declined over time from 62% in 2002 to 40% in 2014, while the proportion of EDRS participants reporting that, fluctuated over time from a low of 12% in 2005 to highs of 60% in 2003 and 2001, and 62% in 2012.

The average IDRS proportion reporting crystal purity to be high was highest in period 1 (61%) and lower in periods 2 (44%), 3 (40%) and 4 (42%) which were all very similar to each other. The average EDRS proportion was highest in period 3 (53%) and only slightly lower in periods 1 (43%), 2 (47%) and 4 (48%). These trends are not consistent with either period 2 or 4 being peak periods of supply.

The annual proportion of national EDRS and IDRS participants who commented on meth/amphetamine powder purity and reported it to be high is shown in Figure 45b. The proportion of EDRS and IDRS participants reporting powder purity to be high was generally much lower than the proportion reporting crystal purity to be high, which is consistent with the Vic purity data showing crystal to be much higher in purity on average than powder throughout the analysis period. The IDRS proportion fluctuated between lows of 13% and 14% in 2010 and 2009, and highs of 26% and 29% in 2003 and 2014. The EDRS proportion was slightly higher for most of the analysis period and fluctuated between lows of 10% and 18% in 2005 and 2008 to highs of 37% and 35% in 2013 and 2012.

The average IDRS proportion reporting powder to be high in purity was highest in period 4 (28%) and lower in periods 2 and 3 (17% each) and 1 (21%) which were all similar to each other. The average EDRS proportion was also highest in period 4 (34%), lowest in period 1 (19%) and slightly higher in periods 2 (24%) and 3 (28%). These trends suggest that period 4 was a peak period in which powder purity was highest and there was no evidence to suggest period 2 was a peak period from these trends.

Figure 45. The annual proportion of national EDRS and IDRS participants who commented on meth/amphetamine crystal (a) and powder (b) purity and reported it to be high, 2002-2014.
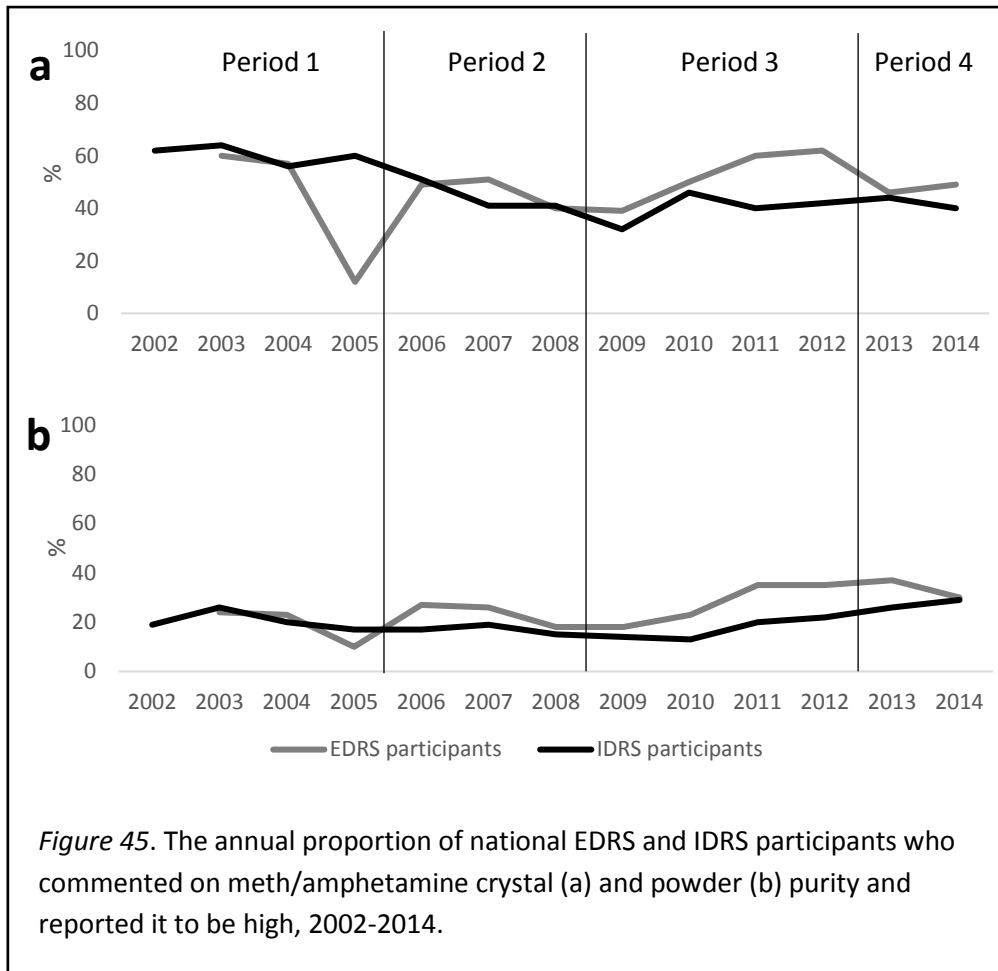
Weight bins

Figure 46 shows the annual total weight and number of border detections compared to the same analysis by weight bin. All bins produced differences in trends and bin 3 was most similar to the aggregate trend. This shows that the aggregate trend was most reflective of high-level supply changes and failed to detect supply changes at lower distribution levels. Bin 1's trend shows a large quantity increase in 2006 (which was the beginning of the 'ice age' period). It suggests a large quantity decrease over subsequent years and then a large increase in 2012 which is a year before the most recent period of concern. Bin 2 shows from 2010, quantity began increasing to unprecedented levels, which coincided with the beginning of the significant increase in crystal meth/amphetamine purity in Victoria. Bins 2, 3 and the aggregate trend all show an exceptionally large quantity increase from 2013.Figure 47 shows the annual total weight of border detections as a proportion by form compared to the same analysis by weight bin. Bin 3 was most similar to the aggregate trend (which showed most detections by weight were either crystal or liquid over time). Bins 1 and 2 showed very different trends.

Specifically, bin 2 showed a gradual shift from non-crystal forms to crystal over time which began to shift in 2005 and by 2012 crystal accounted for the clear majority of detected weight. Bin 1 showed crystal to be more prominent at the beginning (2002-2004) and end (2012-2014) of the analysis period, and between those periods of time most detections by weight were either tablet or capsule. Bin 3 was the only trend to show large quantities of liquid detections. This suggests that liquid was mostly converted to other forms on arrival into Australia before being trafficked to lower distribution levels.

Figure 48 shows the annual total weight of crystal border detections as a proportion by supply routes compared to the same analysis by weight bin. Again, the aggregate trend was most similar to bin 3 which showed a gradual shift from Asia to the Americas in the middle of the analysis period, and then gradually shifted back to Asia. Supply route shifts were less prominent in the mid-level than high, albeit followed a similar trend. Bin 1 showed a shift to the Americas much later than the high or mid-level (not till 2009) and then from 2012 onwards there was a shift to more supply arriving from Europe (although the Americas still accounted for the most weight). This shows that unlike the higher-levels, the low-level did not see shifts in supply routes back to Asia by the end of the analysis period.

Figure 49 shows the annual total weight of crystal border detections as a proportion by mode of transport compared to the same analysis by weight bin. Again, all three bins produced different trends and the aggregate trend was similar to bin 3, which showed air/sea cargo was most prominent in all years except 2002. Bin 2 was a mix of post and air/sea cargo over time bar 2003, and bin 1 was mostly post over time bar 2003 and 2010. This shows that different distribution levels have different methods of importation for crystal meth/amphetamine and that their methods of importation remained largely the same over time.
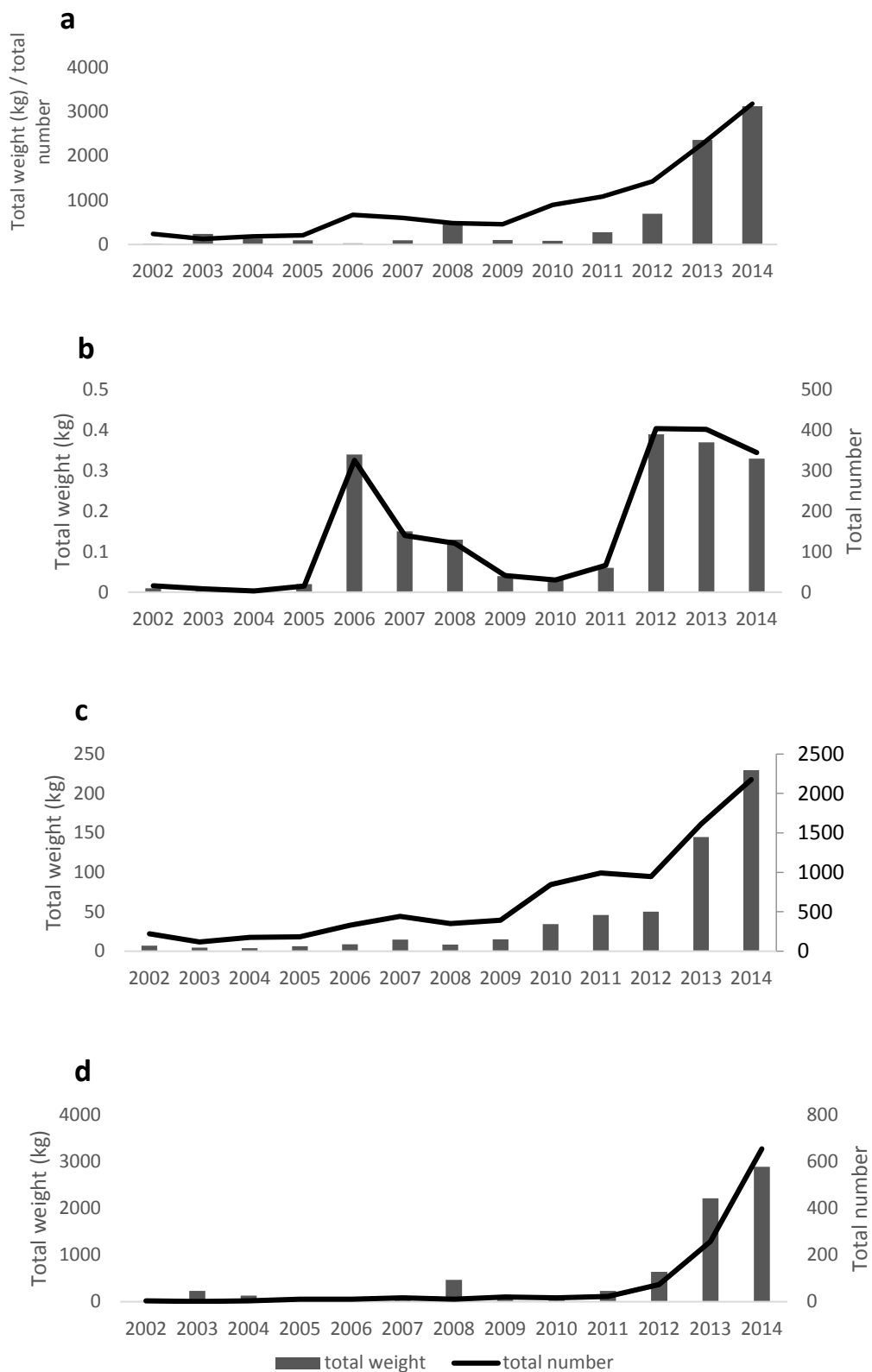
Figure 46. Aggregate total weight and number trends of end-product border detections (a) compared to the same data analysed by weight bin (using the law method) in bins 1 (b), 2 (c) and 3 (d).
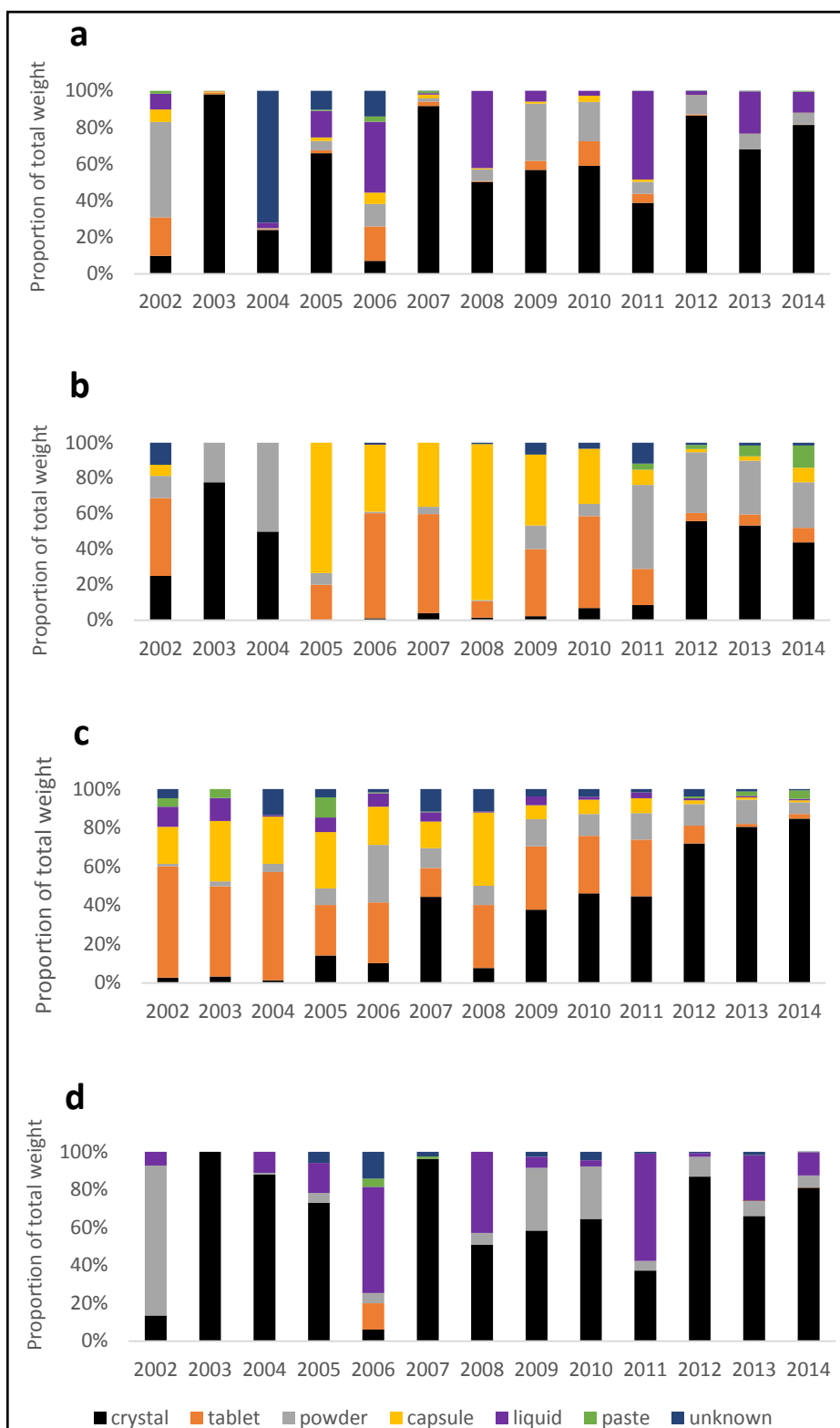
Figure 47. Aggregate total weight trend of end-product border detections as a proportion by form (a) compared to the same data analysed by weight bin (using the law method) in bins 1 (b), 2 (c) and 3 (d).

Figure 48. Aggregate total weight trend of end-product crystal border detections as a proportion by supply routes (a) compared to the same data analysed by weight bin (using the law method) in bins 1 (b), 2 (c) and 3 (d).

Figure 49. Aggregate total weight trend of end-product crystal border detections as a proportion by mode of transport (a) compared to the same data analysed by weight bin (using the law method) in bins 1 (b), 2 (c) and 3 (d).

Discussion

This research aimed to do three things: to identify supply changes in Australia's meth/amphetamine market between 2002 and 2014 noting when and where they happened; to compare trends across four periods to test whether those periods of market change hypothesised in the Australian media are consistent with the evidence; and to examine trends at different distribution levels by applying weight bin analysis and comparing them to their corresponding aggregate trends to see whether any additional supply changes can be identified.

Consistent with global trends, the quantity of meth/amphetamine available in Australia appeared to see a substantial increase over the analysis period. This was evidenced by general increases in: the total weight and number of meth/amphetamine border detections, meth/amphetamine supplier arrests, the proportion of EDRS and IDRS participants reporting crystal meth/amphetamine to be easy or very easy to obtain, the total weight and number of meth/amphetamine precursors detections and the annual total number of meth/amphetamine clandestine laboratory detections in Australia.

Also consistent with global trends, there was a gradual but substantial shift in form over time from mostly powder and tablet, to mostly crystal. This was evidenced by three findings. First, a large increase over time in the total weight and number of meth/amphetamine border detections, which were mostly in crystal form. Second, an increase over time in the proportion of EDRS and IDRS participants reporting crystal meth/amphetamine to be easy or very easy to obtain, but no change in those reporting powder meth/amphetamine to be easy or very easy to obtain. Third, an increase over time in the proportion of meth/amphetamine seizures in Victoria that were in crystal form.

There appeared to be three main phases of purity changes for meth/amphetamine crystal and powder. In Victoria, the average crystal purity of seizures significantly increased between 2002 and 2004, and then declined slowly but substantially until its lowest point in 2010. From there, crystal purity saw an increasing trend and by 2014 had returned to previous peak levels seen in 2004. The average purity of powder seizures followed a similar trend, but the low point was in 2009 not 2010, and this form had a much lower average purity than crystal over time. The average tablet purity of seizures remained stable and very low over time. Both EDRS and IDRS subjective reports of crystal purity suggest that, in line with the Vic purity data, purity peaked at the beginning of the analysis period, before declining, but the increase since 2009 as per the

Vic purity trend was not reported by participants. On the other hand, EDRS and IDRS subjective reports of powder purity followed a more similar trend to that of the Vic purity trend.

The present findings suggest that powder and crystal purity were decreasing in the context of increasing quantity between 2004 and 2009, which then shifted to increasing crystal and powder purity in the context of increasing quantity. This is somewhat unusual as one might expect quantity to decline in the context of declining purity as per economic theory would suggest.

Coinciding with the decline in purity was a shift in the prominent type of precursor imported from a mix of ma huang and ephedrine to a mix of pseudoephedrine and ephedrine. This also coincided with the beginning of the form shift to crystal and a shift in supply routes from mostly Asia (particularly China/Hong Kong) to mostly the Americas (particularly Canada). The purity increase from 2009/2010 coincided with a shift back to Asia (particularly China/Hong Kong) and the further increased availability of crystal.

There were similar parallels with Australia's ecstasy market. Chapter 5 showed that ecstasy tablet purity declined from 2006 until 2010, before increasing and ecstasy powder purity declined from 2002 to 2010 before increasing. Similarly, this chapter showed that meth/amphetamine crystal purity declined from 2004 to 2010, before increasing while powder declined from 2004 to 2009 before increasing. Also consistent between Australia's ecstasy and meth/amphetamine markets was that shifts in purity coincided with shifts in supply routes. In both markets, the prominent embarkation point of border detections was the same when purity was highest and different when purity was lowest. This suggests that any future shifts in supply routes for these drugs may lead to shifts in their purity in Australia.

There was little evidence to suggest period 2 was much of a peak period in meth/amphetamine supply. Monthly average meth/amphetamine powder and crystal purity significantly declined over period 2 and their period average purities were both lower in that period compared to any other. Further, there was only a slight increase in border detections in period 2 and evidence of a major increase in domestic manufacture during period 2 was lacking (slightly more precursor weight detected relative to period 1 but same numbers of clandestine laboratory detections). The only difference in period 2 relative to 1 was that slightly more crystal was available, but it was less pure than before. In contrast, period 4 had the highest average powder and crystal purity, the highest scale of end-product and precursor importations, more clandestine laboratory detections and increases in EDRS and IDRS

perceptions of crystal availability, and more supplier arrests. Hence there was little evidence to justify media claims of an 'ice age' in period 2, but media and government perceptions of a peak period in period 4 (since 2013) is justified according to the present analysis (Department of the Prime Minister and Cabinet, 2015).

The findings suggest that meth/amphetamine supply in Australia since 2013 was fundamentally different to during the previous period of concern. Not only was there evidence of more supply, but there was more ephedrine than pseudoephedrine being imported, more end-product and precursor supply arriving from China/Hong Kong and a greater supply of crystal relative to other forms of the drug. However, the findings do not imply that all crystal meth/amphetamine arriving from China/Hong Kong was manufactured there. While it is manufactured in the region, "large amounts of crystalline methamphetamine were perceived to have been trafficked to East and South-East Asia from Western Africa, Western Asia, North America, and, more recently, South Asia" (UNODC, 2015b, p. 12). Thus China/Hong Kong may (at least in some instances) be the final embarkation point in more complex supply routes to Australia. The large increase in the quantity of meth/amphetamine available and shift to mostly crystal supply in period 4 is in support of studies that estimated unprecedented increases in harms associated with meth/amphetamine use in Australia (Degenhardt et al., 2016; Degenhardt et al., 2016; Heilbronn et al., 2013; Lim, Cogger, Quinn, Hellard, & Dietze, 2015) and also a shift to more crystal use (Degenhardt et al., 2016). There are two plausible reasons to explain why these shifts in supply may have occurred.

The identified shifts in border supply magnitude and nature over time are perhaps a consequence of the strengthening of legislative controls on the meth/amphetamine precursor pseudoephedrine in Australia and abroad. Drug traffickers are adept at adapting to supply changes (Decker & Chapman, 2008; Desroches, 2005; Matrix Knowledge Group, 2007; Ovenden, Loxely, & McDonald, 1995) and the identified market shifts have coincided with the precursor legislative changes. Specifically, marked increases in pseudoephedrine border detections arriving from Asia began in 2008, immediately following the year Project STOP was implemented Australia-wide (Miller, April 2009). This also coincided with a period in which precursor controls in many parts of Asia were in their infancy (McKetin, 2008). The second more recent shift (substantial increases since 2013 in the total weight of end-product border detections and a shift in the primary precursor detected, i.e. pseudoephedrine to ephedrine) immediately followed the implementation of tougher pseudoephedrine controls in China (Australian Crime Commission, 2015b). All of these events are consistent with adaptation to

the new controls. It is also consistent with assertions from the Australian Crime Commission that methamphetamine traffickers "are adept at exploiting regulatory weaknesses in Australia and overseas, and at adapting to fluctuations in precursor availability" (Australian Crime Commission, 2015b, p. 11). However, it is also possible that the change in legislation was the source of the rise in border detections. For example, law enforcement officers may have given increased attention to known illicit precursor trafficking routes following the implementation of Project STOP. Interviews with Australian and Chinese drug law enforcement agencies or with drug traffickers may help to verify which cause of the supply changes at the border is most plausible.

The shift to more crystal supply and the most recent increase in crystal purity may have been associated with shifts in supply routes to China/Hong Kong which is known to manufacture large quantities of high purity crystal meth/amphetamine (Global SMART Programme, 2012). The present findings also suggest that the Australian meth/amphetamine market has become less domestically controlled with far greater influence from overseas markets, especially China/Hong Kong. Together, this may help to explain why the price per pure gram of meth/amphetamine in Victoria declined between 2008 and 2013 (Scott, Caulkins, Ritter, Quinn, & Dietze, 2015). The price of meth/amphetamine is much cheaper overseas, particularly in China where the wholesale price per kilogram in 2010 was estimated to be approximately 30 to 50 times cheaper than in Australia (Australian Crime Commission, 2014b). This may have lead traffickers to decrease the price of meth/amphetamine to their customers in Australia. But how traffickers specifically adapt to supply changes like these is yet to be studied in detail and that is something that Chapters Seven and Eight address. If the hypothesis that the more recent meth/amphetamine supply changes are an adaptive response to the strengthening of precursor legislative controls is correct, this raises important questions about the desirability and efficacy of expanding such controls, and the need to consider both intended and unintended policy consequences of legislative responses (Babor et al., 2010; McKetin, 2008).

Weight bins

Finally, when the border data were reanalysed by weight bin, additional supply changes were identified that were not detected by the aggregate trends. For example, weight bin analysis by form showed that high-level importations mostly comprised crystal throughout the analysis period. However, at the mid-level there was a gradual shift from mostly powder and tablet to mostly crystal over the analysis period. The low-level trend showed a shift from mostly crystal

between 2002 and 2004 to mostly tablets and powder between 2005 and 2011 which then shifted back to crystal between 2012 and 2014. When compared to the aggregate trend, there was no apparent form shift as most of the detections by weight over the analysis period were in crystal form. This supports past research which demonstrates the value of weight bin analysis as more supply changes can be detected over and above the aggregate trend alone (Kilmer & Hoorens, 2010; Singleton, Cunningham, Groshkova, Royuela, & Sedefov, 2018).

Limitations

As outlined in Chapter 3, all drug supply indicator data have limitations. The primary concern with using law enforcement data to indicate supply changes is that changes in seizure quantities may be more indicative of changes in law enforcement activity than supply. There is no guarantee that trends produced by these data are indicative of real supply changes in Australia. That said, analysis in Chapter 4 showed that the annual total weight and number of border detections significantly correlated with several other indicators of supply (EDRS and IDRS subjective availability and purity reports). This results in more confidence that the border data was indicative of real supply changes. Data triangulation methods were also used which further reduces the likelihood of misinterpretation. A second limitation was the use of descriptive methods of analysis for the border data. An inferential statistics procedure such as time series analysis would have strengthened the analysis and findings, but this was not possible given there were insufficient sample sizes per data point. A third limitation was the purity analysis being on data from the state of Victoria only. Meth/amphetamine purity in Victoria is not indicative of meth/amphetamine purity at the border, nor is it necessarily consistent with meth/amphetamine purity in other Australian states or territories.

Conclusion

To conclude, there were many major supply changes in Australia's meth/amphetamine market between 2002 and 2014: changes in quantity, purity, supply routes, precursor type and form. The main supply change identified was an unprecedented quantity increase of meth/amphetamine in the 2013 to 2014 period, and this coincided with meth/amphetamine powder and crystal purity returning to peak levels not seen since 2004. This supports media and government suggestions of a peak and concerning period between 2013 and 2014. In contrast, the data indicated that the 'ice age' period–as depicted by Australian media from 2006 to 2008–was not markedly different to preceding years, indicating that this was not a peak period of supply. Finally, this research showed the value of weight bin analysis which

identified more supply changes in Australia's meth/amphetamine market over and above the aggregate trends alone. The next two chapters examine how high-level synthetic stimulant traffickers and their networks adapt to some of the main supply changes identified in Chapters 5 and 6.

Chapter 7: High-Level Synthetic Stimulant Trafficker Adaptations to Supply Changes and the Consequences

Changes in supply are an inevitable part of the illicit drug trade. As shown in Chapters 5 and 6, there have been numerous supply changes in Australia's ecstasy and meth/amphetamine markets, including changes in quantity, purity, form, supply routes and mode of transport. This raises the question: how do drug traffickers adapt to these supply changes? The present chapter examines the ways in which high-level synthetic stimulant traffickers adapt to five of the ten kinds of supply changes that were outlined in Table 1 (Chapter 1): quantity, purity, textural-quality, content-quality, and form.

As detailed in Chapter 2, studies on high-level drug trafficking suggest that traffickers are often exposed to supply changes throughout their careers, and use several strategies to mitigate risk against supply changes so they can continue to generate an income (Matrix Knowledge Group, 2007; Ovenden, Loxely, & McDonald, 1995; Tzvetkova et al., 2014). For example, incarcerated traffickers in Europe reported having multiple backup suppliers in the event that their regular supplier was unavailable, or stocking up drugs when they envisaged a period of low supply or if the batch they received was of unusually high quality.

There are a range of adaptations that traffickers may make when faced with a supply change. As shown by the literature review conducted in Chapter 2, adaptations identified by past studies of high-level drug trafficking include the following: looking for an alternative supplier, increasing or decreasing the price of the drugs to the customer, returning the drugs to the supplier if they were poor quality, buying more drugs than usual if exposed to high quality, or sourcing precursors and manufacturing drugs instead of buying the end-product (Adler & Adler, 1983; Bright & Delaney, 2013; Desroches, 2005; Dunlapa, Gravesb, & Benoita, 2012; Reuter & Haaga, 1989; Tzvetkova et al., 2014). Several traffickers have reported that their use of adaptations allows them to continue selling drugs in most instances when faced with supply changes, including those caused by law enforcement intervention (i.e. seizures), (Ovenden, Loxely, & McDonald, 1995; Pearson & Hobbs, 2001).

While past studies have identified a range of adaptations that traffickers may use after exposure to a supply change, a systematic analysis is lacking. This leaves many important questions unanswered. First, it is not known what kinds of adaptations are the norm. Second, it is unclear whether there is a relationship between the various characteristics associated with

a supply change (such as the supply change kind, cause or direction) and how traffickers adapt. For example, traffickers may adapt differently to law-enforcement-caused supply changes than they do to non-law-enforcement-caused supply changes; or may adapt differently to purity changes than to quantity changes. Third, it is unclear what proportion of traffickers are able to continue selling drugs after a supply change, nor do we know whether their ability to continue selling drugs is influenced by the various characteristics of the supply change. For example, traffickers may be less likely to continue selling drugs after purity changes than quantity changes. The lack of knowledge in this area limits ability to understand whether / to what extent there will be changes in the potential for harm to the public when supply changes occur. This study seeks to provide a systematic analysis of trafficker adaptations to five kinds of supply changes and the consequences thereof.

Research questions

The following questions were asked:

1) What supply change kinds are high-level synthetic stimulant traffickers most often exposed to in Australia?
2) How often do traffickers engage in at least one adaptation after a supply change?
3) What are the most and least common adaptations made?
4) To what extent is there a relationship between how traffickers adapt and the following supply change characteristics:
    a. the cause;
    b. the kind;
    c. the direction;
    d. the drug type associated with the supply change;
    e. whether the trafficker is exposed to one or multiple supply changes;
    f. the length of time passed; and
    g. the trafficking style (i.e. whether the trafficker is a mono or poly drug trafficker)?
5) What proportion of traffickers continue to sell drugs after a supply change?
6) To what extent is there a relationship between whether traffickers continue to sell drugs after the supply change and the following supply change characteristics:
    a. the cause;
    b. the kind;
    c. the direction;

d. the drug type; and

e. the trafficking style.

Method

A quantitative content analysis was conducted on transcriptions of judges' sentencing comments from Australian court cases of high-level synthetic stimulant trafficking over the period January 2002 to October 2016. The study began by obtaining a starting sample of judges' sentencing comments from Australasian Legal Information Institute (AustLII), (n = 495), applying exclusion and inclusion criteria, and then coding the remaining sub-sample of transcripts (n = 295) for demographic content (e.g. year and state of court, drugs trafficked, type of offence, prior convictions, etc.). The judges' narratives of case facts were used to identify the occurrence of supply changes. A total of 53 transcripts contained one or more supply change references. For each supply change that was identified (n = 91), I coded the supply change kind, cause and direction, trafficker adaptations that followed (if any) and the consequence (i.e. whether the trafficker continued to sell drugs after the supply change). See Figure 50 for a flow diagram of the sampling and coding procedure, and see Appendix B for an example of a sentencing-comments-transcript downloaded from AustLII. The example transcript is of a cocaine trafficking case in New South Wales. It is not a transcript analysed in the present study as that would contravene the conditions of ethics approval. The sampling and coding methods are explained in more detail below. This project was approved by the University of New South Wales Human Research Ethics Advisory Panel: HC16978.

Figure 50. Flow diagram of the sampling procedure.
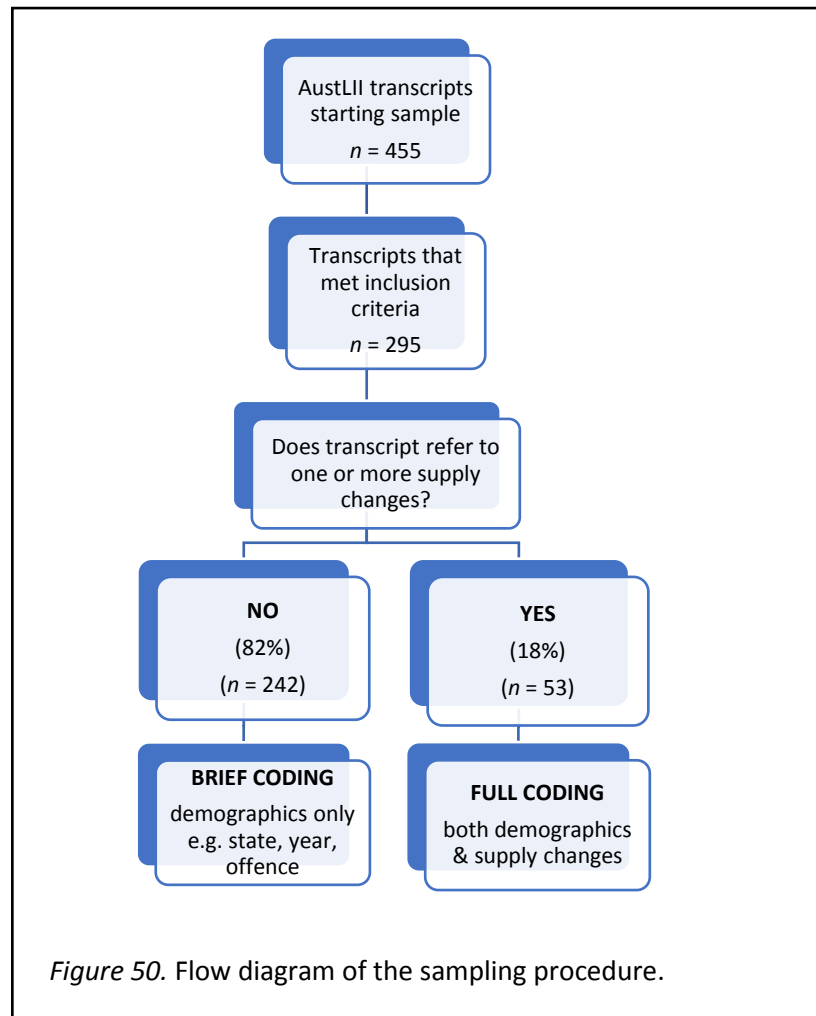
How the starting sample of AustLII transcripts was selected

The AustLII website allows searches and downloads of sentencing transcripts from available databases. A preliminary search of transcripts via AustLII was conducted in October 2016 to identify an optimal search term (i.e. a search term that would return a large enough, yet feasible sample of transcripts with a high proportion fitting study inclusion criteria). The inclusion criteria were:

- The offender(s) being sentenced must be convicted for one of the following: trafficking, supplying, manufacturing, possessing with intent to supply, or attempting to possess a commercial / large commercial quantity of ecstasy and/or ecstasy precursors in Australia. The offender's convictions did not need to be exclusively these. For example, they could also be simultaneously convicted for other drug and non-drug related offences;

- The judgment was made no earlier than the 1st of January 2002 and no later than the 19th of October 2016.

The exclusion criteria were:

- The commercial / large commercial ecstasy or precursor trafficking conviction was quashed in the transcript;
- The accused had not yet been convicted of a commercial / large commercial ecstasy or precursor trafficking offence (e.g., the offender was applying for bail while awaiting trial for an ecstasy trafficking charge);
- The commercial / large commercial ecstasy or precursor trafficking conviction belongs only to a co-offender who was not being sentenced in the transcript.

Transcripts from all Australian jurisdictions were eligible.

A number of AustLII search strategies were trialled. The final search term entered into AustLII was:

> (ecstasy OR methylenedioxymethylamphetamine OR MDMA OR MDA OR methylenedioxyamphetamine OR MDEA OR methylenedioxyethylamphetamine) w/8 commercial OR ((safrole OR isosafrole OR MDP2P OR piperonal OR PMK OR helional) w/8 commercial).

This returned a starting sample of 455 sentencing transcripts made between January 2002 and October 2016. A starting sample of 455 was considered appropriate as, based on preliminary reading during the search term trials, a small proportion of transcripts in the final sample were expected not to meet inclusion criteria. Moreover, an even greater proportion was expected not to contain any supply change references (the most important data for this study). Hence a large enough starting sample was required in order to ensure enough transcripts with supply change references would be present in the sample. In total, 295 transcripts (64.8%) met inclusion criteria and were coded according to the coding schedule. The remaining 160 transcripts were excluded from coding and analysis.

The logic for focusing the search on ecstasy trafficking offences specifically (as opposed to both ecstasy and meth/amphetamine) was as follows. It was originally planned to conduct two separate searches: one which captured ecstasy trafficking offences (as above) and another which captured meth/amphetamine trafficking offences. However, after obtaining the sample of transcripts from the ecstasy search, a large overlap was observed. That is, about one-third of the sample of transcripts also comprised meth/amphetamine trafficking. Hence this sample was considered appropriate for analysis and a second sample using meth/amphetamine specific search terms was therefore not obtained for analysis.

Developing the coding schedule

All 295 included transcripts were firstly read for familiarisation and notes were taken. Then, a semi-deductive draft coding schedule was devised, derived from both the literature and the data. It was designed to identify transcript demographics (for example the year and state of the court, the drugs trafficked, the type of offence, whether any prior convictions) and supply change variables (e.g., the kind, cause and direction of the supply change, adaptations that followed [if any] and whether drugs were sold after the supply change).

The coding schedule also took into account the time frame that the supply changes and adaptations occurred in. It has been recognised that traffickers may adapt differently in short and long-term time frames (Bouchard, 2007). For instance, Dorn, Levi, and King (2005) highlight the need to consider differences between short and long-term law enforcement operations, recognising that each may have different effects on drug markets. Despite recognition that length of time is an important variable to consider, there is no clear consensus as to what defines "short-term" versus "long-term" time frames. There is one European study of high-level drug traffickers from which arbitrary time frames could be derived. Tzvetkova et al. (2014) found that on average the maximum length of time traffickers in Europe were without a supply of drugs was two weeks. Considering this, a decision was made to define a long-term time frame as any period of time after one month and a short-term time frame as any period of time within one month. Two time frames were therefore coded: 'within one month' and 'after one month'. Adaptations and whether drugs were sold were coded in each time frame (where applicable).

My two supervisors and I had several meetings until the coding schedule was refined and clear. My primary supervisor and I tested the coding schedule on a pilot sample of transcripts which were then further refined during later meetings until the coding schedule was optimised. Once optimised, all demographics and supply change variables were coded (where applicable) in the transcripts. A total of 5% of transcripts were dual coded to test inter-rater reliability. An overall Cohen's Kappa of .987 was achieved, indicating near perfect agreement (Hallgren, 2012; McHugh, 2012).

See Table 16 for an abridged version of the supply change variables that were coded. For the full coding schedule (which also includes the coded demographic variables) see Appendix C. The coding schedule specifically coded for five of the 10 supply change kinds outlined in Table 1 (Chapter 1): quantity, purity, textural quality, content quality and form. These five kinds were examined because they were the only kinds to be referenced by the judge in the transcripts.

Other supply change kinds such as mode of transport or supply routes were not referenced by the judge and hence could not be analysed. This is most likely because supply changes like these are less likely to be relevant to the sentencing process. Purity, textural-quality, and content-quality were clustered together, coded and analysed as a single group. This is because it was not always possible to distinguish the difference between these three kinds in the data. Hence from herein the term 'purity/quality' change refers to any purity, textural-quality or content-quality change.

Both supply changes experienced by the traffickers (referred to herein as exogenous supply changes) and caused by the traffickers (referred to herein as endogenous supply changes) were coded. However, the core focus of the chapter was on exogenous supply changes. This is because the research questions of interest are concerned with how traffickers adapt to supply changes they are exposed to. As such, adaptations and consequences were only coded against exogenous supply changes.

Finally, three units of analysis were coded: the transcript (which may or may not contain a supply change reference), the supply change reference (of which one or more could occur per transcript), and the adaptation (of which one or more could occur per supply change).

Table 16

Abridged coding schedule for supply changes

Items to code	Definitions/examples
Supply change reference	
Was there a supply change reference in the transcript (any drug type): yes or no? (multiple may be coded)	Did the judge make reference to an instance where the offender became aware of a purity/quality or quantity change to his/her end-product or precursor supply, or a form change to his/her end-product supply, prior to his/her arrest? Code supply changes that the offender was exposed to (e.g. the offender receives drugs of lesser purity than usual) as well as supply changes caused directly by the offender (e.g. the offender cuts his/her own drugs). Code yes here FOR EACH supply change referenced in the transcripts and code the remaining codes below separately for each supply change. Note: the drug type associated with the supply change does not matter. For example, can code an ecstasy, meth/amphetamine, heroin or cocaine supply change (drug type is coded in the next variable).
Was the supply change associated with ecstasy or another drug? Code either ecstasy or other.	For example, if the purity of ecstasy decreased then code an 'ecstasy' supply change, or if the purity of meth/amphetamine decreased then code an 'other' supply change.

Items to code	Definitions/examples
Supply change category	
What was the kind: quantity, purity/quality, or form?	Quantity change: There is evidence that the offender's access to drug X or drug X's precursors changed relative to an earlier point in time. For example, the offender's regular supplier was unavailable thereby decreasing the quantity of drugs available to the offender; the offender was introduced to a new supplier thereby increasing the quantity of drugs available to the offender; or law enforcement seized the offender's drugs prior to his/her arrest thereby decreasing the quantity of drugs available to the offender.

Purity/quality change: There is evidence that the offender became aware of change to the composition of his or her drugs (for example a change in the amount of adulterants or cutting agents); or became aware of a change to the textural quality of his or her drugs (for example the offender received ecstasy tablets that had crumbled/broken into pieces); or became aware of a change to the amount of the active ingredient in his or her drugs (for example the offender had received ecstasy that produced a stronger ecstasy effect than usual).

Form change: There is evidence that the offender's drug supply was converted from (for example) powder to tablets, crystal to tablets or powder to crystal. |
| What was the cause: law enforcement, or non-law enforcement? | Law enforcement change: A quantity or purity/quality change caused directly by law enforcement intervention. For example, law enforcement seized the offender's drugs mid transit before he/she received them or seized them at his/her property and either replaced them with an inert substance or seized them without replacing.

Non-law enforcement change: Any supply change not caused directly by law enforcement intervention. For example, the offender received drugs of a higher purity than usual from a supplier. |
What was the direction: increase or decrease?	Increase: increased quantity or purity/quality. Decrease: decreased quantity or purity/quality.
Was the supply change endogenous or exogenous?	Endogenous means the trafficker caused the supply change. Exogenous means the trafficker was exposed to the supply change. If endogenous stop coding here. If exogenous then code all remaining below.
Adaptations within one month	
Was there evidence that the offender adapted to the supply change within one month: yes or no?	An adaptation was defined as a business related adjustment made after being exposed to the new supply condition (i.e. the supply change).
If yes, how did the offender adapt to the supply change within one month? (multiple adaptations may be coded per supply change)	1 'Attempt to improve the purity/quality' 2 'Reduce the purity / quality' 3 'Increase price to customer' 4 'Decrease price to customer' 5 'Attempt to expand business by selling more of the same drug(s) or precursor(s)'

Items to code	Definitions/examples
	6 'Attempt to expand business by selling a different drug or precursor in addition' 7 'Find/switch to an alternative supplier of the same drug or precursor of same drug' 8 'Find/switch to an alternative supplier of a different drug or precursors of a different drug' 9 'Cease trafficking that drug or precursor' 10 'Regard the drugs/precursors as waste and dispose of them' 11 'Attempt to return drugs/precursors to supplier' 12 'No adaptation - receive drugs and pass them on' 13 'Attempt to locate missing drugs/precursors' 14 'Response/adaptation unclear' 15 'Attempt to source manufacturing equipment / chemicals and/or manufacture the drug' 16 'Become inactive' 17 'Become re-active' 18 'Attempt to sell new form' 19 'Buy more drugs than usual' 20 'Buy less drugs than desired' 21 'Attempt to sell higher purity/quality drugs' 22 'Attempt to sell lower purity/quality drugs' 23 'Attempt to import or order more of the same drug type from the supplier' 24 'Attempt to import a different drug type' 25 'Attempt to import more of both same and different drug type' 26 'Attempt to import more drugs but unclear whether same or different drug type' 27 'Purchase more drugs at an inflated price'.
Consequence within one month	
Was there evidence of any drugs being sold by the offender within one month: yes or no?	Code yes if the offender sold any drug type within one month of the supply change happening. The drug sold does not have to be the same as the drug associated with the supply change. For example, if there was an ecstasy supply change and the offender sold meth/amphetamine within one month, then code yes here. *(Note: in some cases it was clear that drugs were sold after the supply change [because the judge made reference to that fact]. On the contrary, there were cases in which no reference was made as to whether drugs were sold post supply change. In these cases, it was never possible to be sure that drugs were not sold (an absence of evidence is not evidence of absence). Hence only "yes" and "no evidence" was coded for this variable.)*
Adaptations after one month	
Was there evidence that the offender adapted to the supply change after one month: yes or no?	
If yes, how did the offender adapt after one month? (multiple adaptations may be coded per supply change)	See above for the list of possible adaptations to code

Items to code	Definitions/examples
Consequence after one month	
Was there evidence of any drug type being sold by the offender after one month: yes or no?	Code yes if the offender sold *any* drug type after one month of the supply change happening. *(Note: as per the consequence within one month, "yes" and "no evidence" was similarly coded for this variable.)*

The complexities coding and analysing adaptations using judges' sentencing comments

There are a number of complexities analysing adaptations to supply changes using judges' sentencing comments. This section discusses the challenges and how I attempted to resolve them.

Follow up hearings

The sentencing process in a small proportion of transcripts in this sample (4.6%) occurred over multiple hearings and hence over multiple transcripts. This meant that some transcripts were follow-up hearings of previous transcripts. This in turn meant that some follow-up transcripts repeated information (including supply changes and adaptations) that had already been stated in an earlier transcript of the same case. In order for the analysis to be systematic and replicable, all transcripts in this sample were coded individually and separately, and for the analysis, each transcript was considered a unique case even though some were clearly not unique. The downside to this approach is this is that some demographic and supply change variables were coded more than once which may have skewed the results. But any skew effect is arguably small given only a small proportion of transcripts were duplicates.

One versus multiple traffickers being sentenced simultaneously

Some transcripts comprised the sentence hearing for a single trafficker while others comprised the sentence hearing for multiple traffickers who were sentenced simultaneously (the average number of traffickers in a single transcript was two and the maximum was five). Demographics and supply change variables (including adaptations) were coded for all traffickers in each transcript. For example, if a transcript had two traffickers and one had a prior conviction for murder while the other had a prior conviction for drug trafficking, then the transcript was coded as comprising both drug and non-drug related priors. If the same two traffickers were

exposed to a supply change and each made two adaptations, then four adaptations were coded against that supply change.

The problem of multiple supply changes

Transcripts with supply changes could either have one supply change reference or multiple. Figure 51 is an example outline of a transcript with just one supply change which has an adaptation coded within one month and another coded after one month. In this example, it is clear that adaptation A is the short-term adaptation and adaptation B is the long-term adaptation.

Figure 51. Example transcript with only one supply change coded and an adaptation coded within one month and another after one month.
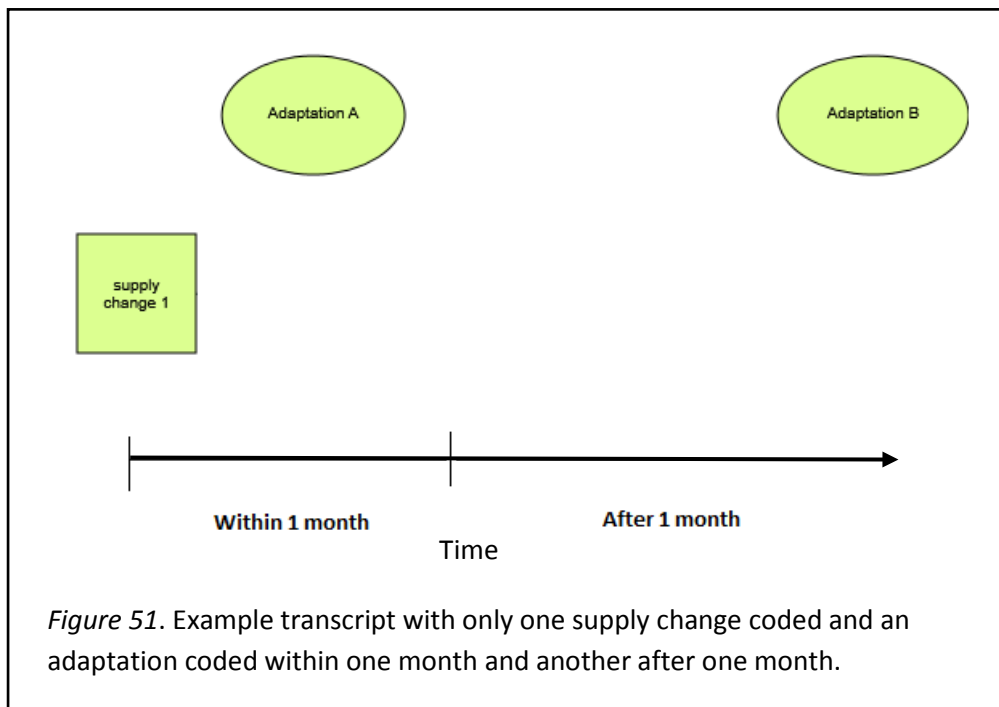
However, things become a little more complex when the transcript has multiple supply changes (see Figure 52). In this example, adaptation A is still clearly a short-term adaptation to supply change 1. But, is adaptation B a short-term adaptation to supply change 2 or a long-term adaptation to supply change 1? Or is it a mix of both? This highlights the complexities involved in coding and analysing trafficker adaptations to supply changes. Given this complexity, there is no ideal way to code and analyse adaptations to multiple supply changes in the transcripts. Hence for transcripts with multiple supply changes (resembling the situation depicted in Figure 52), adaptation B was coded twice: once as a long-term adaptation for supply change 1 and once as a short-term adaption for supply change 2. One limitation with

this procedure was that the total number of times that some adaptations were coded may be inflated, and some adaptations may be erroneously coded as a short-term adaptation to a supply change when it was really a long-term adaptation to another. However, given it is impossible to know from the data whether adaptation B was linked to supply change 1, 2 or both, it was believed that this was the most appropriate way to code and analyse the data.

Figure 52. Example transcript with multiple supply changes coded, each followed by an adaptation.
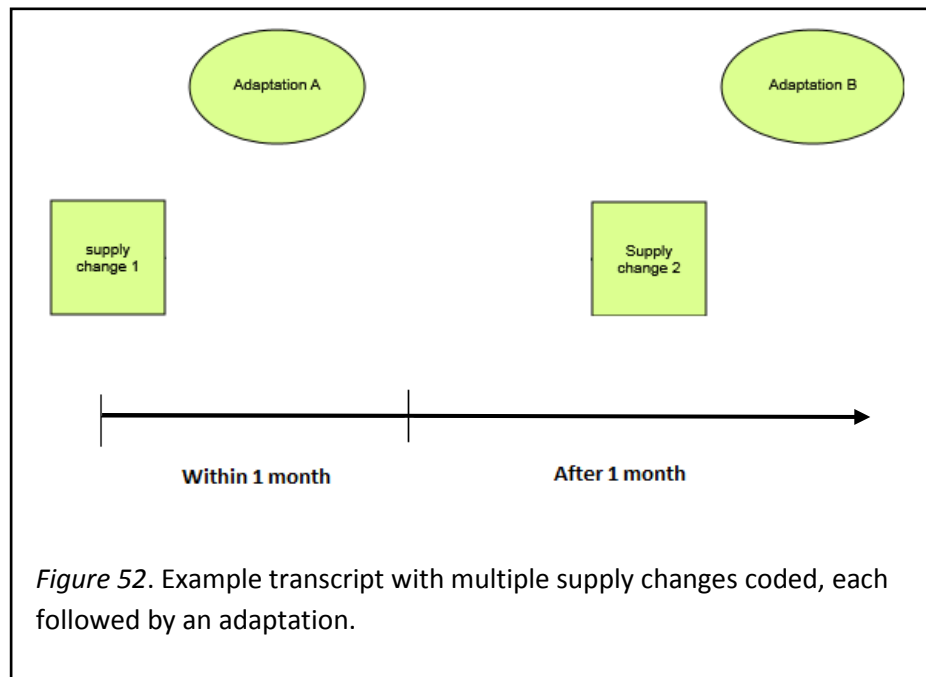
Analysis

A quantitative content analysis was conducted on the de-identified data. Research questions 1 to 5 (which include whether / to what extent there is a relationship between trafficker adaptations and the various supply change variables) were answered via descriptive analysis. Chi-square tests of independence determined whether there was a relationship between whether drugs were sold after the supply change and the various supply change variables (research question 6). Cramer's *V* determined the strength of the relationships.

Sample demographics

The total sample of 295 transcripts comprised hearings from all Australian jurisdictions, but most were from NSW (54.6%) and VIC (32.2%) courts (see Figure 53). This is unsurprising given that NSW and VIC are the two drug trafficking hubs in Australia. Figure 54 shows the number

of transcripts in the sample per year. There were more transcripts from years in the middle of the analysis period (particularly 2009, 2010 and 2011, which comprised 31, 28 and 35 transcripts respectively) than there were at the beginning and end of the analysis period (for e.g., 2003 and 2016 comprised just eight and 12 transcripts respectively). Figure 55 shows the proportion of transcripts by number, by drug types trafficked. About half of all transcripts comprised ecstasy only trafficking while just over a third comprised either 'ecstasy and meth/amphetamine' or 'ecstasy, meth/amphetamine and other drugs' trafficking.

Figure 53. Proportion of transcripts in the sample by court jurisdiction.

Figure 54. Number of transcripts in the sample by year of hearing.

Figure 55. Number of transcripts as a proportion by drug type trafficked. 'Other' referred to any of the following drug types: cocaine, heroin, new psychoactive substances (NPS), cannabis, and steroids.
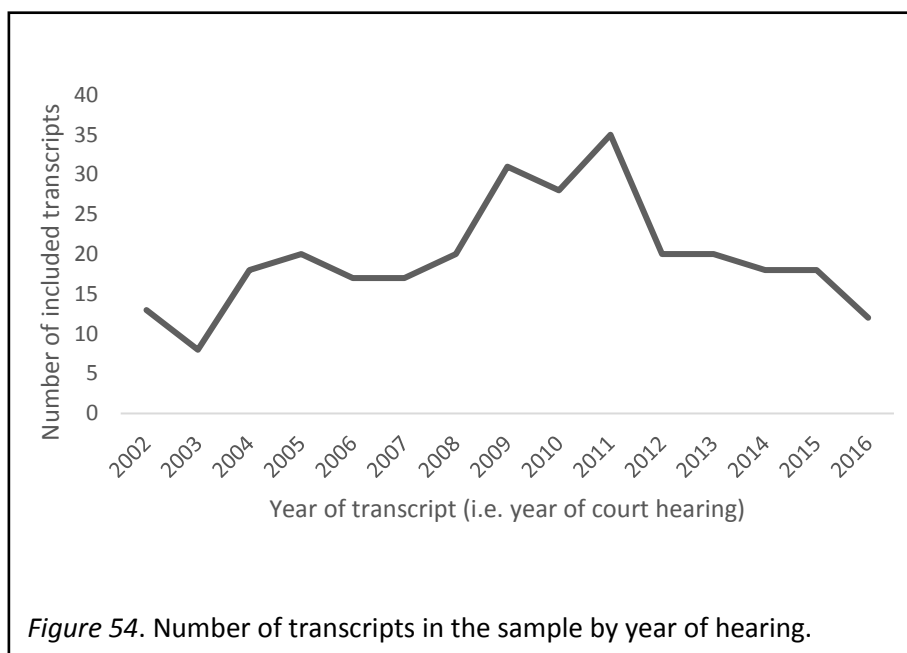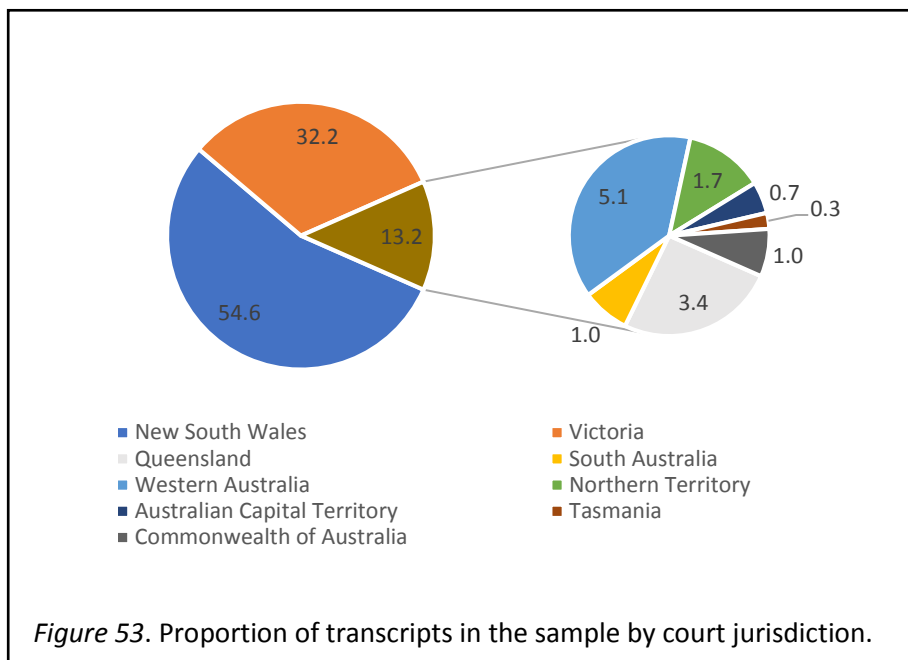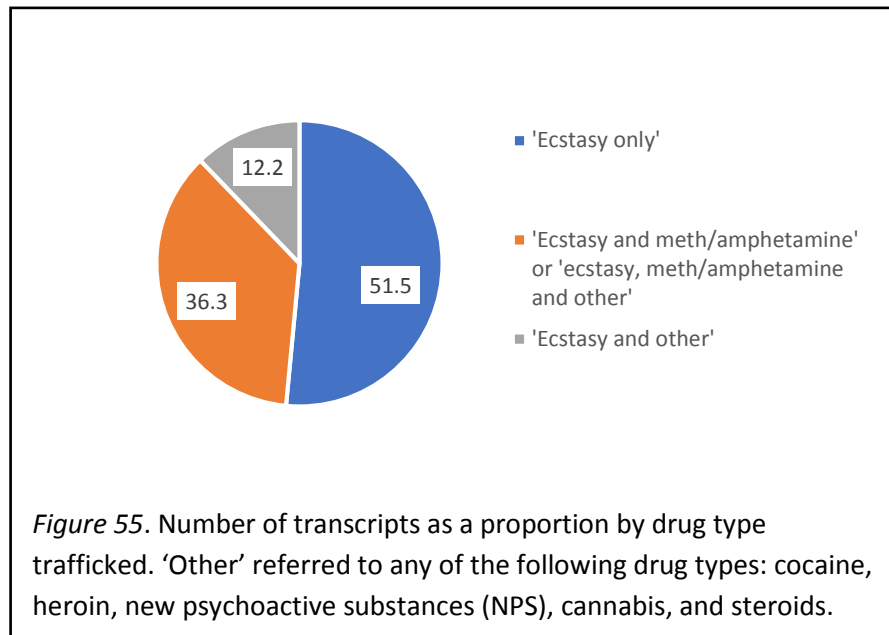
Table 17 reports transcript demographics of the total sample coded (*n* = 255). The most common ecstasy related offence committed was end-product supply (reported in 66% of transcripts), followed by end-product import (30%) and end-product manufacture (10%). In contrast, ecstasy precursor trafficking/importing/manufacturing offences were rare (3%). Just over half of the transcripts reported concurrent offences of any nature (58%), most of which were concurrent drug supply offences for non-ecstasy drugs (49%). Thus the ratio of ecstasy only traffickers to ecstasy poly drug traffickers was approximately evenly split (51% to 49% respectively). In the ecstasy poly drug trafficking transcripts, the majority involved meth/amphetamine trafficking offences (36%). A minority of transcripts involved concurrent non-drug offences such as assault or theft (28%).

Finally, just over half of all transcripts (54%) referenced the presence of one or more prior convictions (with the most common being a non-drug related offence [30%]), half referenced the offender as being a person who used drugs (49%) and a small minority reported trafficking in or across multiple jurisdictions (14.6%).

Table 17

Transcript demographics

Variable	% of all transcripts	Number of transcripts
Ecstasy supply offences		
Any	100	295
Traffic end-product	66	196
Import end-product	30	88
Manufacture end-product	10	30
Traffic precursor	2	6
Import precursor	1	4
Manufacture precursor	<1	1
Concurrent offences		
Any	58	171
Drug supply offence for any non-ecstasy drug or precursor	49	143
Meth/amphetamine end-product (supply or manufacture)	36	107
Other (e.g. NPS, cannabis or steroids)	24	71
Cocaine	19	55
Heroin	4	11
Non-drug supply offence (e.g. assault or robbery)	28	83
Prior convictions		
Yes (any)	54	158
Other only (e.g. robbery or assault)	30	87
Both drug supply and other	12	36
Only drug supply	9	25
Had a prior but unclear what kind	3	10
Unclear whether had prior	29	84
No	18	53
Drug use by offender		
Yes	49	145
unclear	43	127
No	8	23
Trafficked in or across multiple jurisdictions		
Yes	15	43

Note. Some transcripts contained multiple offences, hence ecstasy and concurrent offence proportions do not total to 100%.

Table 18 shows the demographic differences between transcripts without any supply change references (n = 231) and those with at least one supply change reference (n = 64). Transcripts with at least one supply change reference were significantly more likely to contain poly drug trafficking (i.e. have concurrent meth/amphetamine, heroin and cocaine supply offences), more likely to report that the offender did not use drugs, and more likely to report trafficking in or across multiple jurisdictions.

Table 18

Demographic differences between transcripts with at least one supply change reference and transcripts without a supply change reference

Variable	% transcripts with a supply change reference (n=64)	% transcripts without a supply change reference (n=231)
Ecstasy supply offences		
Any	100	100
Traffic end-product	75	64
Import end-product	25	31
Manufacture end-product	11	10
Traffic precursor	0	3
Import Precursor	2	1
Manufacture precursor	0	<1
Concurrent offences		
Any	64	53
Drug supply offence for any non-ecstasy drug or precursor *	61	45
*Meth/amphetamine end-product (supply or manufacture) *￼	47	33
Other (e.g. cannabis or steroids)	33	22
*Cocaine **	31	15
*Heroin **	9	2
Non-drug supply offence (e.g. assault or robbery)	38	26
Prior convictions		
Yes (any)	59	52
Other only (e.g. robbery or assault)	31	29
Both drug supply and other	13	12
Only drug supply	9	8
Had a prior but unclear what kind	6	3
Unclear whether had prior	18	31
No	22	17
Drug use by offender		
Yes	59	46
Unclear **	27	48
No *	14	6
Trafficked in or across multiple jurisdictions		
Yes **	28	11

Note. Comparisons between the two groups were compared with Chi-square test of independence.

p < .05. **p* < .01.

Results

Fifty-three transcripts (18% of the whole sample) were coded as containing at least one endogenous or exogenous supply change reference. Of these, 39 (13%) referenced just one endogenous or exogenous supply change while 15 (5%) referenced multiple endogenous or exogenous supply changes. In total, 91 endogenous and exogenous supply changes were coded. See Table 19 for the distribution of supply changes across the transcripts.

Table 19

Distribution of supply change references (either endogenous or exogenous) across the sample of transcripts

Number of supply changes per transcript	Number of transcripts	Total
1	39	39
2	7	14
3	2	6
4	4	16
7	1	7
9	1	9
Total	53	91

Out of all 91 endogenous and exogenous supply changes coded, purity/quality changes were the most common (52%), followed by quantity changes (38%), and then form changes (10%). Most supply changes were caused by non-law enforcement means (59 out of 91). Finally, most purity/quality and quantity changes were of a decreased direction (86% and 82% respectively), (see Table 20 and Table 21).

Table 20

Total number of all supply changes coded (exogenous and endogenous) distinguishing between cause and kind

Supply change cause	Purity / quality	Quantity	Form	Total
Law enforcement	15 (47%)	17 (53%)	0 (0%)	32 (100%)
Non-law enforcement	34 (58%)	16 (27%)	9 (15%)	59 (100%)
Total	51 (52%)	31 (38%)	9 (10%)	91 (100%)

Table 21

Total number of all supply changes coded (exogenous and endogenous) distinguishing between kind and direction

Supply change kind	Decrease	Increase	Undirected	Total
Purity / quality	42 (86%)	7 (14%)	0	49 (100%)
Quantity	27 (82%)	6 (18%)	0	33 (100%)
Form	0	0	9 (100%)	9 (100%)
Total	69 (76%)	13 (14%)	9 (10%)	91 (100%)

Out of the total of 91 supply changes coded, 62 were exogenous supply changes specifically, while 29 were endogenous. Table 22 and Table 23 compare the distribution of exogenous and endogenous supply changes, distinguishing between cause and kind, and kind and direction respectively. There was a relatively equal number of law enforcement (32) and non-law-enforcement-caused (30) supply changes in the exogenous group (by definition there were no law-enforcement-caused supply changes in the endogenous group). Also for exogenous supply changes, there was an equal amount of purity/quality (48%) and quantity (48%) changes, but few form changes (4%). This is in contrast to endogenous supply changes which had far more purity/quality (66%) than quantity (10%) changes, and more form changes (24%). A supply decrease was the most common direction for both exogenous (87%) and endogenous (52%) supply changes.

Table 22

Total number of exogenous supply changes compared with endogenous:
Distinguishing between cause and kind

| | Exogenous supply changes | | | | Endogenous supply changes | | | |
| | Kind | | | | Kind | | | |
Cause	Purity / quality	Quantity	Form	Total	Purity / quality	Quantity	Form	Total
Law enforcement	15 (47%)	17 (53%)	0 (0%)	32 (100%)	NA	NA	NA	NA
Non-law enforcement	15 (50%)	13 (43%)	2 (7%)	30 (100%)	19 (65.5%)	3 (10.3%)	7 (24.1%)	29 (100%)
Total	30 (48%)	30 (48%)	2 (3%)	62 (100%)	19 (65.5%)	3 (10.3%)	7 (24.1%)	29 (100%)

Table 23

Total number of exogenous supply changes compared with endogenous:
Distinguishing between kind and direction

| | Exogenous supply changes | | | | Endogenous supply changes | | | |
| | Direction | | | | Direction | | | |
Supply change kind	De-crease	In-crease	Un-directed	Total	De-crease	In-crease	Un-directed	Total
Purity / quality	27 (90%)	3 (10%)	0	30 (100%)	15 (79%)	4 (21%)	0	19 (100%)
Quantity	27 (90%)	3 (10%)	0	30 (100%)	0	3 (100%)	0	3 (100%)
Form	0	0	2 (100%)	2 (100%)	0	0	7 (100%)	7 (100%)
Total	54 (87%)	6 (10%)	2 (3%)	62 (100%)	15 (52%)	7 (24%)	7 (24%)	29 (100%)

Given that the present analysis is concerned only with how traffickers adapt to exogenous supply changes, the remaining analyses are concerned with exogenous supply changes only.

Adaptations

Consistent with past research showing traffickers to be highly adaptable to market changes (Bouchard, 2007; Matrix Knowledge Group, 2007; Vijlbrief, 2012), almost all exogenous supply changes in this sample (94%) resulted in the trafficker making at least one adaptation (see Table 24).

Table 24

Proportion of exogenous supply changes which were followed by at least one adaptation

Adaptation	% (n)
None (i.e. attempted pass drugs from supplier to customer without adjustment)	3 (2)
Engaged in at least 1 adaptation	94 (58)
Unclear	3 (2)
Total	100 (62)

Table 25 shows the distribution of all adaptations made by traffickers following exogenous supply changes. A wide range of adaptations were identified. The most common adaptations (comprising 71% of all adaptations made across the sample) were associated with attempts to maintain a sufficient quantity or purity/quality of the same drug type. These included (but were not limited to): attempting to locate missing drugs/precursors (that had been seized by police) (13%), looking for an alternative supplier of the same drug (13%), attempting to import more of the same drug (8%), attempting to improve the purity/quality (6%), regarding the drugs/precursors as waste and disposing of them (5%), and attempting to return drugs/precursors to supplier (3%).

In contrast, adaptations associated with attempts to sell a different drug type were less common (comprising 17% of adaptations in total). These included: importing or ordering more of both the same and a different drug type from the supplier (9%), importing more of a different drug type (7%), and finding/switching to an alternative supplier of a different drug (1%). Adaptations associated with price changes were even less common (comprising 10% of

all adaptations made across the sample). These included: purchasing drugs at an inflated price (2%), increasing the price to customer (2%), and decreasing the price to customer (1%). Finally, the least common adaptation, made by only one trafficker in the sample (an ecstasy manufacturer), was to become inactive (1%). However, this trafficker became reactive after two months (1%) meaning that no trafficker in this sample became permanently inactive after a supply change.

Table 25

Distribution of adaptations to exogenous supply changes

Adaptation	% (n)
Attempt to locate missing drugs/precursors	13 (13)
Find/switch to an alternative supplier of the same drug or precursor of same drug	13 (13)
Attempt to import more of both same and different drug type	9 (9)
Attempt to import or order more of the same drug type from the supplier	8 (8)
Attempt to import a different drug type	7 (7)
Attempt to import more drugs but unclear whether same or different drug type	6 (6)
Attempt to improve the purity/quality	6 (6)
Attempt to sell lower purity/quality drugs	5 (5)
Regard the drugs/precursors as waste and dispose of them	5 (5)
Buy more drugs than usual from the supplier	4 (4)
Attempt to return drugs/precursors to supplier	3 (3)
Attempt to source manufacturing equipment / chemicals and/or manufacture the drug	3 (3)
Attempt to sell new form	2 (2)
Buy less drugs than desired	2 (2)
Increase price to customer	2 (2)
Purchase drugs at an inflated price	2 (2)
Response/adaptation unclear	2 (2)
Attempt to sell higher purity/quality drugs	1 (1)
Become inactive	1 (1)
Become re-active	1 (1)
Decrease price to customer	1 (1)
Find/switch to an alternative supplier of a different drug or precursor	1 (1)
Total	100 (97)

Table 26 shows the distribution of adaptations made by traffickers following exogenous supply changes, distinguishing supply change cause. Adaptations appeared to depend on the cause. The most common adaptation to law-enforcement-caused supply changes was to attempt to locate the missing drugs/precursors (22%). Below is an example excerpt from the transcripts illustrating this adaptation. All identifying information has been censored.

> It was accepted by [X] that if the container had been seized, he and [Y] had to cover the loss that had been incurred (which was thought to be around €[figure] million, or approximately AUD[figure] million). [Z] had also said at the meeting that they were all better off losing the drugs, rather than trying to go through with the plan, only to end up in gaol… Notwithstanding the views expressed at the [date] meeting, in the following days, attempts continued to be made to obtain possession of the shipment. Several further meetings between the conspirators took place in that period (transcript #52).

On the other hand, the most common adaptation to non-law-enforcement-caused supply changes was to find/switch to an alternative supplier of the same drug type (24%). For example:

> On 20 [date] [X] again contacted [Y] and commenced negotiations with him for the purchase of [number] MDMA tablets. [Y] advised [X] that his usual supplier was unavailable and that he would have to source the tablets from another associate. As a result of this negotiation, [Y] contacted [Z] (transcript #254).

> Between [date] and [date], the appellants made attempts to source the 2kg of methylamphetamine. On [date], [A] contacted [Z] to inform him that there were "some delivery problems". The pair met again on [date] and they discussed the possibility of obtaining the methylamphetamine from alternative sources (transcript #326).

There were other important differences. Law-enforcement-caused supply changes were much more likely to result in attempts to import more drugs, specifically: import both the same and a different drug type (14%), the same drug type (12%), a different drug type (12%) or unclear what drug type (10%). In comparison, just 3% of adaptations to non-law enforcement-caused supply changes were to attempt to import more of both the same and a different drug. This suggests that supply changes caused by law enforcement might be more likely to result in the increased importation of other drug types into the country than supply changes caused by non-law enforcement means. Moreover, adaptations associated with changing the price were

slightly more common after exposure to non-law-enforcement-caused supply changes (8% in total) than law-enforcement-caused supply changes (3% in total). For example:

> [X] then communicated with [Y] about the quality of the drugs which had been supplied, and the fact that the quantity did not meet his requirements. Ultimately this dispute was resolved when [Y] and [X] renegotiated the price to be paid for the drugs which were delivered (transcript #104).

The only supply change that was followed by the trafficker becoming inactive was to a law-enforcement-caused supply change. After becoming aware that law enforcement had seized his ecstasy laboratory, he fled overseas. There was no evidence in the transcript of any trafficking or manufacturing by the offender while overseas (other than receiving a payment for a past supply of ecstasy). It was therefore assumed that he was inactive during this time. Two months later, however, the offender returned to Australia and became reactive as an ecstasy manufacturer.

> The police located the drug laboratory in [month] and the applicant fled the country for Thailand on [date]… Whilst in Thailand, the applicant received approximately $[number] from [X] by way of payment for past supplies of MDMA… The applicant returned to Australia on [date] and entered into discussion with [X] with a view to the applicant's setting up a laboratory in [suburb] to manufacture MDMA for supply to [X]. To that end, the applicant and [X] acquired equipment and chemicals at a cost of over $[number] and produced [number]ml of isosafrole (transcript #243).

Table 26

Distribution of adaptations to exogenous supply changes distinguishing the supply change cause

Adaptation to law-enforcement-caused supply changes	% (n)	Adaptation to non-law-enforcement-caused supply changes	% (n)
Attempt to locate missing drugs/precursors	22 (13)	Find/switch to an alternative supplier of the same drug or precursor of same drug	24 (9)
Attempt to import more of both same and different drug type	14 (8)	Attempt to improve the purity/quality	16 (6)
Attempt to import or order more of the same drug type from the supplier	12 (7)	Buy more drugs than usual	11 (4)
Attempt to import a different drug type	12 (7)	Attempt to source manufacturing equipment / chemicals and/or manufacture the drug	8 (3)
Attempt to import more drugs but unclear whether same or different drug type	10 (6)	Attempt to return drugs/precursors to supplier	5 (2)
Regard the drugs/precursors as waste and dispose of them	9 (5)	Attempt to sell new form	5 (2)
Find/switch to an alternative supplier of the same drug or precursor of same drug	7 (4)	Attempt to sell lower purity/quality drugs	5 (2)
Attempt to sell lower purity/quality drugs	4 (3)	Increase price to customer	5 (2)
Purchase more drugs at an inflated price	3 (2)	Attempt to sell higher purity/quality drugs	5 (2)
Attempt to return drugs/precursors to supplier	2 (1)	Decrease price to customer	3 (1)
Become inactive	2 (1)	Find/switch to an alternative supplier of a different drug or precursors of a different drug	3 (1)
Response/adaptation unclear	2 (1)	Response/adaptation unclear	3 (1)
Become re-active	2 (1)	Buy less drugs than desired	3 (1)
		Attempt to import more of both same and different drug type	3 (1)

Table 27 shows the distribution of adaptations made by traffickers following exogenous supply changes, distinguishing supply change kind. Adaptations appeared to differ according to the kind. To supply changes concerned with a change in purity/quality, traffickers in this sample were most likely to attempt to locate the missing drugs[5] (28%) or attempt to improve the purity/quality (13%). In contrast, traffickers adapted to a quantity supply change most commonly by finding/switching to an alternative supplier of the same drug or precursor (39%). When the supply change concerned a change in the form of the drug (such as a shift from capsules to crystals) the most common adaptation identified was attempting to sell the new drug form (67%). For example:

> The offender agreed to supply MDMA to the man and informed him that MDMA capsules are usually pre-ordered... The offender informed [X] that he was now pushing crystals and possessed half a kilogram of it... On [Date], [Y] ordered a quarter of a gram of MDMA and a bottle of steroids from the offender (transcript #3).

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[5] Some law-enforcement-caused supply changes involved customs officers seizing imported drugs in transit, replacing the package with an inert substance (thereby reducing the purity/quality of the offender's drugs), and then conducting a controlled delivery to the offender. In some instances, the offender realised upon opening the package that the drugs had been replaced with fake drugs, and then made attempts to locate the original substance.

Table 27

Distribution of adaptations to exogenous supply changes distinguishing the supply change type

Adaptation to purity/quality changes	% (n)	Adaptation to quantity changes	% (n)	Adaptation to form changes	% (n)
Attempt to locate missing drugs/precursors	28 (13)	Find/switch to an alternative supplier of the same drug or precursor of same drug	39 (9)	Attempt to sell new form	67 (2)
Attempt to improve the purity/quality	13 (6)	Buy more drugs than usual	9 (2)	Attempt to import more of both same and different drug type	33 (1)
Regard the drugs/precursors as waste and dispose of them	11 (5)	Increase price to customer	9 (2)		
Find/switch to an alternative supplier of the same drug or precursor of same drug	9 (4)	Attempt to import a different drug type	4 (1)		
Attempt to return drugs/precursors to supplier	6 (3)	Find/switch to an alternative supplier of a different drug or precursors of a different drug	4 (1)		
Attempt to source manufacturing equipment / chemicals and/or manufacture the drug	6 (3)	Purchase more drugs at an inflated price	4 (1)		
Attempt to sell lower purity/quality drugs	6 (3)	Response/adaptation unclear	4 (1)		
Attempt to import or order more of the same drug type from the supplier	4 (2)	Become inactive	4 (1)		
Attempt to import a different drug type	4 (2)	Attempt to import or order more of the same drug type from the supplier	4 (1)		
Decrease price to customer	2 (1)	Buy less drugs than desired	4 (1)		
Response/adaptation unclear	2 (1)	Buy more drugs than usual	4 (1)		
Buy more drugs than usual	2 (1)	Become re-active	4 (1)		
Attempt to sell higher purity/quality drugs	2 (1)				
Attempt to import more of both same and different drug type	2 (1)				
Purchase more drugs at an inflated price	2 (1)				

Supply changes could be associated with an increase or decrease in the quantity or purity/quality supplied. Table 28 shows the distribution of adaptations to exogenous supply changes distinguishing between these two variables. Traffickers in this sample were exposed to far more supply decreases than increases. This meant that far more adaptations to decreases were identified resulting in a very small sample size of adaptations to supply increases. Nevertheless, the analysis provides tentative evidence that adaptations might be dependent on the direction of the supply change. For instance, the equal most common adaptation to a decrease in quantity or purity/quality was to find/switch to an alternative supplier of the same drug or precursor (15%) and attempt to locate missing drugs/precursors (15%). Whereas the most common adaptation to an increase in quantity or purity/quality was to buy more drugs than usual (67%).

> On [date], [X] spoke to [Y] agreeing to supply him with a quantity of methylamphetamine. The drugs were transported from Sydney to Melbourne by truck. The quantity transported exceeded that ordered by [Y]… On the evening of [date], OS1 had a conversation with another participant in the criminal enterprise who informed him that [Y] may wish to purchase the remaining quantity of methylamphetamine, which amounted to [quantity] grams. A further conversation took place in which [Y] offered to purchase the drugs from OS1. This additional supply and purchase was approved by [X] and, during the evening of [date], [Y] took possession of the drugs (transcript #104).

Exposure to a supply increase also once resulted in an expansion to buying and selling a new drug type.

> Your meeting with [C] was fruitful. Your drug business expanded, now receiving its supply of MDMA or ecstasy from him. In turn you supplied drug runners who, presumably, peddled the poison [C] supplied to their customers at street level. A month or two after meeting [C] you began dealing in "ice" for him (transcript #323).

Table 28

Distribution of adaptations to exogenous supply changes distinguishing the supply change direction

Adaptation to purity/quality or quantity decrease	% (n)	Adaptation to purity/quality or quantity increase	% (n)
Find/switch to an alternative supplier of the same drug or precursor of same drug	15 (13)	Buy more drugs than usual	67 (4)
Attempt to locate missing drugs/precursors	15 (13)	Response/adaptation unclear	17 (1)
Attempt to import more of both same and different drug type	9 (8)	Attempt to sell higher purity/quality drugs	17 (1)
Attempt to import or order more of the same drug type from the supplier	8 (7)		
Attempt to import a different drug type	8 (7)		
Attempt to improve the purity/quality	7 (6)		
Attempt to import more drugs but unclear whether same or different drug type	7 (6)		
Regard the drugs/precursors as waste and dispose of them	6 (5)		
Attempt to sell lower purity/quality drugs	6 (5)		
Attempt to return drugs/precursors to supplier	3 (3)		
Attempt to source manufacturing equipment / chemicals and/or manufacture the drug	3 (3)		
Increase price to customer	2 (2)		
Purchase more drugs at an inflated price	2 (2)		
Decrease price to customer	1 (1)		
Find/switch to an alternative supplier of a different drug or precursors of a different drug	1 (1)		
Become re-active	1 (1)		
Response/adaptation unclear	1 (1)		
Become inactive	1 (1)		
Buy less drugs than desired	1 (1)		

Table 29 shows the distribution of adaptations to exogenous supply changes, distinguishing the drug type associated with the supply change. Adaptations appeared to differ according to the drug type associated with the supply change. The supply changes concerned with ecstasy were most commonly adapted to by attempting to locate the missing drugs/precursors (25%) and finding/switching to an alternative supplier of the same drug or precursor (23%). In contrast, 27% of adaptations to non-ecstasy supply changes involved attempting to import more drugs: either of the same or different type. This suggests traffickers of different drug types might have different strategies for adapting to supply changes.

Table 29

Distribution of adaptations to exogenous supply changes distinguishing the drug type associated with the supply change

Adaptation to an ecstasy supply change	% (n)	Adaptation to a non-ecstasy supply change	% (n)
Attempt to locate missing drugs/precursors	25 (13)	Attempt to import more of both same and different drug type	16 (7)
Find/switch to an alternative supplier of the same drug or precursor of same drug	23 (12)	Attempt to improve the purity/quality	14 (6)
Regard the drugs/precursors as waste and dispose of them	10 (5)	Attempt to import or order more of the same drug type from the supplier	14 (6)
Attempt to sell lower purity/quality drugs	6 (3)	Attempt to import more drugs but unclear whether same or different drug type	14 (6)
Attempt to return drugs/precursors to supplier	4 (2)	Attempt to import a different drug type	9 (4)
Buy more drugs than usual	4 (2)	Attempt to source manufacturing equipment / chemicals and/or manufacture the drug	7 (3)
Increase price to customer	4 (2)	Attempt to sell higher purity/quality drugs	7 (3)
Attempt to import a different drug type	4 (2)	Buy more drugs than usual	5 (2)
Attempt to import more of both same and different drug type	4 (2)	Decrease price to customer	2 (1)
Purchase more drugs at an inflated price	4 (2)	Find/switch to an alternative supplier of the same drug or precursor of same drug	2 (1)
Buy less drugs than desired	2 (1)	Find/switch to an alternative supplier of a different drug or precursors of a different drug	2 (1)
Response/adaptation unclear	2 (1)	Attempt to return drugs/precursors to supplier	2 (1)
Become inactive	2 (1)	Response/adaptation unclear	2 (1)
Attempt to sell new form	2 (1)	Attempt to sell new form	2 (1)
Attempt to import or order more of the same drug type from the supplier	2 (1)		
Attempt to import a different drug type	2 (1)		
Become re-active	2 (1)		

Table 30 shows the distribution of adaptations to exogenous supply changes distinguishing between traffickers who were exposed to one supply change in the transcript and traffickers who were exposed to multiple supply changes in the transcript. There appeared to be differences between these two groups. When exposed to a single supply change, the most common adaptations were attempt to locate missing drugs/precursors (29%), find/switch to an alternative supplier of the same drug or precursor of same drug (22%), and regard the drugs/precursors as waste and dispose of them (11%). In contrast, when exposed to multiple supply changes, the most common adaptations were to attempt to import more of both same and different drug type (15%), attempt to improve the purity/quality (13%), attempt to import or order more of the same drug type from the supplier (12%), and attempt to import more drugs but unclear whether same or different drug type (12%). This suggests that traffickers might change strategies after exposure to numerous supply changes. In particular, it suggests that traffickers might look to import drugs (and sometimes of a different type) if they are unable to successfully maintain a flow of drugs within Australia.

Table 30

*The distribution of adaptations to exogenous supply changes distinguishing
between traffickers who were exposed to one supply change in the transcript and
traffickers who were exposed to multiple supply changes in the transcript*

Adaptations made by traffickers exposed to one supply change only	% (n)	Adaptations made by traffickers exposed to multiple supply changes	% (n)
Attempt to locate missing drugs/precursors	29 (13)	Attempt to import more of both same and different drug type	15 (8)
Find/switch to an alternative supplier of the same drug or precursor of same drug	22 (10)	Attempt to import a different drug type	13 (7)
Regard the drugs/precursors as waste and dispose of them	11 (5)	Attempt to improve the purity/quality	12 (6)
Attempt to return drugs/precursors to supplier	4 (2)	Attempt to import or order more of the same drug type from the supplier	12 (6)
Buy more drugs than usual	4 (2)	Attempt to import more drugs but unclear whether same or different drug type	12 (6)
Attempt to sell lower purity/quality drugs	4 (2)	Find/switch to an alternative supplier of the same drug or precursor of same drug	6 (3)
Buy less drugs than desired	4 (2)	Attempt to source manufacturing equipment / chemicals and/or manufacture the drug	6 (3)
Increase price to customer	4 (2)	Response/adaptation unclear	4 (2)
Purchase more drugs at an inflated price	2 (1)	Buy more drugs than usual	4 (2)
Become inactive	2 (1)	Attempt to sell lower purity/quality drugs	4 (2)
Attempt to sell new form	2 (1)	Decrease price to customer	2 (1)
Attempt to import or order more of the same drug type from the supplier	2 (1)	Find/switch to an alternative supplier of a different drug or precursors of a different drug	2 (1)
Attempt to import or order more of the same drug type from the supplier	2 (1)	Attempt to return drugs/precursors to supplier	2 (1)
Become re-active	2 (1)	Attempt to sell new form	2 (1)
Attempt to import more of both same and different drug type	2 (1)	Attempt to sell higher purity/quality drugs	2 (1)
		Attempt to sell lower purity/quality drugs	2 (1)
		Purchase more drugs at an inflated price	2 (1)
Total	100 (45)		100 (53)

Table 31 shows the six cases identified in this sample where a trafficker was exposed to just one supply change and made both short and long-term adaptations. The aim of this analysis was to see whether they adapted differently in the long-term compared to the short-term. The reason why traffickers who were exposed to multiple supply changes were not included in this analysis is due to the problems outlined in Figure 51 and Figure 52 in the method section: it cannot be known whether long-term adaptations to earlier supply changes are not really just short-term adaptations to later supply changes. Hence the only way to answer the question of whether traffickers adapt differently in the long-term is to analyse only traffickers who were exposed to just one supply change and who had not been arrested within the first month of the supply change ($n = 6$). Four out of 6 traffickers exposed to a single supply change continued to engage in the same adaptation after one month whereas two traffickers who were exposed to a single supply change used a different adaptation after one month. Given the very low sample size, this finding is indicative only, but suggests that the adaptation used by traffickers in the short-term might predict the adaptation they use in the long-term.

Table 31

The sequence of adaptations made over time for traffickers who were exposed to just one supply change and made adaptations both within and after one month

Adaptations within one month		Adaptations after one month			Same or different?
Adaptation 1	Adaptation 2	Adaptation 1	Adaptation 2	Adaptation 3	
Become inactive		Become re-active			Different
Attempt to return drugs/precursors to supplier	Find/switch to an alternative supplier of the same drug or precursor of same drug	Find/switch to an alternative supplier of the same drug or precursor of same drug			Same
Attempt to locate missing drugs/precursors		Attempt to locate missing drugs/precursors			Same
Attempt to locate missing drugs/precursors		Attempt to locate missing drugs/precursors	Attempt to import more of both same and different drug type	Purchase more drugs at an inflated price	Different
Find/switch to an alternative supplier of the same drug or precursor of same drug		Find/switch to an alternative supplier of the same drug or precursor of same drug			Same
Buy more drugs than usual		Buy more drugs than usual			same

Table 32 shows the distribution of adaptations distinguishing between the trafficking style of the trafficker exposed to the supply change. Adaptations appeared to vary according to the trafficking style. Mono drug traffickers most commonly adapted by attempting to locate the missing drugs (35%) and by looking for alternative suppliers (23%). In contrast, poly drug traffickers most commonly adapted by attempting to import more of both the same and different drug type (14%) or by attempting to import more of a different drug type (11%). This suggests that poly drug traffickers have different strategies to mono drug traffickers in dealing with supply changes. In particular, poly drug traffickers may attempt to sell a different drug type after exposure to a supply change and seem more likely to engage in border trafficking after supply changes. In contrast, mono drug traffickers seem more likely to make attempts to maintain a sufficient quantity or purity/quality of the same drug type within Australia.

Table 32

The distribution of adaptations to exogenous supply changes distinguishing between trafficking style

Adaptations made by mono-drug traffickers	% (n)	Adaptations made by poly-drug traffickers	% (n)
Attempt to locate missing drugs/precursors	35 (11)	Attempt to import more of both same and different drug type	14 (9)
Find/switch to an alternative supplier of the same drug or precursor of same drug	23 (7)	Attempt to import a different drug type	11 (7)
Regard the drugs/precursors as waste and dispose of them	16 (5)	Attempt to improve the purity/quality	9 (6)
Attempt to return drugs/precursors to supplier	6 (2)	Find/switch to an alternative supplier of the same drug or precursor of same drug	9 (6)
Increase price to customer	6 (2)	Attempt to import or order more of the same drug type from the supplier	9 (6)
Become inactive	3 (1)	Attempt to import more drugs but unclear whether same or different drug type	9 (6)
Attempt to import or order more of the same drug type from the supplier	3 (1)	Attempt to sell lower purity/quality drugs	8 (5)
Buy less drugs than desired	3 (1)	Attempt to source manufacturing equipment / chemicals and/or manufacture the drug	5 (3)
Become re-active	3 (1)	Buy more drugs than usual	5 (3)
		Attempt to locate missing drugs/precursors	3 (2)
		Response/adaptation unclear	3 (2)
		Attempt to sell new form	3 (2)
		Purchase more drugs at an inflated price	3 (2)
		Decrease price to customer	2 (1)
		Find/switch to an alternative supplier of a different drug or precursors of a different drug	2 (1)
		Attempt to return drugs/precursors to supplier	2 (1)
		Buy more drugs than usual	2 (1)
		Attempt to sell higher purity/quality drugs	2 (1)
Total	100 (31)		100 (64)

The consequences

This section examines the consequences of the exogenous supply changes. That is, the extent to which the supply changes impacted on traffickers' selling ability. While sample sizes turned out to be small for some of the relationships being examined (meaning a Chi-square could not be performed in those instances), the findings discern potential patterns which could be the subject of further research. Overall, the majority (69%) of traffickers sold drugs at least once after exposure to an exogenous supply change.

A Chi-square test of independence found no relationship between the cause of the supply change and whether drugs were sold, χ^2(1, N = 62) = 0.01, p = .92 (see Table 33). This suggests that law-enforcement-caused supply changes are no more effective at reducing selling behaviour than supply changes caused by other means.

Table 33

The relationship between the supply change cause and whether drugs were sold

Cause of supply change	Evidence of drugs sold?		Total
	Yes	No	
Law enforcement	22 (69%)	10 (31%)	32
Non-law enforcement	52 (70%)	8 (30%)	30

When examining whether / to what extent the supply change kind was related to traffickers' ability to continue selling drugs, form changes were excluded from the Chi-square analysis. This was due to very small sample size of exogenous form supply changes that was below the minimum required for a Chi-square analysis. The Chi-square test of independence found no relationship between the kind of the supply change (comparing only quantity and purity/quality) and whether drugs were sold, χ^2(1, N = 60) = 0.69, p = .405 (see Table 34). This indicates that traffickers are no less likely to continue selling drugs after exposure to quantity changes than they are after exposure to purity/quality changes.

Table 34

The relationship between the supply change kind and whether drugs were sold

Kind of supply change	Evidence of drugs sold?		Total
	Yes	No	
Purity/quality	19 (63%)	11 (37%)	30
Quantity	22 (73%)	8 (27%)	30
Form	2 (100%)	0 (0%)	2

Due to a very small sample size for supply increases that was below the minimum required, a Chi-square analysis could not analyse whether / to what extent the direction of the supply change was related to traffickers' ability to continue selling drugs. The analysis was therefore descriptive only and suggests that the direction of the supply change might have no effect on traffickers' ability to continue selling drugs: 69% of exogenous supply decreases were followed by traffickers selling drugs and 67% of exogenous supply increases were followed by traffickers selling drugs (see Table 35).

Table 35

The relationship between the supply change direction and whether drugs were sold

Direction of supply change	Evidence of drugs sold?		Total
	Yes	No	
Decrease	37 (69%)	17 (31%)	54
Increase	4 (67%)	2 (33%)	6

A Chi-square test of independence found a significant relationship between the drug associated with the supply change and whether drugs were sold, χ^2(1, N = 62) = 8.20, p = .004 (see Table 36). The effect size was moderate (Cramer's V = .36). This suggests that traffickers are less likely to sell drugs when the drug associated with the supply change was ecstasy compared to when it was non-ecstasy.

Table 36

The relationship between the drug type associated with the supply change and whether drugs were sold

Drug type associated with supply change	Evidence of drugs sold?		Total
	Yes	No	
Ecstasy	17 (53%)	15 (47%)	32
Non-ecstasy	26 (87%)	4 (13%)	30

Finally, a Chi-square test of independence showed that ecstasy poly drug traffickers were significantly more likely than ecstasy mono drug traffickers to continue selling drugs after exposure to a supply change, χ^2(1, N = 62) = 18.39, p < 0.0001 (see Table 37). The effect size was large (Cramer's V = .55). This suggests that poly drug traffickers are more likely to continue selling drugs after a supply change than mono drug traffickers.

Table 37

The relationship between the style of the trafficker exposed to the supply change and whether drugs were sold

Trafficking style	Evidence of drugs sold?		Total
	Yes	No	
Mono drug trafficker	6 (32%)	13 (68%)	19 (100%)
Poly drug trafficker	37 (86%)	6 (14%)	43 (100%)

Discussion

This study systematically analysed a sample of judges' sentencing comments to explore how high-level synthetic stimulant traffickers in Australia adapt to supply changes and the consequences thereof. The most common supply change kind that traffickers became aware of in this sample was purity/quality, followed by quantity and then form, albeit for exogenous supply changes (the focus of this chapter), purity/quality and quantity changes were equally common.

Almost all exogenous supply changes identified resulted in the trafficker making at least one adaptation (as opposed to no adaptation where the trafficker was said to have made no modification to his or her business strategy). A wide range of adaptations was identified. The most common adaptations overall were associated with attempts to maintain a sufficient quantity or purity/quality of the same drug type. In contrast, adaptations associated with switching to a different drug type, changing the price or becoming inactive, were uncommon.

There appeared to be a relationship between the adaption made and all of the supply change variables tested. That is, trafficker adaptations appeared to depend on the kind, cause and direction of the supply change, the drug type associated with the supply change, whether the trafficker was exposed to more than one supply change and the length of time that had passed after the supply change.

Further, most traffickers (69%) continued to sell drugs after a supply change had occurred suggesting that traffickers are adept at adapting to supply changes. There was no evidence to

suggest that traffickers' ability to continue selling drugs after a supply change depended on the supply change kind, cause or direction. However, there was a significant relationship between whether drugs continued to be sold and two supply change variables: the drug type associated with the supply change and the trafficking style. Specifically, traffickers were significantly less likely to continue selling drugs after exposure to an ecstasy supply change than they were after exposure to a non-ecstasy supply change (e.g. a meth/amphetamine or cocaine supply change), and poly drug traffickers were significantly more likely to continue selling drugs after a supply change than mono drug traffickers.

The central finding about the strong adaptability and resilience of high-level drug traffickers to supply changes was unsurprising given that many studies have found traffickers to adapt after exposure to a supply change (Adler, 1985; Adler & Adler, 1983; Bouchard, 2007; Desroches, 2005; Hughes, Chalmers, Bright, & McFadden, 2016a; Matrix Knowledge Group, 2007; Ovenden, Loxely, & McDonald, 1995; Paoli, Greenfield, & Reuter, 2009; Pearson & Hobbs, 2001; Tzvetkova et al., 2014). However, this study adds to previous research by showing this finding still holds true in a much larger sample. For example, previous interviews with incarcerated traffickers have reported supply changes and adaptations ad-hoc, often based on sample sizes of just a few. This study showed that traffickers in a much larger sample continued to sell drugs after most supply changes. This suggests a higher level of adaptability and resilience of illicit drug traffickers than previously known.

Limitations

The main limitation with this research is that despite the sample of exogenous supply changes (n = 62) and adaptations to them being much larger than examined in any previous study, it is still relatively small overall. This limits the generalisability of findings. Nevertheless, the sample size was an expansion of previous research and a number of novel potential adaptation patterns were identified that should be the subject of future research. Another limitation lies with the use of judges' sentencing comments. These data comprise a narrative summary of case facts that are only what has come to the light of authorities. This means other adaptations made by traffickers may have not been captured in the data. Finally, the present research was an analysis of adaptations at the transcript level only and could miss adaptations made in the broader network of traffickers, such as changes in network functionality or structure. This limitation is addressed in the next chapter, which examines how a high-level synthetic stimulant trafficking network adapted to supply changes over a 15-year period.

Conclusion

In conclusion, this research highlights the complexities involved with studying drug trafficker adaptations to supply changes. In particular, there were no overwhelmingly dominant adaptations used by high-level synthetic stimulant traffickers to supply changes, but some adaptations appeared more likely after exposure to particular supply change categories than others.

The next chapter examines how one high level trafficking syndicate evolved and adapted to supply changes over a 15-year period between 1993 and 2007. The primary aim is to examine whether any new insights about how traffickers adapt to supply changes can be gained through a network lens.

Chapter 8: How a High-Level Synthetic Stimulant Trafficking Network Adapts to Supply changes

This chapter extends on the research presented in Chapter 7 by examining adaptations and the consequences thereof through a network lens. As outlined in the previous chapter, one limitation of examining adaptations via an individual trafficker lens is that several key adaptations may be missed, such as changes in the size of the drug trafficking network, changes in roles or in network structure. The research presented in this chapter addresses that limitation by conducting a social network analysis of a single high-level synthetic stimulant trafficking network that operated primarily in Melbourne between 1993 and 2007. The chapter first begins by outlining what social network analysis is and how it has been used previously, followed by its strengths and limitations with its application to study a drug trafficking network.

Social Network Analysis. What is it? How Has it Been Used? What are the Limitations?

A social network is a group of individuals who have direct or indirect relationships with one another. Social network analysis (SNA) is a tool to study the structure and characteristics of social network, including who the key individuals are, who knows who (i.e. ties), how the network participants interact with one another, and the network size. Researchers have previously used SNA to study criminal networks, including drug traffickers (Bright & Delaney, 2013; Bright, Hughes, & Chalmers, 2012; Hughes, Bright, & Chalmers, 2017; Morselli & Petit, 2007; Tenti & Morselli, 2014), terrorists (Helfstein & Wright, 2011) and car thieves (Morselli & Roy, 2008). SNA has also been applied to non-criminal networks such as health care professionals (Cheong, Armour, & Bosnic-Anticevich, 2013; Chiu & West, 2007) and teachers (Coburn, Russell, Kaufman, & Stein, 2012; Van Waes et al., 2016). Social network analysis is a versatile tool which can be applied quantitatively (Bright, Hughes, & Chalmers, 2012; Tenti & Morselli, 2014), qualitatively (Cheong, Armour, & Bosnic-Anticevich, 2013; Van Waes et al., 2016) or with a mixed methods design (Chiu & West, 2007; Edwards, 2010).

Research on criminal networks and specifically drug trafficking networks has been receiving increased attention in recent years (Bichler, Malm, & Cooper, 2017; Bright, Greenhill, Reynolds, Ritter, & Morselli, 2015; Bright, Greenhill, Ritter, & Morselli, 2015; Chandra & Joba, 2015; Diviak, 2018; Heber, 2009; Hughes, Bright, & Chalmers, 2017; Morselli, 2009b; Tenti &

Morselli, 2014). Most SNA research on drug trafficking networks has been of the network at a single time point in order to identify aspects such as the overall network structure, the roles of those involved or key individuals. For instance, Bright, Hughes, and Chalmers (2012), who applied social network analysis to a meth/amphetamine trafficking syndicate using judges sentencing comments from Australian court cases, identified a network of 36 members. The network was comprised of two loosely connected sub-groups and identified a range of roles in the network including the managers, workers, cooks, brokers and corrupt officials. Bright, Greenhill, Reynolds, Ritter, and Morselli (2015), who analysed files from the New South Wales Office of the Director of Public Prosecutions, identified a meth/amphetamine trafficking network in Australia comprised of 128 individuals. The researchers identified who the key individuals were and found the most connected participants in the network typically possessed the most resources.

SNA can also be applied to study changes in the network structure or functionality over time, but this has been done much less often. Morselli and Petit (2007) analysed court transcripts in Montreal to study how a drug trafficking network changed over a two-year period after exposure to a series of law enforcement seizures. The network was exposed to 11 law enforcement seizures over that time without anyone being arrested until after the final seizure. The network was observed to have decentralised over time following each seizure (i.e. the network became less dependent on any one individual). Moreover, the network changed in structure: new members with contacts to new suppliers were recruited in order to facilitate new importations following the previous failed attempts. Bright and Delaney (2013) performed SNA on an Australian meth/amphetamine trafficking network to examine structural and functional changes in the network over time. While the analysis wasn't specific to how the network adapted to supply changes, they found that over time the network decentralised, saw role changes, and displayed both increases and decreases in size.

The past applications of SNA outlined above show that SNA can not only be used to identify the key individuals, roles and structure of a drug trafficking network, but can also identify changes in these aspects overtime. This makes SNA suitable for the present study which aims to identify the structural and functional changes to a high-level synthetic stimulant trafficking network over time after exposure to various categories of supply changes.

Research Objectives

This study examines structural and functional changes to a high-level synthetic stimulant trafficking network over time after exposure to various categories of supply changes. The following research questions are asked:

(1) Can any new insights about adaptations to supply changes be gained through a network lens that could not be detected at the level of the transcript? Specifically:

    a. are there any changes in network density, centrality, size, roles, trafficking style, trafficking location (i.e. trafficking domestically versus internationally), or collaborations with new traffickers or corrupt public officials? and

    b. what roles in the network are most likely to be responsible for adapting?

(2) To what extent is there a relationship between the adaptations undertaken and the various supply change characteristics, including the cause, kind, direction, drug type, time elapsed, and location (international vs domestic)?

(3) To what extent is there a relationship between the various supply change characteristics and whether the network continued to sell drugs after the supply change?

Method

A mixed methods SNA was applied to one high-level synthetic stimulant trafficking network which operated primarily in Melbourne, Australia between 1993 and 2007. The study began by selecting a network for analysis, then building on methods demonstrated by (Bright, Hughes, & Chalmers, 2012; Hughes, Bright, & Chalmers, 2017), network participants were identified from judges' sentencing comments, a biography of the network's main manager (referred to herein as the 'biography'), and mainstream media. All known supply changes that the network was exposed to were identified and SNA was applied over five time periods. Finally, how the network adapted to those supply changes within and between time periods were compared and contrasted. This project was approved by the University of New South Wales Human Research Ethics Advisory Panel: HC16978

    The network selected for analysis and how it was chosen

The aim was to select one high-level syndicate, identified from the judges' sentencing comments analysed in Chapter 7, for a SNA. In order to be considered, the network must have trafficked in both ecstasy and meth/amphetamine, had at least 5 members identified in total

by the judges and had at least two supply change references coded. This narrowed down the selection to just three possibilities. Further reading was conducted on each of the three networks to scope the breadth of information available (e.g. retrieving and reading more transcripts associated with members in the network and conducting book and media searches). The network chosen for analysis was selected because it had the most information available.

The three data sources

As stated above, the three data sources used were judges' sentencing comments, the biography, and mainstream media. Data source triangulation (i.e. the use of multiple data sources) was used to enhance the understanding of the network and to increase the credibility and internal validity of the research (Barbour, 2001). An outline of each data source is below.

> *Judges' sentencing comments* were outlined in detail in Chapter 7, so an outline is not
> repeated here. This data source has been used within the context of SNA (Bright,
> Hughes, & Chalmers, 2012; Hughes, Bright, & Chalmers, 2017). Fifty-one transcripts
> associated with the selected network's participants were obtained from AustLII (by
> searching for the names of those involved). Transcripts were anywhere between a few
> pages and 38 pages in length. They mostly comprised data from the years 2000 to 2007
> because facts in these years were most relevant to the charges. Only limited information
> was presented about events prior to 2000. Hence the two additional data sources were
> used to triangulate, broaden and strengthen the data collection process.

> *The biography* was 322 pages and covered topics such as how the network's main
> manager began the network, how and why it grew, and how the network eventually
> collapsed. It also included numerous details about supply changes faced by the network
> (both law enforcement intervention and other) over a 15 year period in which the
> network operated. One advantage of this data source was that it contained exclusive
> data collected by the author through his own research, including personal interviews
> with network members and law enforcement.

> *Mainstream media* was used to further uncover any network members and to collect
> any additional data not covered in either the transcripts or biography. Twenty-nine
> media articles were downloaded either from Google searches or from the Factiva
> database. The advantage of this data source was that it contained police and witness

statements that were not presented in court, or were not part of hearings available on AustLII.

Data coding

Coding consisted of firstly identifying all nodes (i.e. network participants), followed by their relationship ties (i.e. who interacted with who) and attributes (e.g. drugs trafficked or role in the network). A tie (i.e. a relationship) between two nodes was said to be present if any type of one or two-way exchange took place between them, such as a conversation (either in person or on the phone), an exchange of money or goods, or when one node directly gave orders to the other (either in person or on the phone). To code ties, a 105x105 matrix was constructed in Excel with the names of all 105 identified individuals laid out both vertically in the far left column and horizontally in the top row. A '1' was used to indicate the presence of a tie between two individuals, while a blank cell indicated the absence of a relationship. Only undirected ties were coded (i.e. a tie was said to exist regardless of whether information or goods flowed only one way between nodes, or both ways). This is because it was not always clear which direction goods or information flowed. The following attributes were coded in a separate Excel sheet for each node: the year(s) of operation, drug type(s) sold, location of trafficking, and primary role. A node's attributes were coded separately for each of the five time periods (which are outlined below), allowing for any change over time. For example, a node may have trafficked domestically in one time period and then changed to an end-product cook in a later period after exposure to supply changes. See Table 38 for a description of all roles coded.

Table 38

Roles

Role	Definition
Manager / assistant manager	Individuals who gave orders, oversaw the sale and/or manufacture of illicit drugs, financed operations, or arranged meetings.
Corrupt official	A law enforcement or legal figure (e.g. a lawyer) who was working for the network to traffic illicit drugs or to provide information about operational matters and/or ways to avoid detection
International smuggler	Arranged and/or executed importations or exportations of drugs or precursors.
End-product cook	Involved in the manufacturing of end-product drugs.
Precursor cook	Involved in the manufacturing of precursor chemicals.
Domestic trafficker	Sold or delivered drugs to other traffickers or dealers.
Resource provider	Provided chemicals, equipment or facilities for drug or precursor manufacture, or provided specialist knowledge such as how to manufacture drugs.
Worker	Provided manual labour, such as transporting drugs on behalf of someone else, or storing someone else's drugs.
Legal precursor supplier	Law abiding individuals who worked for a legitimate company which manufactured pseudoephedrine and were involved in its legal supply.
Money launderer	Provided a legal business that was used to conceal the illicit origins of money obtained to make it appear legitimate.

Time periods

To examine changes in the network over time, five time-periods were defined post-hoc (i.e. after the data were collected and initially examined). An event-based rather than a time-based split was chosen to devise the periods of analysis. An event-based split means that periods were chosen based on the occurrence of one or more significant events that occurred. The devised periods were the following.

T1: early-1993 to late-1998—the establishment of meth/amphetamine trafficking

network.

T2: late-1998 to early-2000—the expansion to new drug types.

T3: early-2000 to mid-2002—a shift to a greater focus on importing drugs.

T4: mid-2002 to early-2006—a switch from international importation to domestic

manufacture and trafficking.

T5: early-2006 to Mid-2007—the establishment of a new major subnetwork.

Analysis

All identifying information was removed prior to analysis and hence all nodes were given a
unique identifier code (e.g. M2.19). The prefix referred to the time period in which the node
was first identified and the suffix was the unique identification number. For example, M2.19
was first identified in T2 and has the unique identification number of 19.

As previously stated, this study applied a mixed methods SNA. A quantitative approach uses
numbers to describe and characterise a complex network in a concise way whereas qualitative
SNA can examine areas that are difficult or impossible to quantify, such as why and how
structural or relationship changes have occurred and whether the observed changes were
attributable to supply changes (Crossley, 2010; Edwards, 2010). Both the quantitative and
qualitative analysis approaches used in the present study are described below.

The qualitative SNA

Using a modified version of steps based on those outlined by (Braun & Clarke, 2006), a
deductive, thematic analysis was conducted on the data. First, all data were read numerous
times to facilitate immersion. Next, a brief narrative outlining how each supply change
unfolded was written, along with dot points outlining how the network adapted. Finally, the
data sources and page numbers used to construct the narratives were noted so that each
could be traced back to the raw data from which they were derived. The final narrative, as
presented in the results, thus described how the network evolved and adapted overtime with
respect to the identified supply changes.

The quantitative SNA

Both the network-tie-matrix and attribute spreadsheets were uploaded into the SNA software
package "Visone", version 2.17 (Brandes & Wagner, 2004). This software was used to construct
network diagrams and obtain standardised centrality, centralisation and density scores in each

time period, which was based on the Freeman method (Freeman, 1979). Standardised scores, as opposed to raw scores, were used so comparisons between each time period could be made. See below for an outline of each measure and what each is used to proxy. The following measures were used to proxy the network structure as a whole.

Network density is a general measure of how connected nodes in the network are. A high density score implies that a higher number of nodes are directly tied with one another. Alternatively, a low density score implies that only a few nodes are directly connected and that most are loosely connected via indirect ties. Network density is calculated using the following formula:

(Number of actual ties) / (Number of possible ties).

Hence network density is the proportion of potential ties that are actual ties. Density, however, is sensitive to the total number of nodes, which often decreases when more nodes are added to the network (Morselli, 2009b).

Degree centralisation measures the extent to which the network is dependent on a single central node (Morselli & Petit, 2007). It is a proxy for how centralised the network is. The lower the score, the more decentralised the network is and the less dependent it is on any single node to operate efficiently.

The following measures were used to proxy the centrality of individual nodes.

Degree centrality is the number of ties any given node has with other nodes in the network. It is a proxy for how active a node is within a network. A node with high degree centrality is highly active and able to directly communicate or do business with a high number of other actors in the network without needing to go through a third party.

Betweenness centrality is a measure of the extent to which a node indirectly connects other pairs of nodes together in a network fashion. A high betweenness score indicates that the node is very central in the network and connects a high number of other network participants together.

Closeness centrality is a measure of how connected a node is with other nodes via direct and indirect paths (i.e. through other nodes). It is a proxy for the quality of relationships or the ease with which a node can communicate with other nodes.

Results

The studied syndicate primarily operated from Melbourne (in the state of Victoria)—the second largest city in Australia—between 1993 and 2007. Melbourne is one of the two main illicit drug trafficking hubs in Australia (with Sydney being the other major hub). The syndicate began small but evolved to be a moderately large network that manufactured and/or trafficked meth/amphetamine as well as cocaine, hashish, ecstasy and LSD. For the first seven years there were up to 14 identified active members at any given time. For the final 8 years there were up to 46 identified active members at any given time. During the analysis period, the syndicate operated on an exceptional scale. For instance, the network made large importations such as 2.9 tonnes of cannabis and 500,000 ecstasy tablets worth 25 million; and the police officer in charge of the task force assigned to disrupting the network said that the syndicate was "one of the most significant organised crime groups not only this state but this country has ever seen" (biography).

Identified supply changes

A total of 33 supply changes were identified across T1-T5 (see Table 38). A range of supply changes were coded within and across time periods, but the most common were domestic, quantity, law enforcement and decreases. T2 was the only period where all supply changes were the same kind, direction, source and cause (i.e. there were three domestic law-enforcement-caused quantity decreases). All other periods had multiple supply change categories. For example, T1 had both law enforcement and non-law enforcement caused supply changes, both domestic and international supply changes, and both decreased and increased supply changes.

Table 39

Distribution of identified supply changes across T1-T5

	Total	By kind		By direction		By location		By cause		
		Quantity	Purity/ quality	Decrease	Increase	Domestic	International	Law enforcement	Non-law enforcement	Unclear
T1	4	4	0	2	2	3	1	1	3	0
T2	4	4	0	4	0	4	0	4	0	0
T3	9	8	1	6	3	5	4	5	5	0
T4	8	8	0	7	1	8	0	5	2	1
T5	8	5	3	8	0	8	0	5	3	0
Total	33	29	4	27	6	28	5	20	13	0

Qualitative analysis

The qualitative component of the analysis regarding network adaptations to supply changes is presented first. A narrative of adaptations to supply changes in each time period follows below.

T1: 1993 to late 1998

Figure 56 shows the network roles and location in T1 where four supply changes were identified. Table 40 shows a summary of identified adaptations in T1. In 1993, M1.10 was supplying methamphetamine precursors to M1.11, the head of an outlaw motor cycle gang who at the time was running the largest amphetamine ring in Australia. M1.10 had a falling out with M1.11 after a deal went bad and was left with a $500,000 debt. M1.1, who had recently become acquainted with M1.10, saw a new opportunity to obtain a supply of precursors. Hence the first supply change was an increase in precursor quantity to M1.1. M1.10 subsequently made deals with M1.1, supplying him precursors and teaching him how to cook. M1.1 adapted to the increased precursor supply by manufacturing and selling meth/amphetamine to the motorcycle gang.

Over time, M1.10 started offering increasing amounts of precursors to M1.1, starting from one-25kg barrel per deal to as many as ten. Hence supply change two was a further increase in precursor quantity and M1.1 adapted by buying more precursors than previously and then recruiting a new node to assist with manufacturing meth/amphetamine end-product: a talented meth/amphetamine cook and pill presser (M1.55) who was "one of the best pill makers in the country" (biography). M1.1 groomed M1.55 and the two became business partners.

In late 1996, the third supply change happened which was a further increase in precursor quantity. M1.1 organised the theft of 750kg of pseudoephedrine from a dock in New South Wales. M1.1 adapted to this by funding the establishment of two new meth/amphetamine labs and recruiting two new cooks to operate them. M1.1 had now assumed a managerial role (another adaptation) and would oversee the operations of the new labs. One lab was being operated by M1.24, who produced over 40 kg of methamphetamine worth 78 million in a matter of months.

In early 1997, M1.24 accidentally knocked over some chemicals and the lab exploded. When police arrived, they discovered the biggest meth/amphetamine laboratory in Victorian history. M1.24 survived initially, but died in 2001 of heart failure while serving time in prison. A few

months later the fourth supply change happened, which was the law enforcement seizure of the second lab that was established. The scale of that operation was unknown. The immediate adaptation was also unknown.

In April 1998, M1.1 and M1.10 pleaded guilty to conspiring to traffic meth/amphetamine and both were imprisoned, but M1.1 was released a few months later. The prison sentence appeared to inspire, rather than deter his illegal activities. Upon his release, several network adaptations appear to have taken place.

Figure 56. Roles and network location at T1.
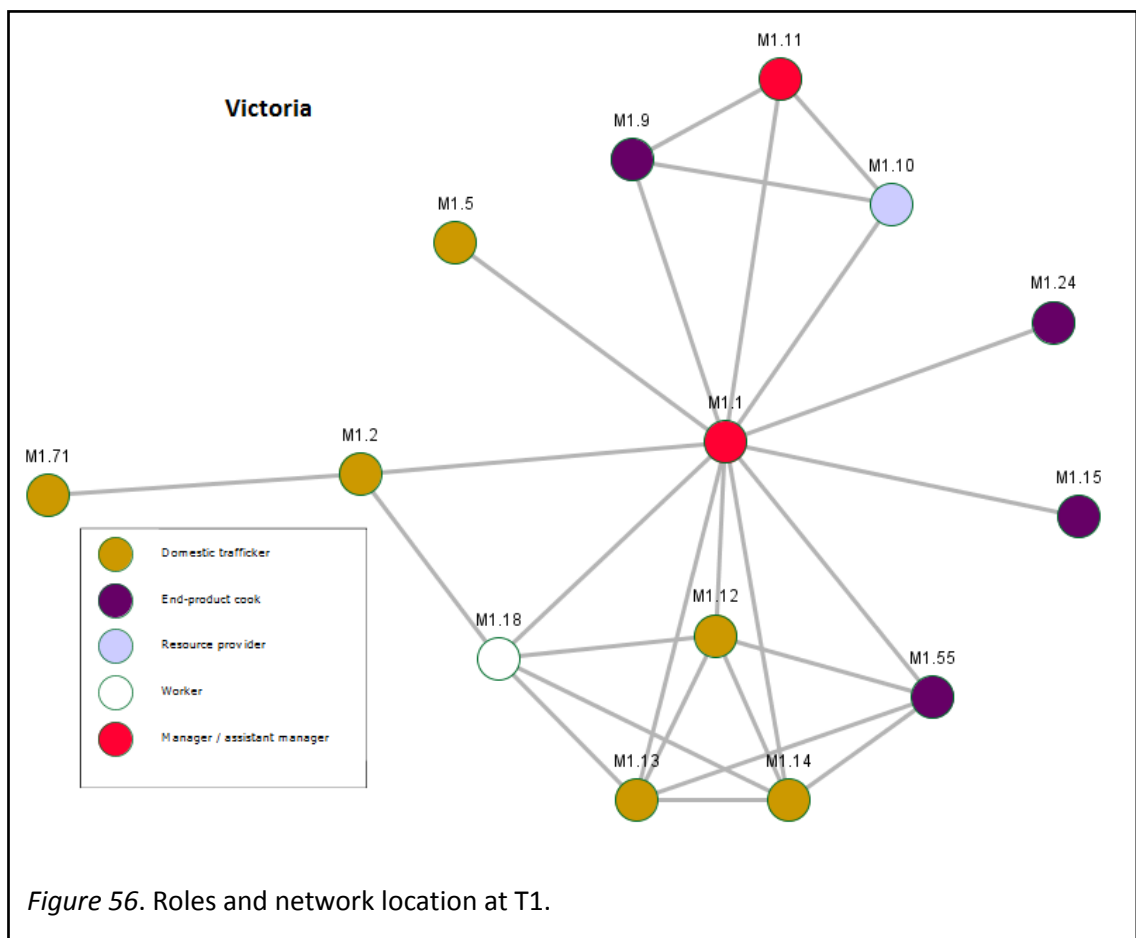
Table 40

Summary of adaptations identified within T1

Attempt to manufacture drugs
Buy more precursors than usual
Recruit new nodes to assist with trafficking or manufacturing
Order more drugs but a larger quantity
Establish a new drug laboratory
Change roles: switch from manufacturer to a manager

T2: Late 1998 to early 2000

Figure 57 shows the network roles and location in T2. Table 41 shows a summary of the adaptations identified in T2. Four long term adaptations to the supply changes in T1 were identified. First, the network expanded with respect to the range of drugs it trafficked. M1.1 began building capacity to traffic cocaine, hashish, ecstasy and LSD in addition to meth/amphetamine. Second, the network recruited new nodes to assist in the trafficking of new drugs. Third, existing members also began trafficking other drugs in addition to meth/amphetamine: M1.12, M1.13 and M1.14 were now also dealing in ecstasy while M1.18 was now also dealing in ecstasy and cocaine. Finally, there were now less end-product cooks available (just one as opposed to four in T1).

During T2, the only identified supply changes were four law-enforcement-caused quantity decreases that all occurred in 1999. First, 3,700 speed tablets along with an unknown quantity of cocaine were seized from M2.23's property (the first supply change). Second, M2.16, was arrested and 50,000 LSD tabs were seized (the second supply change). At the time, this was the largest ever seizure of LSD in the history of Victoria. It was not clear whether this seizure came after or before the speed and cocaine seizure. M1.1 adapted to the LSD seizure by organising an even larger order of 80,000 LSD tabs, but this was also seized by police (the third supply change). Finally, M2.19's house was raided and 30,000 ecstasy pills were seized (the fourth supply change). Both M1.18 and M2.19 were arrested but later released without charge. No other short-term adaptations to any of the four law enforcement seizures were identified in this time period, but the network appeared to make several long-term adaptations in T3.

After the four supply changes in T2, the network appeared to adapt by again making changes to its structure, but this time on a larger scale. As these appeared to be long term adaptations that occurred in T3, they are outlined in that section.

Figure 57. Roles and network location at T2.
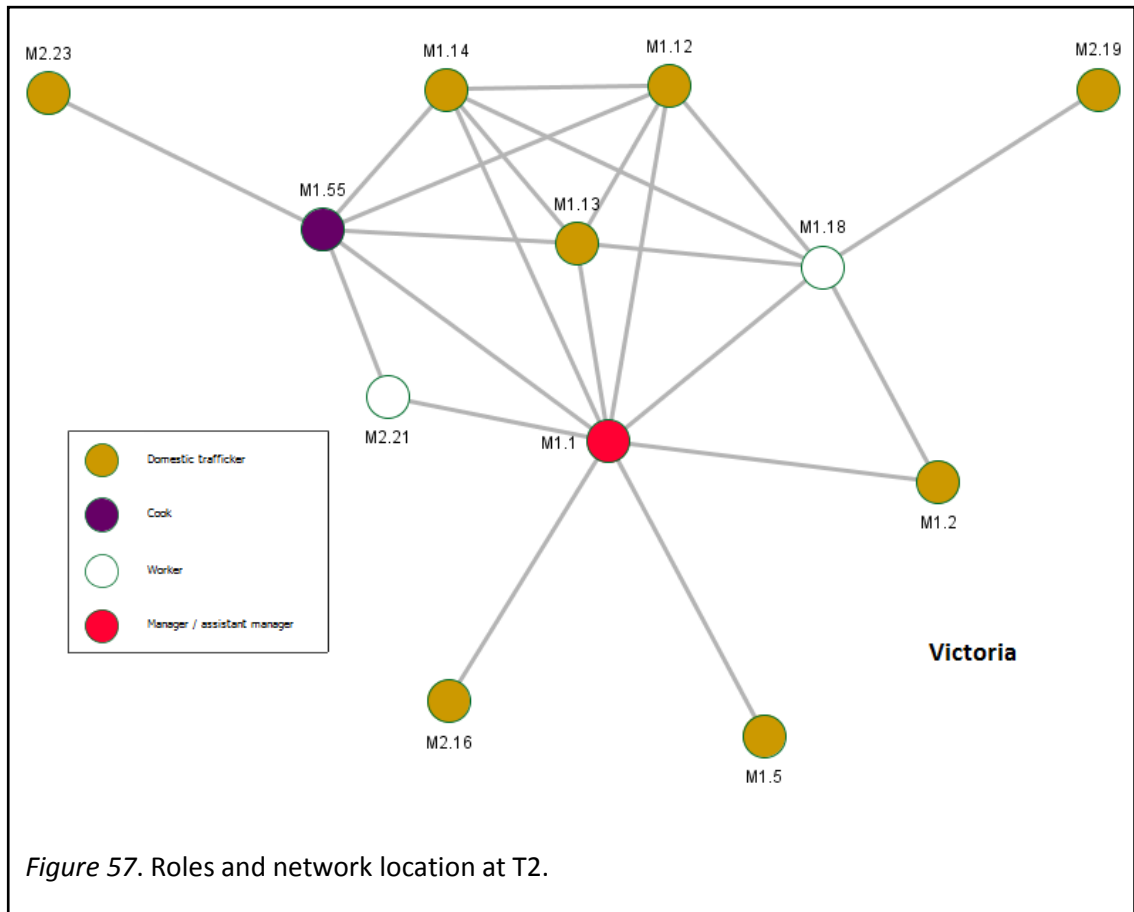
Table 41

Summary of adaptations identified in T2

Decrease in number of meth/amphetamine end-product cooks

Expand to new drug types

Order a larger quantity of drugs than were seized to make up for lost profit

Recruit more nodes to assist with trafficking or manufacturing

T3: Early 2000 to mid 2001

Figure 58 shows the network roles and location in T3. Table 42 shows a summary of the adaptations identified in T3. The network appeared to make long-term adaptations to the four law enforcement seizures in T2 by making major changes to the network structure. First, the network recruited many new collaborators with a range of new skills and resources, including international smugglers, a resource provider, workers and domestic traffickers. Many of these nodes were recruited by the main manager, M1.1. The addition of these nodes may have been an attempt to increase revenue to make up for the losses associated with the seizures last time period. But more significantly, the network also recruited six corrupt officials in T3 (detectives, a lawyer and a customs officer), who were recruited by M1.1 and some of the domestic traffickers. The addition of six corrupt officials may have been done to reduce the likelihood of further arrests or seizures following the significant law enforcement pressure in T1 and T2.

A total of nine supply changes were identified in T3. The first to occur was an increase in pseudoephedrine quantity. M3.43, M3.44, M3.45 and M3.46 were drug squad detectives working with the local police force. They were part of a unit which was assigned to buying pseudoephedrine from a legal supplier in the form of cold and flu tablets and making controlled deliveries to suspected drug traffickers in the hope of locating clandestine laboratories and identifying the people involved. In mid-2000, an ex-police associate of M3.43 had links to M1.13 and suggested that he sell pseudoephedrine to him with the aim of catching M1.1. As a result of this suggestion, controlled deliveries of cold and flu tablets (containing pseudoephedrine) began to M1.13, thereby increasing the availability of pseudoephedrine to the network (supply change one). Eventually, however, the unit became corrupt and began selling pseudoephedrine illegally to the network. It was not clear from the data whether the detectives instigated the illegal pseudoephedrine supplies or whether M1.13 corrupted the unit. However, the adaptation following the first supply change (an increase in pseudoephedrine quantity) appeared to be the integration of the corrupt detectives into the network.

Sometime within the next month, M1.13 requested that he receive pure pseudoephedrine rather than pseudoephedrine mixed in with cold and flu tablets. The corrupt detectives agreed to meet the request and arranged for the supply of 99.7% pure pseudoephedrine which was forwarded onto M1.13 via the usual chain of people. Hence the second supply change was a large increase in pseudoephedrine purity. The immediate adaptation was unclear.

Shortly afterwards, M1.13 was shot dead by M1.18. In the wake of the shooting, police made a number of raids and arrests. It is unclear why, but two of the corrupt detectives, M3.45 and M3.44, conducted one of these raids despite recently collaborating with the network. This may have been a security tactic to portray to other detectives that they were operating legitimately. The third supply change which occurred during these raids was a 2kg pseudoephedrine seizure that had originated from the legal suppliers.

Shortly after the increase in pseudoephedrine purity and law enforcement seizure, M1.1 adapted by decreasing the price of his ecstasy and methamphetamine supply. A plausible explanation for this is that the recent increase in pseudoephedrine purity may have resulted in the network making more profits, and so could afford to reduce the price of their drugs in the hope of enticing more customers and further expanding their business. Another explanation is that the network could have had product stockpiled and after the seizure they may have wanted to offload it fast, especially if they were under surveillance. It is also plausible that the adaptation was in response to both the recent seizure and purity increase.

The fourth supply change happened the following month. M1.55's house was raided by police and they seized 9kg of ecstasy, 2kg of cocaine and 2kg of cannabis. M1.55 subsequently became a registered informer for law enforcement. The result of this was that M1.55 took part in controlled deliveries of chemicals from the corrupt detectives to M1.1 and also purchased amphetamines, cocaine and ecstasy from M1.1 while secretly taping the transactions.

The fifth supply change was a reduction in ecstasy quantity from international suppliers. M1.1 adapted to this by organising fake ecstasy tablets to be made from locally sourced amphetamines, ketamine or other similar drugs that could mimic an ecstasy effect. It is unclear from the data whether the fake tablets were sold.

The sixth supply change was a quantity increase of cocaine. In late 2000, M3.42 informed M1.1 that M3.39 had a contact in Mexico who could export unlimited supplies of cocaine. M1.1 adapted to this by recruiting workers to organise the importation, sale and distribution of cocaine. He also corrupted a customs official to facilitate the importations. The following nodes were recruited for this operation: M3.42, M3.38, M3.39, M1.55 and M3.37. A small test sample was imported first, then a 3kg importation was organised.

A couple of months later, the seventh supply change was a law enforcement seizure of the 3kg imported cocaine. Due to the informing work of M1.55, police were aware of the 3kg importation, which was intercepted and seized. M3.42, M3.38, M3.39 and M3.37 (peripheral

network participants) were all arrested. M1.1 (a core network participant), however, was not. M1.1 adapted to this over the next half year by switching to alternative suppliers and organising the importation of 500,000 ecstasy tablets worth 25 million dollars, more than a tonne of pseudoephedrine worth 2 billion dollars, and together with M1.1, M1.12, M1.13, and M1.14, organised the importation of 2.9 tonnes of cannabis resin. It is unclear who else was involved in the ecstasy and pseudoephedrine importations, but five new nodes were added to the network to assist in the cannabis importation: M3.59, M3.60, M3.61, M3.62 and M3.63.

In mid 2001, both M3.45 and M3.44, two key brokers in the corrupt detective sub-network, were arrested on corruption charges and the chemical diversion unit within the police was shut down. Hence the eighth supply change was a quantity decrease of pseudoephedrine as the network no longer had access to the corrupt detectives' source.

Just days later, the ninth supply change occurred: a 2.9 tonne cannabis resin importation was seized. All five of the new recruits were arrested. The managers (M1.1, M1.12 and M1.14) were not arrested at that time. It's unclear whether there were any adaptations after supply changes eight and nine in the short term. Twelve nodes were arrested within the same month, including the managers, but many would be released a short time later. Approximately one year later, it appeared that the network engaged in some long-term adaptations which are discussed in the next section.

Figure 58. Roles and network location at T3.
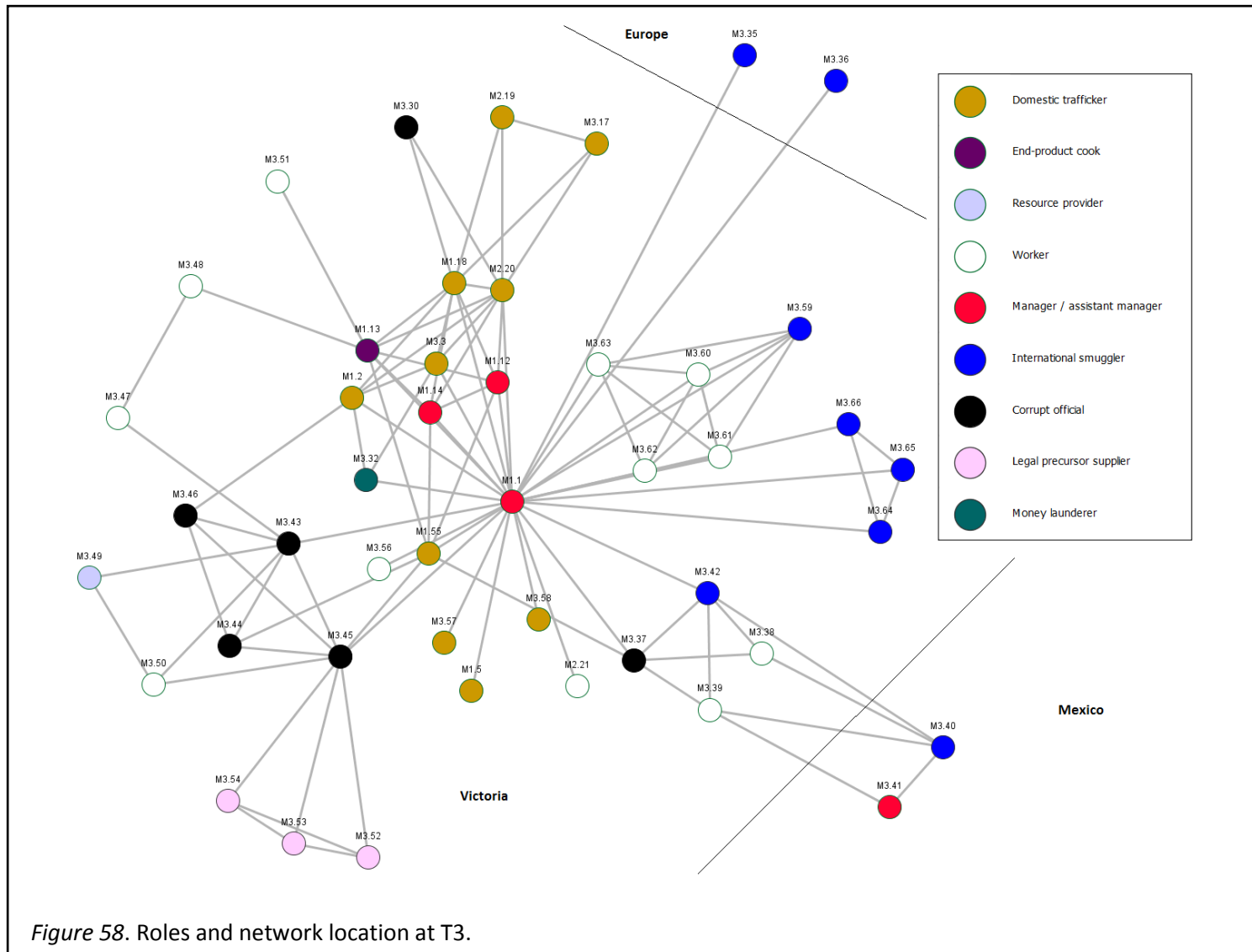
Table 42

Summary of adaptations identified in T3

Shift to a focus international trafficking
Changes in network structure (the network became much larger and acquired many new roles such as international smugglers, more managers, workers and corrupt public officials)
Decrease the price of drugs to customers
Make fake ecstasy from locally sourced meth/amphetamine or ketamine
Recruit new nodes to assist with trafficking
Import more drugs or precursors of different drug types
Switch to alternative supplier

T4: Mid 2002 to early 2006

Figure 59 shows the network roles and location in T4. Table 43 shows a summary of the adaptations identified in T4. During T4, the network adapted by making several key role shifts. First, M1.2, M1.55 and M3.3 now took on managerial roles replacing two mangers who were removed from the network last period. The network was also now less focussed on international smuggling (with six less nodes having international trafficking as their primary role compared to T3) which coincided with the addition of many new cooks (taking the total to 11 from just one in T3). It seems plausible that the series of law enforcement seizures of imported drugs during T3 may have led to a reshaping of the network's strategy; that is, a shift towards more local production. Finally, three new nodes joined as money launderers for the network (suggesting that in spite of the law enforcement disruptions the network was continuing to expand in sales), and there were now less corrupt officials (the two corrupt detectives who were arrested in T3 were not replaced).

There were eight supply changes in T4. One of the new nodes (M4.67) operated a meth/amphetamine laboratory from May 2002. The first supply change in T4 was a quantity decrease of meth/amphetamine as this lab ceased operating mid 2002, though it is unclear why. A few months later, the network adapted to this by establishing a second meth/amphetamine laboratory where M4.67 and M1.2 were cooks. They supplied

meth/amphetamine to three separate sub-networks via M1.2, M4.68 and M1.1 respectively. Chemicals were supplied to the lab either by M1.2, M1.18 or M4.68, though it was unclear whether they were imported chemicals or made locally.

The second supply change occurred mid 2003. M4.4, who was at the time delivering meth/amphetamine end-product produced in the most recently established meth/amphetamine laboratory, was pulled over by police and 2kg of powder were seized. Police then raided the laboratory and the third supply change, was that laboratory being seized on the same day. The network appears to have adapted to this by establishing yet another meth/amphetamine and ecstasy laboratory seven months later. It was operated by M4.76, M4.77, M4.78 and M4.97 at a location that will be referred to herein as location 1.

About one week after the latest lab establishment, the fourth supply change occurred: a quantity decrease of ecstasy and meth/amphetamine as a result of theft. A house occupied by M4.29 and M4.28 was robbed by M4.25, M4.26 and M4.27. That house manufactured and supplied pills to M1.1 and was also a storage house for meth/amphetamine. The trio stole 1kg of meth/amphetamine and an unknown quantity of ecstasy powder and pills. Police later arrested the trio and hence the fifth supply change was the seizure of the stolen drugs as well as additional drugs that were found within the property: 5.4kg of ecstasy, 4.2kg of methamphetamine, and 2.1kg of amphetamine. The immediate adaptation to these supply changes was unclear but about one year later M1.1 established a new ecstasy laboratory which may have been a long-term adaptation.

Sometime in 2004 the sixth supply change occurred: a quantity increase of ecstasy precursors after M1.1 was introduced to M4.73. M4.73 owned his own legitimate business that operated with chemicals that could be used in the manufacture of ecstasy. M4.73 began selling these chemicals to M1.1. Over the following months, the adaptation to the increased precursor supply was to establish two new laboratories. The first was an ecstasy and methamphetamine laboratory operated by M4.77 at what is referred to herein as location 2. The second was an ecstasy tablet pressing laboratory operated at the company premise owned by M4.73, referred to herein as location 3. At some point later, M1.1 gave funds to M4.73 to purchase a second press to increase the production rate. Hence the network continued to exploit the increased quantity of precursors available by purchasing more pill pressers and increasing the total number of manufacturing sites to three.

Late 2005, M1.1 was arrested and charged with inciting another to import a commercial quantity of ecstasy form the undercover operatives. The ecstasy tablet pressing laboratories

that were operating in locations 3 and 4 were subsequently raided and seized (the seventh and eighth supply changes). The labs at locations 1 and 2 continued to operate and remained undetected for now. M1.1 received bail in late 2005 and adapted by forming a new sub-network of participants who organised "the manufacture and distribution of very large quantities of methylamphetamine, the trafficking of cocaine and MDMA and money laundering" (transcripts).

Figure 59. Roles and network location at T4.
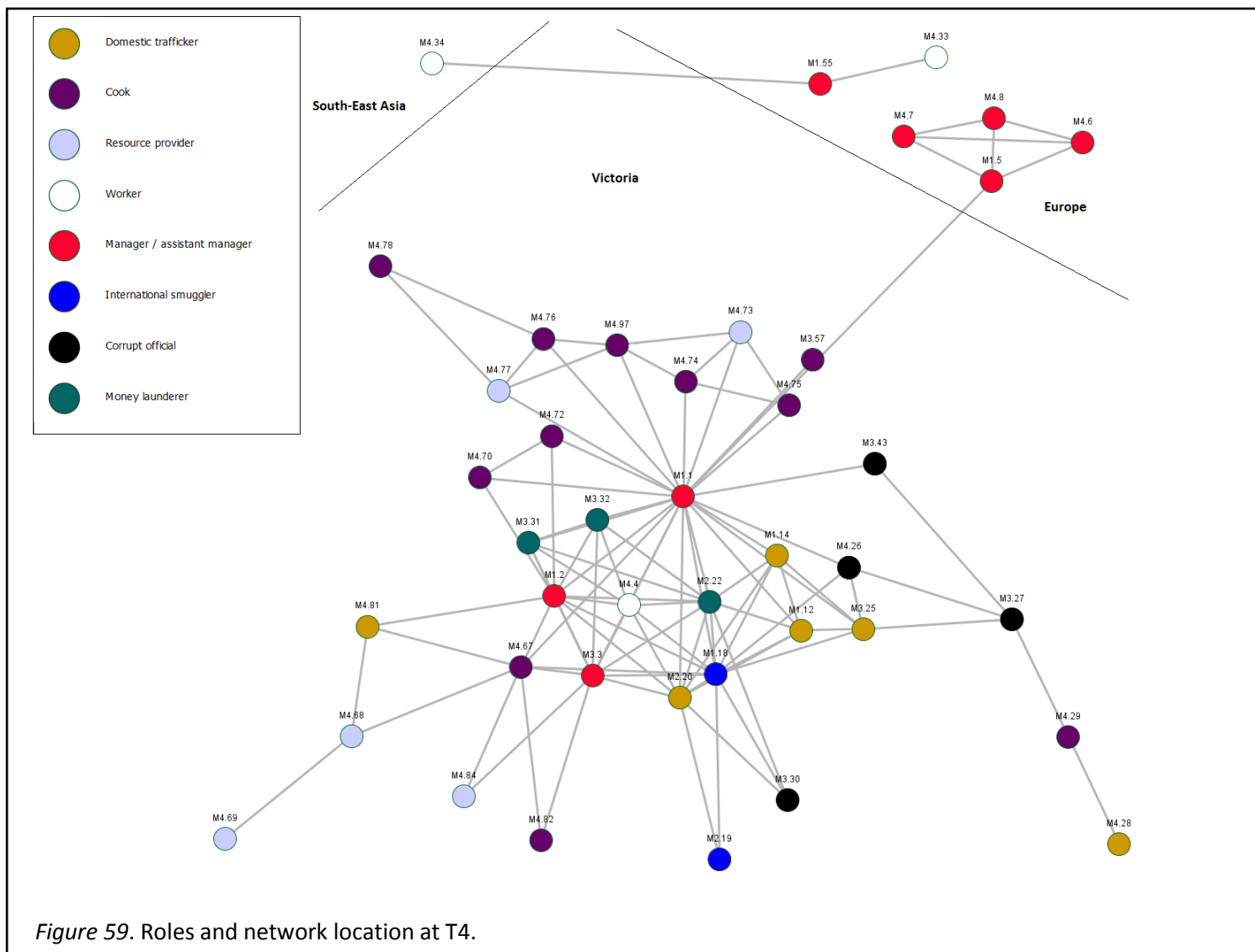
Table 43

Summary of adaptations identified in T4

Shift to more local manufacture and less international trafficking

Recruit many more end-product cooks

Role shifts: some nodes became managers to take over from
previous managers who had left the network last period.

Establish a new drug laboratory

Recruit new nodes to assist with trafficking or manufacturing

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T5: Early 2006 to mid 2007

Figure 60 shows the network roles and locations in T5. Table 44 shows a summary of the
adaptations identified in T5. The network further adapted by making more structural changes
in T5. M1.1 established a new subnetwork. He recruited nine new nodes to assist him in
trafficking meth/amphetamine, cocaine and ecstasy. He assigned two managerial roles to
M5.87 and M5.86, who became new trafficking hubs for the network. They would oversee the
storing of the meth/amphetamine, monitor the quality, cut and repackage it and then on sell
to others in the network. Now for the first time, the network also had precursor cooks (who
could synthesise the chemicals required for meth/amphetamine end-product manufacture).
This may have been a response to further increase manufacturing yield of meth/amphetamine
end-product in order to recuperate losses from the large number of seizures in T4. Another
major change was that M1.1 fled overseas (as he was found guilty of importing the 3kg of
cocaine in T3 and sentenced to significant gaol time) and continued to run the business from
there via mobile phone. In total, there were seven supply changes in T5.

The first supply change was a decrease in cocaine quantity. The network's adaptation was to
expand its sale of ecstasy, to ensure profits could be maintained. It is unclear whether the
additional ecstasy supply was sourced from local or international suppliers, but the network
had both options available.

The next three supply changes were law enforcement caused quantity decreases which all
happened in mid 2016. First, M4.80's car was intercepted transporting drugs, and 11.2kg of
P2P (a meth/amphetamine precursor) were seized. Second, the cook M4.70, was arrested and

his methamphetamine laboratory equipment was seized. M4.70 subsequently agreed to become a police informer and made a controlled delivery of 2.5kg of a white inert powder to M1.2 three days later. M1.2 accepted the package and was subsequently arrested and hence the fourth supply change was a seizure of the laboratory he was managing. The network adaptation to the seizures was to order more drugs.

Sometime mid to late 2006, M5.86 and M5.87 made arrangements to purchase 10 pounds of end-product methamphetamine from M4.97. After the drugs were purchased, the buyers realised there was a problem with the quality. The drugs were melting. Hence the fifth supply change was a quality decrease of meth/amphetamine end-product. The first adaptation was to stop doing business with the trafficker who sold the poor quality drugs (M4.97), and the second was to attempt to improve the quality. The poor-quality drugs were given to M5.92, who was able to successfully remove impurities and on sell the drugs to customers without issue.

The sixth, supply change was a law enforcement caused quantity decrease: a 1kg seizure of meth/amphetamine. The immediate adaptation was unclear.

The seventh and eighth supply changes were non-law enforcement caused quality decreases. M5.105 was the main P2P cook for the syndicate, but died of a heart attack in early 2007. M5.91 assumed the role, but was unable to match the quality of the former cook. As a result, he produced poor quality P2P (the seventh supply change). This in turn resulted in a quality decrease of the syndicate's end-product meth/amphetamine (the eighth supply change). Initially, there was no adaptation to these changes. The poor quality meth/amphetamine was distributed through a number of members in the network without adjustment. One customer, M5.100, complained that the drugs were making his customers physically ill and some even had to receive medical attention. His adaptation was to return 6 pounds of the poor quality drugs to the supplier (M5.92). M5.92 told M5.100 that he would fix them problem and M5.100 observed M5.92 attempting to do so. M5.92 re-bagged the drugs following the rectification process and returned them to M5.100. This however did not fix the problem and M5.100 's customers continued to complain. The network manager, M1.1, was then informed. He adapted by insisting that the batch still be sold but instructed his associates to sell it at a reduced price to clear the stock out. There were further discussions between network participants in an attempt to resolve this issue. M1.1 made inquiries as to why the quality of end-product had declined. M5.91, the new P2P cook, informed M1.1 that the problem was in fact at the point of P2P manufacture and believed he used too much sodium while cooking the

last batch and also complained of broken equipment. He informed M1.1 of a desire to attempt to improve the quality during the next batch he cooks. He also expressed a desire to increase the production of P2P and encouraged M1.1 to take steps to do so. In addition, M5.92 adapted by offering to assist with the manufacturing process, and then M5.87 arranged for the supply of highly sought after glassware for the purpose of meth/amphetamine manufacture. M5.92 said he was able to source methamphetamine precursors but only once he completed a period of home detention which he was serving at the time.

After the next P2P cook by M5.91, the network found itself in possession of another poor quality batch of meth/amphetamine. Hence the problem had persisted. This time, however, rather than continue attempts to sell this batch, the adaptation was to source methamphetamine end-product from a different manufacturer than usual. In mid 2007, M1.1 told M5.92 that M5.87 would give him some meth/amphetamine from a new batch that would be delivered by M5.88 in the coming week and that M5.92 was to check the purity. A sample of the new batch was then delivered but the quality was still perceived to be poor by M5.88. Hence their adaptations appeared not to have resolved their quality issues this time round.

M5.92 was arrested one week later so was never able to source precursors and engage in meth/amphetamine manufacture. Most of the other members were arrested around the same time, including M1.1 who was arrested in Greece.
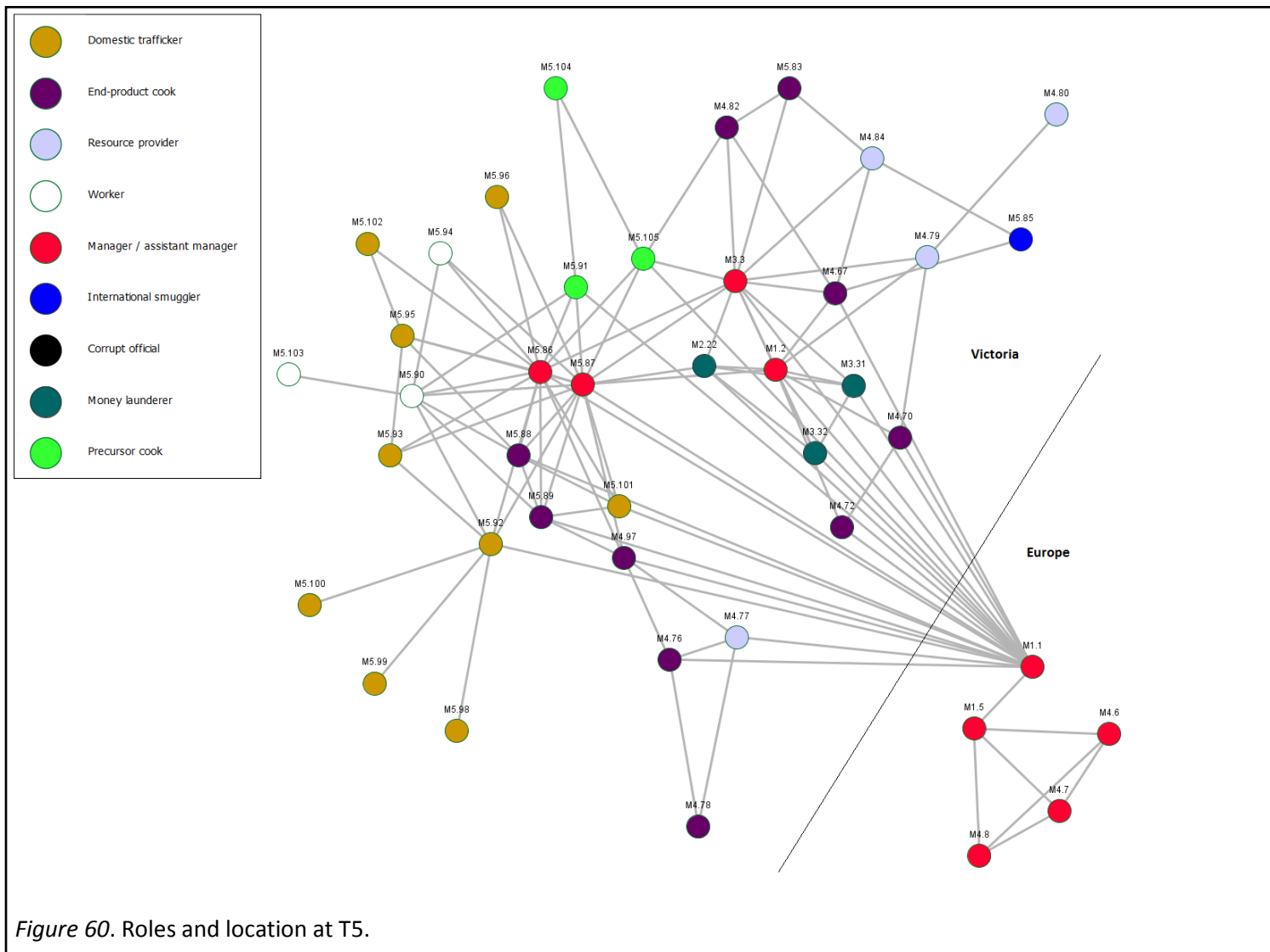
Figure 60. Roles and location at T5.

Table 44

Summary of adaptations identified in T5

Attempt to manufacture drugs
Recruit a new sub network including two new managers to oversee the operation.
Shift to cooking own precursors and add precursor cooks
Order more drugs but a larger quantity
Establish a new drug laboratory
The manager fled overseas and managed the network from there
Expand sales of a different drug type
Order more drugs
Cease doing business with the supplier
Attempt to improve the quality
Reduce the price of drugs to customers
Attempt to source manufacturing equipment to start a new laboratory
Switch to a different supplier of the same drug type
Return drugs to supplier

Quantitative analysis

The quantitative analysis examines changes in network structure over time. Table 45 shows the number of network nodes, undirected links, density, and degree centralisation by time period. Table 46 shows the number of nodes entering and exiting the network between each time period. Figures 61 to 65 show the network maps in each time period, highlighting the period at which nodes were first identified as operating in the network.

At T1 and T2, the network was relatively small, consisting of 14 and 12 nodes respectively and network density was relatively high (28.6% and 33.3% respectively). In T3 there was a large increase in the number of nodes to 43 and network density reduced to just 9.9% and remained relatively low in T4 (12.5%) and T5 (12.8%). By T4, approximately half of all nodes had left the network (either due to arrest or other reasons) and most were replaced resulting in 42 active

nodes in T4. Once again, by T5 half of all nodes had left the network, which were all then replaced, resulting in 42 active nodes again in T5.

Average degree increased over time, showing that nodes on average became more connected over time. Degree centralisation decreased over time, which means the network became less dependent on any single node to function efficiently.

Table 45

Number of network nodes, undirected links, density, and degree centralisation by time period

Time	Nodes	Undirected links	Network density (%)	Degree centralisation
1	14	26	28.6	0.82
2	12	22	33.3	0.66
3	46	102	9.9	0.56
4	42	103	12.5	0.52
5	42	110	12.8	0.39

Table 46

Number of nodes entering and exiting the network between each time period

	T1-T2	T2-T3	T3-T4	T4-T5
Number entering	4	36	28	23
Number exiting	6	2	32	23
Net growth	-2	34	-4	0

Figure 61. Network map at T1.

Figure 62. Network map at T2.

Figure 63. Network map at T3.
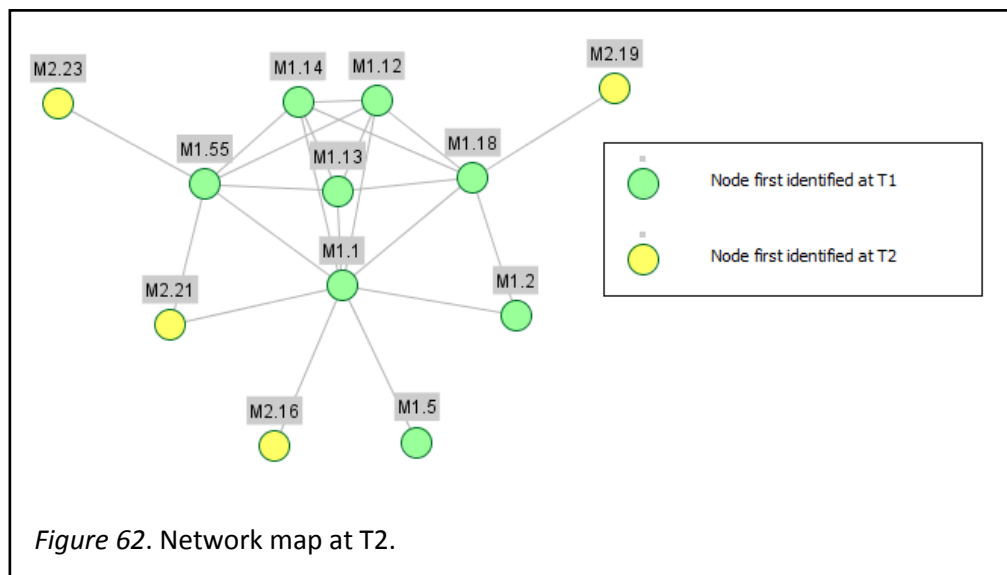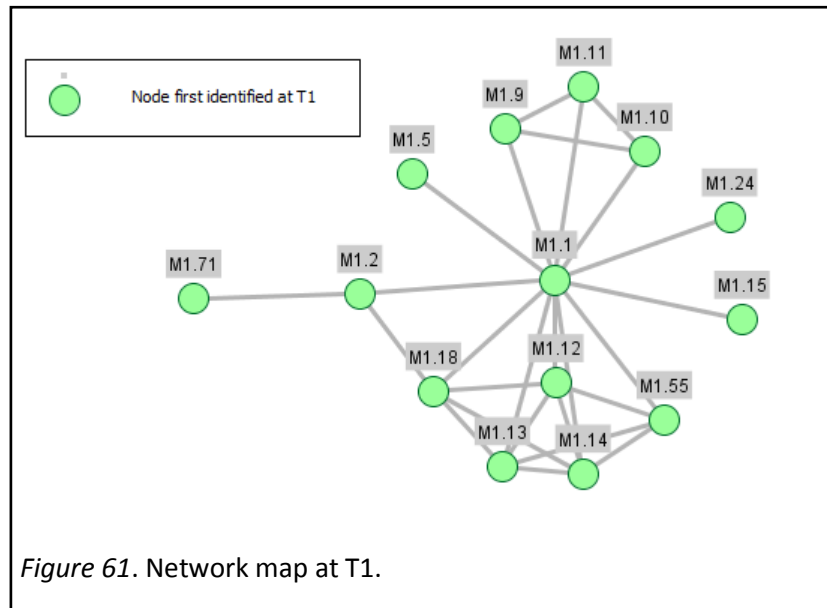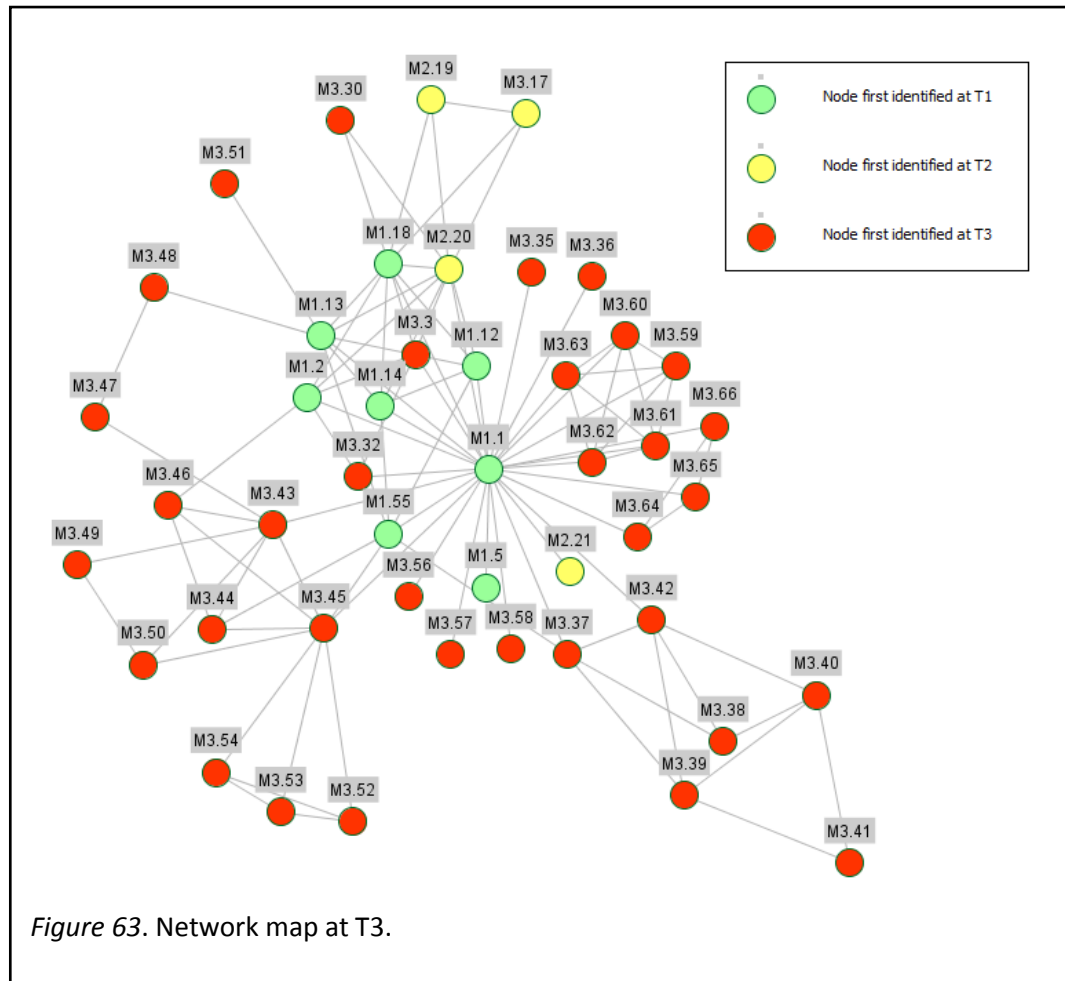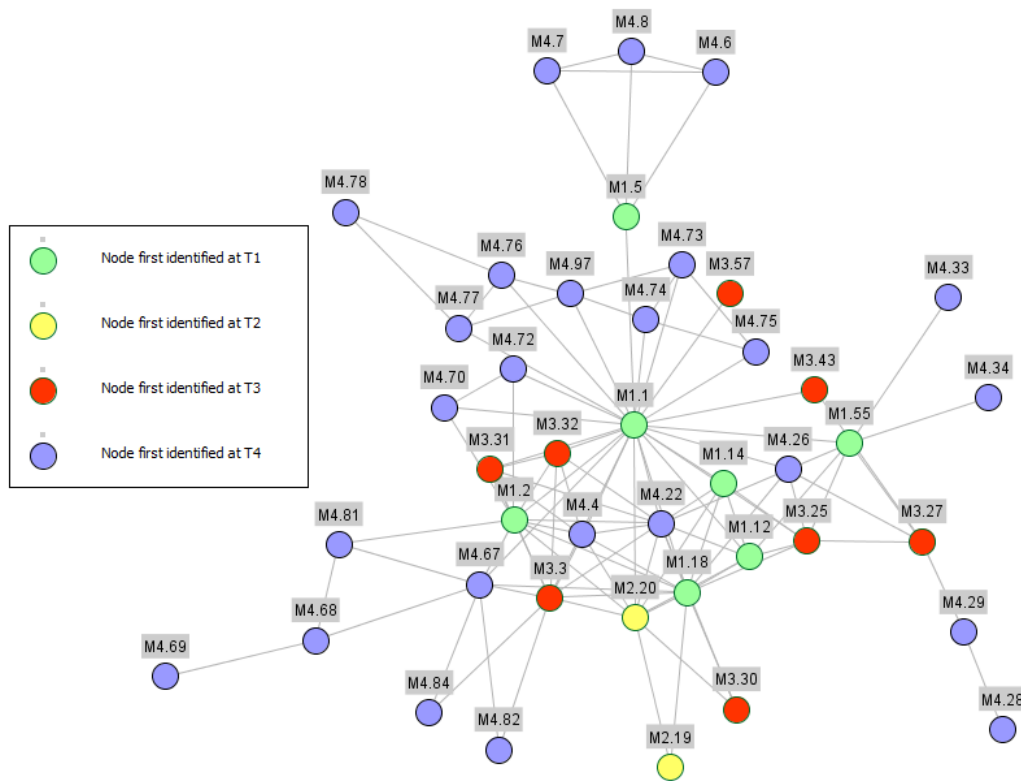
Figure 64. Network map at T4.

Figure 65. Network map at T5
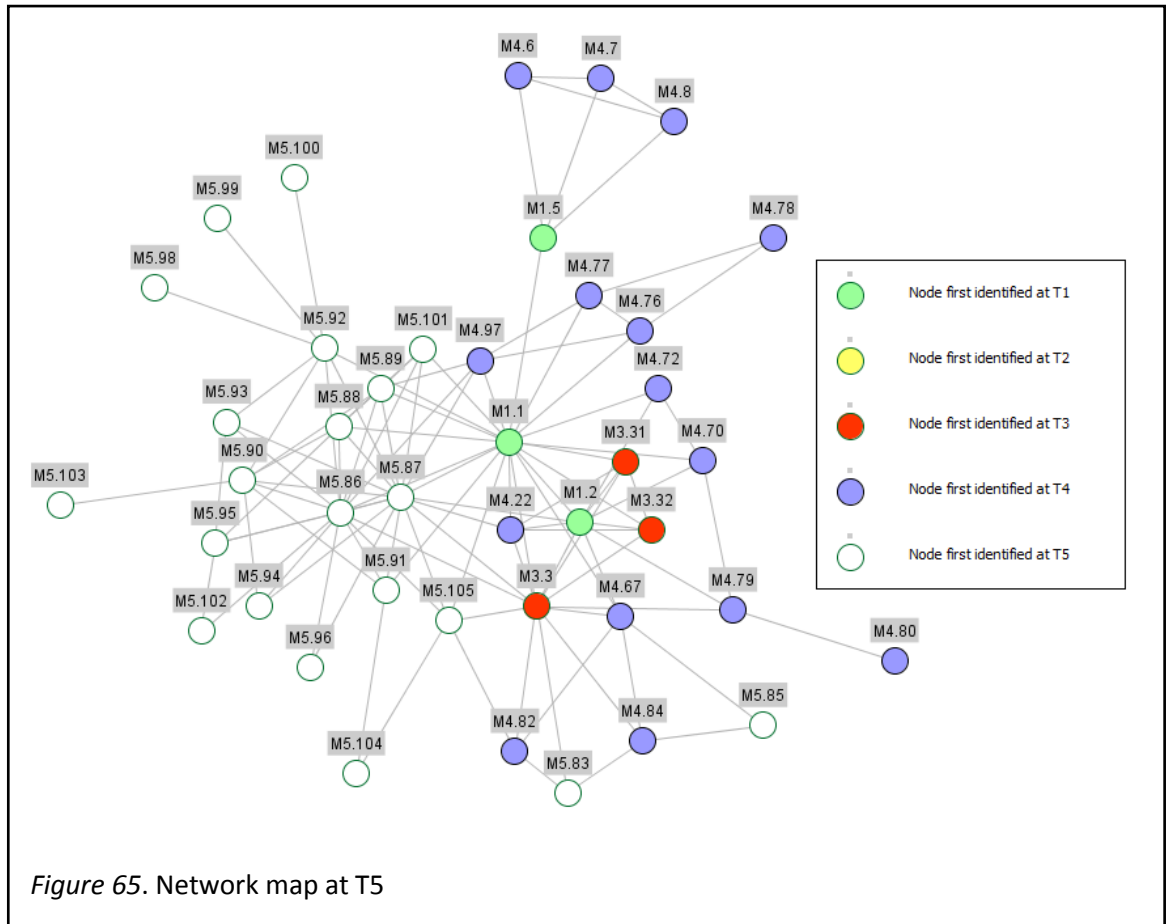
Table 47, Table 48 and Table 49 show the top 20 node centrality scores in each time period for degree, betweenness and closeness respectively. M1.1 began as a central participant in the network and remained the most central at all time points, accounting for the highest degree, betweenness and closeness scores in each period. However, there were major shifts in the ranking of centrality scores over time for other nodes. This was in part due to significant changes in the network structure over time (i.e. many nodes leaving and exiting at each time point) but was also in part due to changes in the ranking of existing nodes. For instance, M3.3 was ranked 20th for betweenness at T3 (when first identified) but ranked 2nd at T5.

Table 47

Top 20 nodes by standardised degree centrality scores across T1 to T5

Rank	Time 1		Time 2		Time 3		Time 4		Time5	
	ID	Deg.	ID	Deg.	ID	Deg.	ID	Deg.	ID	Deg.
1	M1.1	0.92	M1.1	0.82	M1.1	0.62	M1.1	0.59	M1.1	0.49
2	M1.12	0.38	M1.18	0.55	M1.18	0.22	M1.18	0.32	M5.87	0.41
3	M1.13	0.38	M1.55	0.55	M3.20	0.22	M1.2	0.29	M5.86	0.39
4	M1.14	0.38	M1.12	0.45	M3.45	0.20	M4.22	0.27	M3.3	0.32
5	M1.18	0.38	M1.13	0.45	M1.13	0.18	M3.3	0.27	M1.2	0.24
6	M1.55	0.31	M1.14	0.45	M1.55	0.16	M3.20	0.24	M5.90	0.20
7	M1.10	0.23	M1.2	0.18	M3.43	0.16	M4.4	0.20	M5.92	0.20
8	M1.11	0.23	M2.21	0.18	M1.12	0.13	M4.67	0.20	M5.88	0.17
9	M1.2	0.23	M1.5	0.09	M1.14	0.13	M1.12	0.15	M5.89	0.17
10	M1.9	0.23	M2.16	0.09	M1.2	0.13	M1.14	0.15	M4.22	0.15
11	M1.15	0.08	M2.19	0.09	M3.3	0.11	M3.25	0.15	M4.67	0.15
12	M1.24	0.08	M2.23	0.09	M3.37	0.11	M3.31	0.15	M4.97	0.15
13	M1.5	0.08			M3.42	0.11	M3.32	0.15	M5.105	0.15
14	M1.71	0.08			M3.59	0.11	M4.97	0.12	M3.31	0.12
15					M3.60	0.11	M1.5	0.10	M3.32	0.12
16					M3.61	0.11	M3.27	0.10	M5.101	0.12
17					M3.62	0.11	M4.26	0.10	M5.91	0.12
18					M3.63	0.11	M4.73	0.10	M5.95	0.12
19					M3.39	0.09	M4.74	0.10	M1.5	0.10
20					M3.40	0.09	M4.76	0.10	M4.70	0.10

Note. Black = entered at T1, orange = entered at T2, blue = entered at T3, green = entered at T4, and purple = entered at T5.

Table 48

Top 20 nodes by standardised betweenness centrality scores over T1-T5

Rank	Time 1		Time 2		Time 3		Time 4		Time5	
	ID	Btwn	ID	Btwn	ID	Btwn	ID	Btwn	ID	Btwn
1	M1.1	0.76	M1.1	0.51	M1.1	0.77	M1.1	0.64	M1.1	0.47
2	M1.2	0.15	M1.18	0.21	M3.45	0.16	M1.5	0.14	M3.3	0.17
3	M1.18	0.04	M1.55	0.21	M3.43	0.11	M4.67	0.14	M5.87	0.16
4	M1.12	0.00	M1.12	0.02	M3.42	0.10	M1.55	0.13	M5.86	0.16
5	M1.13	0.00	M1.13	0.02	M1.13	0.09	M3.27	0.10	M5.92	0.15
6	M1.14	0.00	M1.14	0.02	M1.18	0.07	M1.18	0.08	M1.5	0.14
7	M1.10	0.00	M1.2	0.00	M3.20	0.07	M3.3	0.06	M5.90	0.06
8	M1.11	0.00	M1.5	0.00	M3.37	0.06	M1.2	0.05	M4.67	0.06
9	M1.15	0.00	M2.16	0.00	M1.55	0.05	M4.29	0.05	M4.79	0.05
10	M1.24	0.00	M2.19	0.00	M3.39	0.03	M4.68	0.05	M1.2	0.05
11	M1.5	0.00	M2.21	0.00	M1.2	0.02	M4.22	0.04	M5.105	0.04
12	M1.55	0.00	M2.23	0.00	M3.40	0.01	M3.25	0.04	M5.91	0.03
13	M1.71	0.00			M3.46	0.01	M4.26	0.03	M4.76	0.02
14	M1.9	0.00			M3.47	0.01	M3.20	0.03	M4.77	0.02
15					M3.48	0.01	M4.76	0.02	M4.97	0.02
16					M3.44	0.00	M4.77	0.02	M4.70	0.01
17					M3.50	0.00	M3.43	0.02	M5.88	0.01
18					M1.12	0.00	M4.81	0.01	M4.84	0.01
19					M1.14	0.00	M1.12	0.01	M5.89	0.01
20					M3.3	0.00	M4.97	0.00	M4.82	0.00

Note. Black = entered at T1, orange = entered at T2, blue = entered at T3, green = entered at T4, and purple = entered at T5.

Table 49

Top 20 nodes by standardised closeness scores over T1-T5

Rank	Time 1 ID	Time 1 Clo	Time 2 ID	Time 2 Clo	Time 3 ID	Time 3 Clo	Time 4 ID	Time 4 Clo	Time 5 ID	Time 5 Clo
1	M1.1	0.93	M1.1	0.85	M1.1	0.71	M1.1	0.63	M1.1	0.64
2	M1.18	0.62	M1.12	0.65	M1.55	0.50	M1.18	0.50	M5.87	0.58
3	M1.12	0.59	M1.13	0.65	M3.45	0.49	M1.2	0.47	M5.86	0.57
4	M1.13	0.59	M1.14	0.65	M1.18	0.49	M3.3	0.46	M3.3	0.53
5	M1.14	0.59	M1.18	0.65	M3.20	0.49	M4.22	0.45	M1.2	0.50
6	M1.2	0.57	M1.55	0.65	M3.43	0.49	M4.67	0.45	M5.105	0.48
7	M1.55	0.57	M1.2	0.52	M1.13	0.48	M3.20	0.45	M5.92	0.48
8	M1.10	0.54	M2.21	0.52	M1.12	0.47	M3.25	0.43	M4.22	0.47
9	M1.11	0.54	M1.5	0.48	M1.14	0.47	M4.4	0.43	M5.88	0.46
10	M1.9	0.54	M2.16	0.48	M1.2	0.46	M1.12	0.42	M5.89	0.46
11	M1.15	0.50	M2.19	0.41	M3.37	0.46	M1.14	0.42	M4.97	0.45
12	M1.24	0.50	M2.23	0.41	M3.42	0.46	M4.26	0.42	M5.91	0.45
13	M1.5	0.50			M3.3	0.45	M3.31	0.42	M4.67	0.44
14	M1.71	0.37			M3.59	0.44	M3.32	0.42	M5.101	0.44
15					M3.60	0.44	M1.5	0.40	M3.31	0.43
16					M3.61	0.44	M3.43	0.40	M3.32	0.43
17					M3.62	0.44	M4.97	0.40	M1.5	0.42
18					M3.63	0.44	M4.76	0.40	M4.70	0.42
19					M3.32	0.43	M4.77	0.40	M5.90	0.42
20					M3.64	0.43	M4.70	0.39	M4.72	0.41

Note. Black = entered at T1, orange = entered at T2, blue = entered at T3, green = entered at T4, and purple = entered at T5.

Discussion

This was a mixed methods SNA of a single high-level synthetic stimulant trafficking syndicate which operated primarily in Melbourne between 1993 and 2007. The research primarily aimed to examine whether any new insights about trafficker adaptations to supply changes can be gained through a network lens, including whether there were any structural or functional changes over time in the trafficking network after exposure to quantity or purity/quality changes. Between five and nine supply changes were identified in each of the five time periods analysed.

Many new adaptations were identified that could not be identified at the transcript level. Network adaptations included decreases in network density and centrality, a large increase in size from 12 to 46 nodes, changes in centrality rankings of network participants, role changes, the recruitment of new collaborators to assist with trafficking or manufacturing (including up to six corrupt public officials at any one time), a change in trafficking style, a switch from mostly domestic trafficking to mostly international trafficking (and vice versa), and the establishment of new ecstasy or meth/amphetamine laboratories. The decentralisation of the network after exposure to supply changes is consistent with the findings of Morselli and Petit (2007), who found that a poly-drug trafficking network in Montreal also decentralised after exposure to a series of law enforcement seizures.

Moreover, the core network participants—in particular the brokers and hubs—seemed to be more involved in driving the adaptability of the network than the less important participants at the periphery of the network. For example, it was usually a broker or hub that drove the network adaptations by organising new recruits, organising meetings or by providing the funds to purchase new drugs or drug laboratories. This supports past research which shows the importance of these key figures in any given criminal network. For example, it has consistently been shown that the best intervention strategy to disrupt a criminal network is to target and remove the brokers (Bichler, Malm, & Cooper, 2017; Bright, Greenhill, Britz, Ritter, & Morselli, 2017; Morselli & Roy, 2008).

Consistent with the analysis of adaptations at the transcript level (shown in Chapter 7), network adaptations appeared to depend on a range of characteristics associated with the supply change, including the cause, kind, direction, drug type, time elapsed, location, and trafficking style. For example, domestic seizures were more likely to result in new drug laboratories being established, whereas seizures of international supply were more likely to result in an attempt to import more drugs. In addition, there was no evidence that the network

experienced major difficulties continuing to sell drugs after exposure to supply changes, regardless of the supply category. For example, after numerous seizures and arrests, the network successfully imported enormous quantities of drugs such as half a million ecstasy tablets and more than a tonne of pseudoephedrine.

Limitations

This research was on a single drug trafficking network only. It also examined a poly drug trafficking network, and Chapter 7 showed poly drug traffickers to be more adaptable and resilient to supply changes than mono drug traffickers. This means that the findings are not generalisable to all drug trafficking networks. The findings nevertheless highlight supply change adaptations and consequences that could occur in other contexts, and should be the subject of future research.

It was also impossible to know with certainty whether the adaptations described here were in fact adaptations caused directly by the supply changes. For example, it was hypothesised that the network expanded to new drug types in T2 as a result of several law enforcement seizures of meth/amphetamine, but the network may have still expanded to new drug types in T2 even if those seizures did not take place. That said, all adaptations described in this research appeared to be plausible responses to the supply changes.

Criticism may also be directed towards the five time periods used, which were somewhat arbitrary. The choice of time periods may have influenced the results significantly. However, the choice of cut off points for each time period is arguably less important in this type of analysis. Most adaptations were described as occurring within time periods, rather than across time periods.

A common criticism of SNA using law enforcement data is that the nodes identified to be central participants (i.e. had high centrality scores) may only be central because they were central to the law enforcement investigation (Morselli, 2009b). This may have led to biased interpretations of who were the key nodes to adapt to supply changes. A biased view of a network may be true in the beginning of an investigation, but the investigations spanned over a 15-year period. This would inevitably have led to the discovery of new central participants who were not originally known. To illustrate this point, just 14 nodes were identified in T1 and this expanded to a peak of 46 in T3. Hence a centrality ranking bias was less likely to have occurred in this study due to the extensive investigative period (15 years).

Finally, the SNA was also conducted using data from a biography and mainstream media, which also have limitations. Notwithstanding the fact that the author of the biography collected data by interviewing law enforcement officers and members of the network, there involves a creative element in writing a book for public sale. Biographies are primarily written for entertainment, and therefore any facts presented may be exaggerated by the author. Mainstream media articles may contain incorrect facts as they are not always subjected to a fact checking process prior to publishing. Media articles are also primarily written for public sale, and thus are also subjected to the same limitations as the biography with respect to creative writing. Notwithstanding these limitations, the use of data triangulation in this study reduced the likelihood of obtaining incorrect facts as many facts could be validated through cross verification.

Conclusion

This study identified a range of new adaptations made by a network of high-level synthetic stimulant traffickers that was not detected at the level of the transcript. It firstly identified changes in network density, centrality, size, roles, trafficking style, trafficking location, and collaborations. It secondly found that hubs and brokers were the main drivers of the network's adaptations. It thirdly found that the adaptations depended on the various characteristics associated with the supply change. Finally, no relationship was found between the various characteristics associated with the supply change and whether the network continued to sell drugs. The network continued to sell drugs over a 15-year period irrespective of the supply change category. The following chapter is a discussion which brings together all of the main research findings in this thesis, and outlines implications for research, policy, and practice.

Chapter 9: Discussion

High-level Illicit drug traffickers are known to be adaptive to supply changes (Bouchard, 2007; Matrix Knowledge Group, 2007; Pardal et al., 2014; Tzvetkova et al., 2014), and several studies have reported a range of different adaptations that traffickers and their networks make (Adler, 1985; Adler & Adler, 1983; Bouchard, 2007; Bright & Delaney, 2013; Desroches, 2005; Matrix Knowledge Group, 2007; Morselli & Petit, 2007; Ovenden, Loxely, & McDonald, 1995; Pearson & Hobbs, 2001; Tzvetkova et al., 2014). Cognizant that drug supply often changes and that adaptations have seldom been the primary focus of research, the primary aim of this thesis was to systematically examine how Australian synthetic stimulant traffickers adapt to changes in their drug supply.

As outlined in the Introduction, studying adaptations (whether by individual traffickers or networks) includes analysis of the kinds of supply changes taking place, the adaptations made by traffickers, the consequences, and whether there is any change to the potential for harm to the public. In line with this approach, the first study acknowledged the limitations with using law enforcement seizure data as an indicator of drug supply changes, and examined ways in which analysis of these data can be improved to more accurately indicate supply changes. The second and third studies examined seizure data using those analyses, along with several other indicators, to identify supply changes in Australia's ecstasy and meth/amphetamine markets respectively between 2002 and 2014. The fourth and fifth studies respectively examined trafficker and network adaptations to supply changes along with the extent to which traffickers and their networks continue to sell drugs following exposure to a supply change.

This chapter begins by addressing each of the seven overarching aims set out by this thesis. A discussion of the implications for research, policy and practice follows, along with the thesis limitations and conclusions.

Improving the Analysis of Law Enforcement Seizure Data When Used as an Indicator of Drug Supply Changes

Law enforcement seizure data is one of the main indicators of drug supply changes in many countries, including Australia. However, there has been longstanding international recognition of limitations with analysis of these data for that purpose (Degenhardt, Topp, & Day, 2003; Kilmer & Hoorens, 2010; Kilmer, Reuter, & Giommoni, 2015; Singleton, Cunningham, Groshkova, Royuela, & Sedefov, 2018; Willis, Homel, & Gray, 2006). For example, changes in

total seizure quantities may be more indicative of changes in law enforcement activity than the total quantity of drugs available. Changes in total seizure quantities also cannot indicate supply changes at the different distribution levels of which illicit drug markets are comprised. Weight bin analysis is increasingly being used for this purpose (Hughes, Chalmers, Bright, Matthew-Simmons, & Sindicich, 2012; Hughes, Chalmers, Bright, & McFadden, 2016b; Kilmer & Hoorens, 2010; Leone, Scatigna, Donati, & Pesce, 2012; Scott, Caulkins, Ritter, Quinn, & Dietze, 2015; Wan, Weatherburn, Wardlaw, Sarafidis, & Sara, 2016), but it is unclear which weight bin thresholds are most optimal for analysis.

In light of these limitations, the utility of two alternative methods to analysing Australian ecstasy and meth/amphetamine border detection data was tested–removing outliers and examining only large-scale seizures—to examine whether trends more indicative of supply fluctuations could be produced (Chapter 4). There is no standard method to dealing with outliers, so three different approaches were trialled: excluding the heaviest one, two, and three detections per year. There is also no standard approach to defining large-scale seizures, which were defined as 'the heaviest 100 seizures made over the analysis period'. In addition, four different methods of defining weight bins were tested through analysis of trends in Australian ecstasy and meth/amphetamine border detection and Victorian forensic purity data, to examine which method was most optimal for each drug type and form. These methods were then applied in Chapters 5 and 6.

Removing outliers and examining only large-scale seizures either improved or made no difference to the analysis (with respect to how well trends reflected supply changes). In particular, the alternative methods improved analysis of the ecstasy dataset which had extreme outliers in it. For example, it was hypothesised based on the standard analysis that in the 2014/15 financial year, ecstasy "made a resurgence in the Australian illicit drugs market, effectively ending a shortage observed in preceding years" (Australian Customs and Border Protection Service, 2015, p. 64). But when outliers were excluded, the trend indicated that supply had not resurged to previous peak levels, and the trend was now significantly correlated with other indicators of supply. This suggests that these alternative analyses can improve analysis for some datasets, particularly if there are outliers in the data.

With respect to analysis by weight bin, both the ecstasy and meth/amphetamine border datasets were found to be best analysed using the 'law' method (Criminal Code Regulations, 2002). For ecstasy, these thresholds are: (1) '<0.5g', (2) '0.5g to <500g', (3) '≥500g'. For meth/amphetamine, these thresholds are: (1) '<2g'; (2) '2g to <750g'; (3) '≥750g'. In contrast,

all ecstasy and meth/amphetamine purity datasets examined were found to be best analysed with a single aggregate trend (i.e. not by weight bin).

Chapters 5 and 6 showed that weight bin analysis could identify additional supply changes in Australia's ecstasy and meth/amphetamine market that were not identifiable by the aggregate trend alone. For example, there was almost a complete shift in ecstasy form at the border in the high-level bin from 2007 (from tablets to non-tablets), but the shift was more gradual in the mid-level bin, and in the low-level bin the form shift did not start until 2012. On the other hand, the aggregate trend showed only a gradual form shift from the mid 2000s onwards. In another example, the high-level meth/amphetamine bin showed a major quantity increase in 2013, but the mid-level bin showed a gradual quantity increase from 2010. The low-level bin showed a large quantity increase in 2006, which then declined, and then another major quantity increase occurred in 2012. On the other hand, the aggregate trend showed only a gradual quantity increase over time, with a major increase in 2013.

These analyses support past research in Europe (Singleton, Cunningham, Groshkova, Royuela, & Sedefov, 2018) and America (Arkes, Pacula, Paddock, Caulkins, & Reuter, 2008; Kilmer & Hoorens, 2010) which demonstrates the utility of weight bin analysis on seizure data. In particular, the present analyses show that weight bin analysis is important for two reasons. First, it can indicate supply changes at different distribution levels so supply trend research can be conducted on each level independently. Second, it can indicate more supply changes than the aggregate trend alone. If more supply changes are known, then this can aid research on trafficker adaptations.

Supply Changes That Have Occurred in Australia's Ecstasy and Meth/Amphetamine Markets Between 2002 and 2014

To date, there has been only limited attention to supply changes in Australia's ecstasy and meth/amphetamine markets (Fowler, Kinner, & Krenske, 2007; Scott & Burns, 2011; Scott, Caulkins, Ritter, Quinn, & Dietze, 2015). Most research on these markets has either focussed on use or harms or on low-level supply. Hence Chapters 5 and 6 were in-depth analyses of supply changes in these markets using law enforcement seizure data and other indicators. Five kinds of supply changes were identified in Australia's ecstasy market: quantity, purity, supply routes, mode of transport, and form. Six kinds of supply changes were identified in Australia's meth/amphetamine market: quantity, purity, supply routes, mode of transport, form, and precursor type.

Specifically, the quantity of ecstasy available in Australia appeared to peak at the beginning of the analysis period and then decline from around 2005, as evidenced by a decline in the total weight of ecstasy border detections (excluding the heaviest detection per year) and a decline in subjective reports of ecstasy availability and purity from EDRS participants. Coinciding with this decline was: a decline in the tablet form and a shift to powder as the most prominent form imported, a shift away from Europe as the most prominent supplier to other world regions (most notably the Americas and Asia), and a significant decline in both tablet and powder purity in Victoria. This is broadly consistent with data in the World Drug Reports suggesting that significant ecstasy production shifted away from Europe to Asia and North America in the mid-2000s (UNODC, 2008; UNODC, 2011). The exception being that the quantity and purity of ecstasy available in Australia reached their lowest points in 2010, one year after Europe's 'shortage'. This coincided with a shift away from air and sea cargo as the most prominent modes of transport, to parcel post, and is consistent with the European market where ecstasy trafficking at all levels is increasingly shifting to postal methods (EMCDDA, 2016c). Importantly, the analysis showed that by the end of the analysis period, Australian ecstasy supply had yet to return to pre-shortage levels. For example, both quantity and tablet purity partially resurged in 2011, but as of 2014 did not return to peak levels seen in 2004.

The quantity of meth/amphetamine available in Australia appeared to rise over the analysis period. This was evidenced by increases over time in most indicators, including in the total weight and number of meth/amphetamine end-product and precursor border detections, clandestine laboratory detections, and arrests for meth/amphetamine supply in Victoria and New South Wales. The apparent increase in quantity coincided with a gradual shift in form, from mostly powder and tablet to mostly crystal. This was evidenced by increases in meth/amphetamine border detections which were mostly in crystal form, and a gradual shift in the form of seizures in Victoria from powder and tablet, to crystal. There were also significant changes in purity over time, as indicated by a forensic purity time series analysis of seizures in Victoria. Both powder and crystal purity peaked in 2004, then significantly declined until 2009 and 2010 respectively, before significantly increasing until 2014 reaching previous peak levels seen in 2004. The decline in forensic purity from 2004 coincided with a shift in crystal meth/amphetamine supply routes from mostly China/Hong Kong to mostly the Americas. The increase in forensic purity from 2009 coincided with a shift back to China/Hong Kong as the primary exporter of crystal meth/amphetamine to Australia.

Taken together, there were several similarities in supply trends between the ecstasy and meth/amphetamine markets. The most prominent was the forensic purity trends, of which

both saw significant declines between the early analysis period and 2009, followed by significant increases between 2009 and 2014. Second, both saw changes in supply routes between the early, and mid to late 2000s, which then shifted back to the original region in the early 2010s. For example, crystal meth/amphetamine border detections shifted from Asia to the Americas, and then back to Asia. Ecstasy tablet border detections shifted from Europe to the Americas, and then back to Europe.

These findings highlight several supply changes in Australia's ecstasy and meth/amphetamine markets that were previously unknown. In particular, it shows that between 2002 and 2014, ecstasy and meth/amphetamine traffickers in Australia were exposed to a number of quantity, purity, form, supply route, precursor type, and mode of transport changes.

The Most and Least Common Adaptations Used by High-Level Synthetic Stimulant Traffickers

Research on high-level drug trafficking to date has demonstrated a range of adaptations that traffickers might engage in after exposure to a supply change (Adler, 1985; Desroches, 2005; Matrix Knowledge Group, 2007; Ovenden, Loxely, & McDonald, 1995; Paoli, Greenfield, & Reuter, 2009; Pearson & Hobbs, 2001; Reuter & Haaga, 1989; Tzvetkova et al., 2014). This study provided the first systematic examination of how traffickers adapt to supply changes. Specifically, a systematic content analysis was conducted on judges' sentencing comments from Australian high-level synthetic stimulant trafficking court cases over the period 2002 to 2016 ($n = 455$). The judges' narratives of case facts were used to identify exogenous supply changes ($n = 62$), the type (quantity, purity, textural quality, content quality, and form), and any short and long-term adaptations made by the traffickers.

Analysis at the transcript level showed that 94% of exogenous supply changes resulted in the traffickers making at least one adaptation. Out of the 97 adaptations made across the sample to those supply changes, the most common were associated with attempts to maintain a sufficient quantity, purity, or quality of the same drug type (71%). Such adaptations included (but were not limited to): attempting to locate missing drugs/precursors (that had been seized by police) (13%), looking for an alternative supplier of the same drug (13%), attempting to import more of the same drug (8%), attempting to improve the purity/quality (6%), regarding the drugs/precursors as waste and disposing of them (5%) and attempting to return drugs/precursors to supplier (3%). In contrast, adaptations associated with attempts to sell a different drug type (17%) or changing the price (5%) were less common. Finally, just 1% of adaptations resulted in the trafficker becoming inactive (albeit for two months only). This is

consistent with reports by incarcerated traffickers in Europe, some of whom reported becoming inactive during supply shortages but only for a short period of time until new supply arrived (Matrix Knowledge Group, 2007; Tzvetkova et al., 2014).

The Relationship Between the Adaptation Undertaken and Various Supply Change Characteristics

Past studies of high-level drug trafficking have not examined the extent to which trafficker adaptations to supply changes vary by characteristics associated with the supply change. A descriptive content analysis of Australian judges' sentencing comments appeared to show a relationship between the adaptation used and all variables tested. That is, trafficker adaptations appeared to be dependent on the kind, cause and direction of the supply change, the drug type associated with the supply change, whether the trafficker was exposed to more than one supply change, the time elapsed after the supply change, and the trafficking style.

For example, law-enforcement-caused supply changes appeared more likely than non-law-enforcement-caused supply changes to result in the trafficker adapting by importing more drugs into the country (either the same drug type, different or both). Non-law-enforcement-caused supply changes were more likely to result in the trafficker looking for an alternative supplier of the same drug type within Australia. Also of interest, was that after exposure to a supply change mono drug traffickers mostly looked for alternative sources of supply within Australia or tried to locate the missing drugs (that had been seized by police), but poly drug traffickers were much more likely to attempt to import more drugs, manufacture drugs, improve the purity or quality, or expand their business. This suggests that poly drug traffickers are more likely to adapt in ways that may be harmful to the public. This is consistent with the limited but growing body of research on poly drug traffickers which also suggests they may be more harmful than mono drug traffickers (Hughes, Bright, & Chalmers, 2017; Hughes, Chalmers, Bright, & McFadden, 2016a; Hughes, Chalmers, Bright, & McFadden, 2016b).

If several characteristics associated with the supply change are known (such as the cause, kind, trafficking style) then researchers, law enforcement officers, and policy makers could gain insight into what traffickers might do in response to any given supply change. For instance, traffickers in this study had a tendency to import more drugs in all of the following scenarios: (a) when the supply change was caused by law enforcement, (b) when the drug associated with the supply change was non-ecstasy, (c) when the trafficker was exposed to more than one supply change, and (d) when the trafficker was a poly drug trafficker. It would therefore seem more likely that any given high-level trafficker would attempt to import more drugs if exposed

to a supply change that met all five of those criteria as opposed to just one or two. Hence knowing the cause, kind, direction, drug type, and trafficking style might result in better predictive power than just knowing the kind and direction, or just the kind and cause.

However, despite some adaptations having a tendency to be more common after particular supply change categories, there was no single adaptation that overwhelmingly dominated in any scenario. There were many types of adaptations used across the sample to all categories of supply changes. For example, despite law-enforcement-caused supply changes most often resulting in attempts to import more drugs, other identified adaptations to these supply changes included: attempting to locate missing drugs or precursors that had been seized, regarding the substitute drugs as waste and disposing of them, looking for alternative suppliers, purchasing more drugs at an inflated price, attempting to sell lower purity or quality drugs, returning the drugs to the supplier, and becoming inactive for a period of two months. This suggests that current capacity to predict exactly how traffickers will adapt to supply changes overall is limited, but knowing something about what traffickers might do is still better than knowing nothing at all.

The Relationship Between the Various Supply Change Characteristics and Whether Traffickers Continue to Sell Drugs After Exposure to the Supply Change

Past research suggests that drug traffickers are skilled at adapting to market changes, including supply changes (Bouchard, 2007; Matrix Knowledge Group, 2007; Pardal et al., 2014; Tzvetkova et al., 2014). For example, several incarcerated traffickers have reported that they or others in the business were able to continue selling drugs after exposure to a supply change (Ovenden, Loxely, & McDonald, 1995; Pearson & Hobbs, 2001). But the extent of their resilience has not been systematically examined. The content analysis of judges' sentencing comments presented in Chapter 7 identified 62 exogenous supply changes and tested trafficker resilience. This was done by first analysing the proportion of supply changes that were followed by the traffickers continuing to sell drugs, and then examining whether there was a relationship between their ability to continue selling drugs and the various characteristics associated with the supply change.

Most supply changes were followed by the traffickers continuing to sell drugs (69%). There was no evidence from Chi-square tests of independence that traffickers' ability to continue selling drugs depended on the supply change cause, $\chi^2(1, N = 62) = 0.01$, $p = .92$, or kind $\chi^2(1, N = 60) = 0.69$, $p = .405$. Nor did ability to continue selling drugs appear to depend on the direction of the supply change: the sample size for supply decreases ($n = 6$) was too small for Chi-square

analysis, but 69% of supply increases were followed by traffickers selling drugs and 67% of supply decreases were followed by traffickers selling drugs. On the other hand, there were significant relationships between selling ability, and both the drug type and trafficking style: traffickers were more likely to continue selling drugs after non-ecstasy supply changes than they were after ecstasy supply changes, $\chi^2(1, N = 62) = 8.20$, $p = .004$; and poly drug traffickers were significantly more likely to continue selling drugs after a supply change than mono drug traffickers, $\chi^2(1, N = 62) = 18.39$, $p < 0.0001$.

These findings support past research which suggest high-level drug traffickers are skilled at adapting to market change (Bouchard, 2007; Matrix Knowledge Group, 2007; Ovenden, Loxely, & McDonald, 1995; Pardal et al., 2014; Pearson & Hobbs, 2001; Tzvetkova et al., 2014). However, certain kinds of traffickers (poly drug traffickers and traffickers who sell particular drug types) appear more resilient than others. This is consistent with past research on poly drug trafficking in Australia which suggests that these traffickers are more resilient to market changes (including supply changes) than their mono counterparts (Hughes, Bright, & Chalmers, 2017; Hughes, Chalmers, Bright, & McFadden, 2016a; Hughes, Chalmers, Bright, & McFadden, 2016b).

The Additional Insights Learned About Adaptations to Supply Changes Through Application of a Network Lens

One of the limitations with the study presented in Chapter 7, and most of the extant literature on drug trafficker adaptations (Loxely, 1998; Pearson & Hobbs, 2001; Reuter & Haaga, 1989; Tzvetkova et al., 2014), is that the primary focus is on individual or small groups of traffickers and not the entire network. Past studies have shown that drug trafficking networks are also flexible and adaptive. For instance, they have the capacity to change in structure and functionality over time, including changes in collaborators, density and centrality (Bright & Delaney, 2013; Morselli & Petit, 2007). Cognizant that focusing only on individual or small groups of traffickers may miss other important areas or methods of adaptation, Chapter 8 presented a social network analysis of a high-level synthetic stimulant trafficking network which operated primarily in Melbourne over a 15-year period (1993-2007). The network comprised up to 46 members in any given period of time. Data on the network, including the supply changes it was exposed to and how it adapted, were obtained from judges' sentencing comments, a biography of a manager in the network, and mainstream media.

Many adaptations not uncovered in Chapter 7 were identified in the analysis. New adaptations included establishing new ecstasy or meth/amphetamine laboratories, decentralisation, and

changes in network density or roles. Another common adaptation was to recruit new collaborators into the network. There were three ways this occurred. First, new additional traffickers or manufacturers were sometimes recruited to expand the network size and increase productivity. For example, the network grew by up to 34 people between Time 2 and Time 3. Second, traffickers or manufacturers were sometimes recruited to replace participants that had been arrested or that had left the network. For example, between Time 4 and Time 5, 23 traffickers left the network and these were replaced with 23 new traffickers. Third, up to six corrupt public officials such as drug squad detectives or customs officers were recruited at any given time, to assist with trafficking drugs and to reduce the likelihood of detection.

Interestingly, the core network participants—in particular the brokers and hubs—seemed to be more involved in driving the adaptability of the network than the less important participants at the periphery of the network. For example, it was usually a broker or hub that drove the network adaptations by organising new recruits, organising meetings or by providing the funds to purchase new drugs or drug laboratories. This supports past research which shows the importance of these key figures in any given criminal network. For example, it has consistently been shown that the best intervention strategy to disrupt a criminal network is to target and remove the brokers (Bichler, Malm, & Cooper, 2017; Bright, Greenhill, Britz, Ritter, & Morselli, 2017; Morselli & Roy, 2008).

The adaptability of the network meant that it did not experience major difficulties continuing to sell drugs after exposure to supply changes. This was regardless of the supply change cause, kind, direction, or location. For example, after numerous seizures and arrests, the network successfully imported enormous quantities of drugs such as half a million ecstasy tablets and more than a tonne of pseudo ephedrine. If the quantity of one drug was temporarily unavailable, the network would increase the trafficking of another drug. If the purity of its drugs declined, the network participants would attempt to fix it and re-sell it. These findings strengthen the research in Chapter 7, which systematically found that most traffickers at the transcript level continued to sell drugs after exposure to a supply change.

The Relationship Between Network Adaptations to Supply Changes and the Various Characteristics Associated with the Supply Change

Consistent with findings from the study of traffickers at the transcript level (Chapter 7), adaptations to supply changes made by the studied high-level synthetic trafficking network (Chapter 8) appeared to depend on all characteristics examined (the supply change cause, kind, direction, location, drug type, and time elapsed). There were also some commonalities

with the transcript level analysis. For example, in both analyses law-enforcement-caused supply changes often resulted in attempts to import more drugs. But arguably the two most important additional supply change characteristics shown from the network analysis that can affect adaptations were location and time elapsed.

First, seizures of imported supply most often resulted in new collaborators being recruited to assist with importing more drugs. On the other hand, domestic supply changes usually resulted in the establishment of new drug laboratories and recruiting new collaborators to assist with domestic production and trafficking. Second, over time, adaptations went from maintaining and expanding the sales of just one drug (meth/amphetamine), (Time 1), to expanding to new drug types (including ecstasy, LSD, cocaine and hashish), (Time 2), to expanding to international trafficking as well as recruiting six corrupt public officials (Time 3), to reverting back to a focus on domestic manufacture and trafficking by establishing new ecstasy or meth/amphetamine laboratories (Time 4), and then to starting a new major subnetwork which trafficked ecstasy, meth/amphetamine and cocaine, as well as recruiting meth/amphetamine precursor cooks (Time 5). This is consistent with suggestions that traffickers may adapt differently to market changes in short and long-term time frames (Bouchard, 2007; Dorn, Levi, & King, 2005).

Implications for Research, Policy and Practice

This research showed that multiple supply changes can and do occur over time in illicit synthetic stimulant markets. It showed that most traffickers continue to sell drugs after supply changes, and their ability to continue selling drugs is not affected by the cause, kind, or direction of the supply change. These findings highlight the resilience of high-level drug traffickers to supply changes and suggest that disrupting the supply of drugs may be difficult via intervention alone. This supports the need for a balanced approach between harm reduction, demand reduction and supply reduction policies in Australia (Commonwealth of Australia [Department of Health], 2017).

The research also suggests that most high-level synthetic stimulant traffickers, when exposed to supply changes, make one or more adaptations. The kinds of adaptations used varied widely, but there are now new insights into patterns and circumstances under which certain adaptations are more or less likely to occur.

For instance, becoming inactive, an adaptation that would result in less potential for harm to the public, was found to be a very uncommon adaptation to any supply change category.

Specifically, analysis at the transcript level showed just one supply change out of the 62 resulted in the trafficker becoming inactive, albeit he became reactive two months later. There was no evidence of permanent inactivity after supply changes in the network level analysis either. Interestingly, several traffickers in both samples even became aware that law enforcement had seized their drugs, but they still kept trafficking anyway. Despite deterrence being an aim of the current supply reduction policy in Australia (Commonwealth of Australia [Department of Health], 2017), this finding suggests that law enforcement interventions are unlikely to deter people from the drug trafficking business. However, it should be made clear that traffickers who have become inactive–by definition–cannot be detected by law enforcement officers. Given that this was research on a *detected* sample, the present sample is likely to be biased towards traffickers who did not become inactive. Therefore, one must exercise caution when interpreting this finding.

Another key finding was that the adaptations used depended on the various characteristics associated with the supply change. While all characteristics examined appeared to be determinants of the adaptations used, identifying the "cause", "trafficking style", and "location" were arguably the most important characteristics for detecting potential changes to harm. First, traffickers appeared more likely to import a different drug type when the cause was law enforcement, but when the cause was non-law enforcement traffickers were more likely to look for alternative sources of the same drug type within Australia. Switching drugs can pose a greater potential for harm: for e.g. if the trafficker switched from ecstasy to meth/amphetamine or heroin (drugs that are more harmful). Second, poly drug traffickers were more likely than their mono counterparts to: import more drugs of a different drug type, manufacture drugs, improve the purity or quality, expand their business, recruit new people into the business, and corrupt public officials. On the other hand, mono drug traffickers were more likely to look for alternative sources of supply within Australia or look for the missing drugs that had been seized by police. The adaptations made by poly drug traffickers very clearly have a much greater potential to cause harm to the public. Third, when the supply change occurred to domestic supply, traffickers were more likely to establish new drug laboratories, but when the supply change occurred to international supply, traffickers were more likely to import more drugs. Establishing new drug laboratories is arguably more harmful than importing more drugs, particularly if the cooks have no prior experience and/or if the laboratory is in a residential area (which they sometimes are), (UNODC, 2014). There is always a risk of explosion (Moor, 2014), and the waste products produced by illicit drug manufacture are potentially toxic for the environment (Pal, Mallavarapu, Naidu, & Kirkbride, 2008).

These findings highlight a need to better monitor supply changes, by collecting more detailed supply indicator data and performing more in-depth analyses of available data (Kilmer & Hoorens, 2010; Singleton, Cunningham, Groshkova, Royuela, & Sedefov, 2018). For example, additional details about seizures not routinely collected could also be coded, such as whether it was a mono or poly drug seizure. This is important for two reasons. First, to better understand market changes, and second, to improve understanding of what traffickers might do next. If there are more kinds of supply changes identified, and more aspects about them are known (such as the cause, drug type or trafficking style), then this would result in an improved capacity to predict what traffickers might do in response to any given supply change, what the consequence might be, and whether there is likely to be a change to the potential for harm to the public.

The research in this thesis developed improved methods for supply trend analysis of seizure data. This has implications for law enforcement, government, and academic reports, which present analyses of seizure trends. Supply trend analysis of these data can be improved using the following approaches: an analysis of annual total weight excluding the heaviest seizure per year; an analysis of the annual total number of the heaviest 100 seizures made over the analysis period; an analysis by weight bin, using bin limits defined by law; and an analysis by total weight or median purity which distinguishes contextual information about the seizures, such as the form, mode of transport, or supply origin. These analyses can identify more supply changes and represent them more accurately than the traditional analyses, which will aid future analyses of trafficker adaptations and consequences thereof.

Finally, the findings of this thesis show that more attention is needed to not *if* but *how* traffickers will adapt to supply changes. This has implications for law enforcement agencies which aim to cause supply changes through intervention. First, there should be a consideration of the type of trafficker before an intervention takes place. As shown in this research, high-level poly drug traffickers appeared more likely to adapt to supply changes in ways that could increase the potential for harm to the public. That's not to say that poly drug traffickers should not be targeted. It is becoming increasingly clear that this style of trafficking poses the most risk to the community (Hughes, Bright, & Chalmers, 2017; Hughes, Chalmers, Bright, & McFadden, 2016a; Hughes, Chalmers, Bright, & McFadden, 2016b). Rather, it is important to consider that by targeting this style of trafficker, there is a real risk that harms may be diverted or increased, rather than reduced. Second, there should be a consideration of the location before an intervention takes place. Domestic seizures appear more likely than international seizures to result in the establishment of new drug laboratories. Again, this is not to suggest

domestic interventions should not take place. But rather, the potential unintended consequences of domestic seizures should be considered prior to intervention. Finally, there is also a need to be mindful of diverting the drug problem to other drug types. Several law enforcement seizures in this study resulted in the trafficker or network switching to a different drug type. This may not always increase the potential for harm (for e.g. if the trafficker switched from cocaine to ecstasy), but can certainly increase the potential for harm in some situations (for e.g. if the trafficker switched from ecstasy to meth/amphetamine or heroin).

Limitations

Each study in this thesis had limitations, and limitations specific to those studies were outlined in their respective chapters. There were, however, more general limitations that apply to the research in this thesis as a whole.

The first caveat is that several of the main findings of this thesis were derived from a descriptive analysis. While an inferential statistical analysis would have been more rigorous, the sample sizes in many instances were too small when the data were broken down into groups. Nonetheless, these findings highlight potential areas of interest for future research to examine further. The second caveat is that all traffickers studied in this thesis were caught traffickers, who may operate differently from traffickers who are not yet caught. The third caveat is that the data analysed in this thesis contained only adaptations that had come to the light of authorities. There may be other key adaptations used by traffickers that are not routinely identified in court.

Future Research

There are 10 main supply change kinds listed in Table 1 (Chapter 1) that high-level synthetic stimulant traffickers are potentially exposed to. However, adaptations to only five of those kinds were examined in this research, which leaves five unaccounted for: supply routes, mode of transport, price, supply origin, and precursor type. This provides a gap for future research to address.

Moreover, given the limitations of the research in this thesis, namely that it was research on traffickers who were caught, additional research on this topic with different methodologies and samples will be of benefit. If more research on trafficker adaptations to supply changes is conducted with different methodologies (e.g. interviews with incarcerated or active traffickers) and on different samples, and that research tells a consistent story to the findings here, then

there can be more confidence that the findings here are representative of the broader population of drug traffickers (as opposed to just drug traffickers who were caught).

Finally, as argued earlier, there is a need to further research on trends in drug supply changes for different drug types and in different countries. Future analyses may benefit from the alternative methods of analysis presented in this thesis. In particular, the application of weight bin analysis could be expanded to other drug types in Australia (such as cocaine) and/or to other world regions. However, these alternative methods of analysis are dependent on sufficient data being available and are therefore not currently applicable in all world regions. For instance, analysis by weight bin would require access to unpublished unit-record law enforcement seizure data.

Conclusion

This thesis highlights the complex adaptive nature of the illicit drug trade. It showed that a wide variety of supply changes occurred in Australia's ecstasy and meth/amphetamine markets between 2002 and 2014. It showed that when high-level synthetic stimulant traffickers in Australia were exposed to supply changes, few became inactive or left the market. Moreover, they were found to make a wide variety of adaptations. While many adaptations were associated with attempts to maintain a sufficient purity, quantity or quality of the same drug type, other adaptations included structural and functional changes to the broader network, including decentralisation, and the recruitment of new traffickers and corrupted public officials. Their adaptations allowed them to continue selling drugs in most instances after exposure to a supply change, which highlights their resilience to supply changes. Some adaptations had the potential to result in less harms to the public, while others had the potential to result in more harms to the public. This makes it difficult to predict the outcome of any policy change or law enforcement intervention that aims to disrupt the supply of illicit drugs.

Importantly, this research showed that the adaptations used and the potential impacts on harm to the public depend on various characteristics associated with the supply change (such as the kind, cause, direction, trafficking style, location, and the time elapsed). This highlights a need to better monitor supply changes and consider the likely impacts. A better understanding of supply changes could lead to a reduction in harm to the public when combined with an analysis of trafficker adaptations. Several suggestions for improving the way law enforcement data are collected and analysed were presented in this thesis. There have recently been steps

in the right direction, but more routine monitoring of supply changes, dedicated research, and analysis of the potential impacts is encouraged.

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Appendix A: Additional Weight Bin Analyses
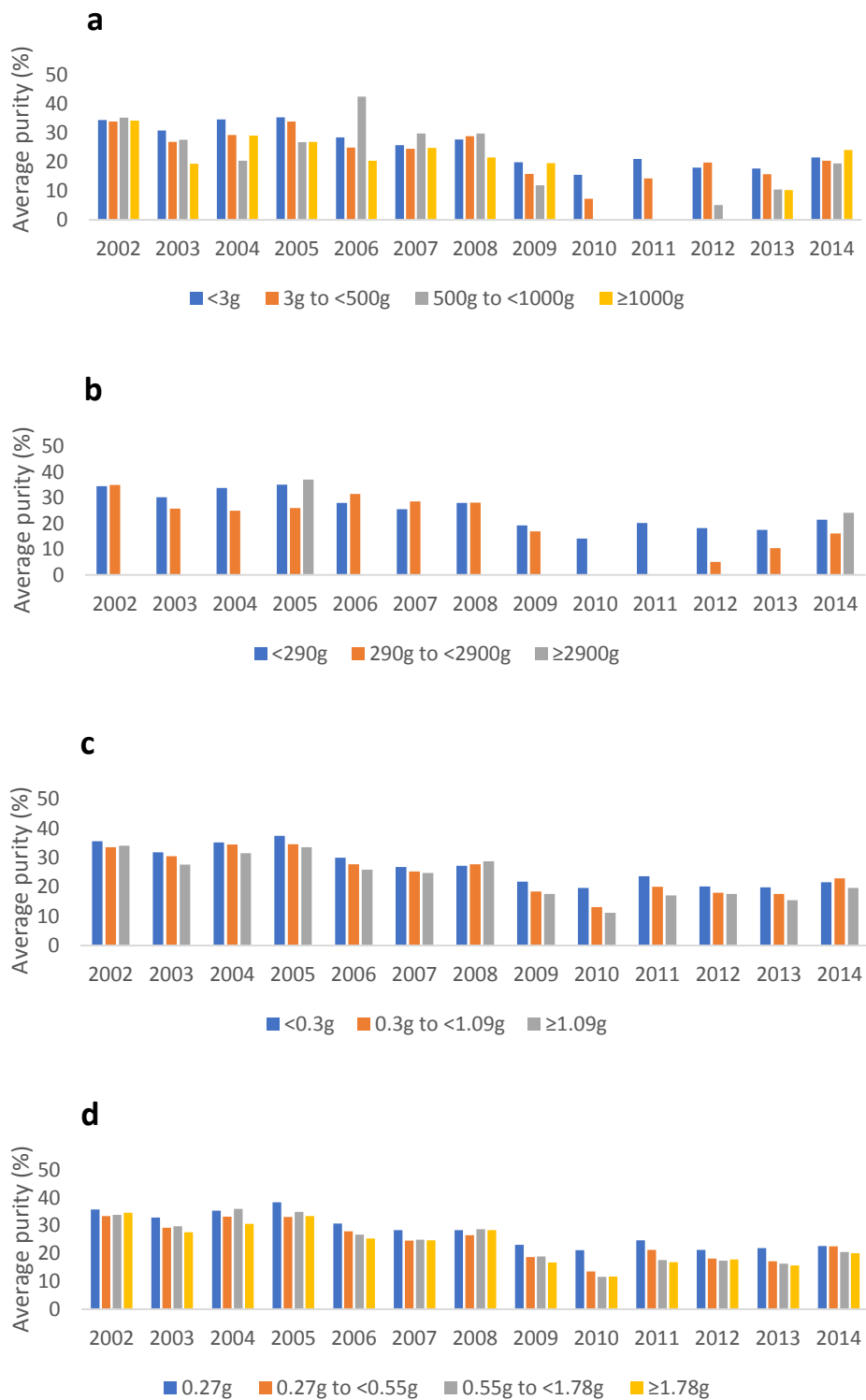
Figure 66. Weight bin analyses of tablet ecstasy Vic purity data distinguishing the four alternative methods: law (a), research (b), third percentiles (c), and quarter percentiles (d).

Figure 67. Weight bin analyses of powder ecstasy Vic purity data distinguishing the four alternative methods: law (a), research (b), third percentiles (c), and quarter percentiles (d).

Figure 68. Weight bin analyses of crystal ecstasy Vic purity data distinguishing the four alternative methods: law (a), research (b), third percentiles (c) and quarter percentiles (d).

Figure 69. Weight bin analyses of tablet meth/amphetamine Vic purity data distinguishing the four methods: law (a), research (b), third percentiles (c), and quarter percentiles (d).

Figure 70. Weight bin analyses of powder meth/amphetamine Vic purity data distinguishing the four alternative methods: law (a), research (b), third percentiles (c), and quarter percentiles (d).

Figure 71. Weight bin analyses of crystal meth/amphetamine Vic purity data distinguishing the four alternative methods: law (a), research (b), third percentiles (c) and quarter percentiles (d).
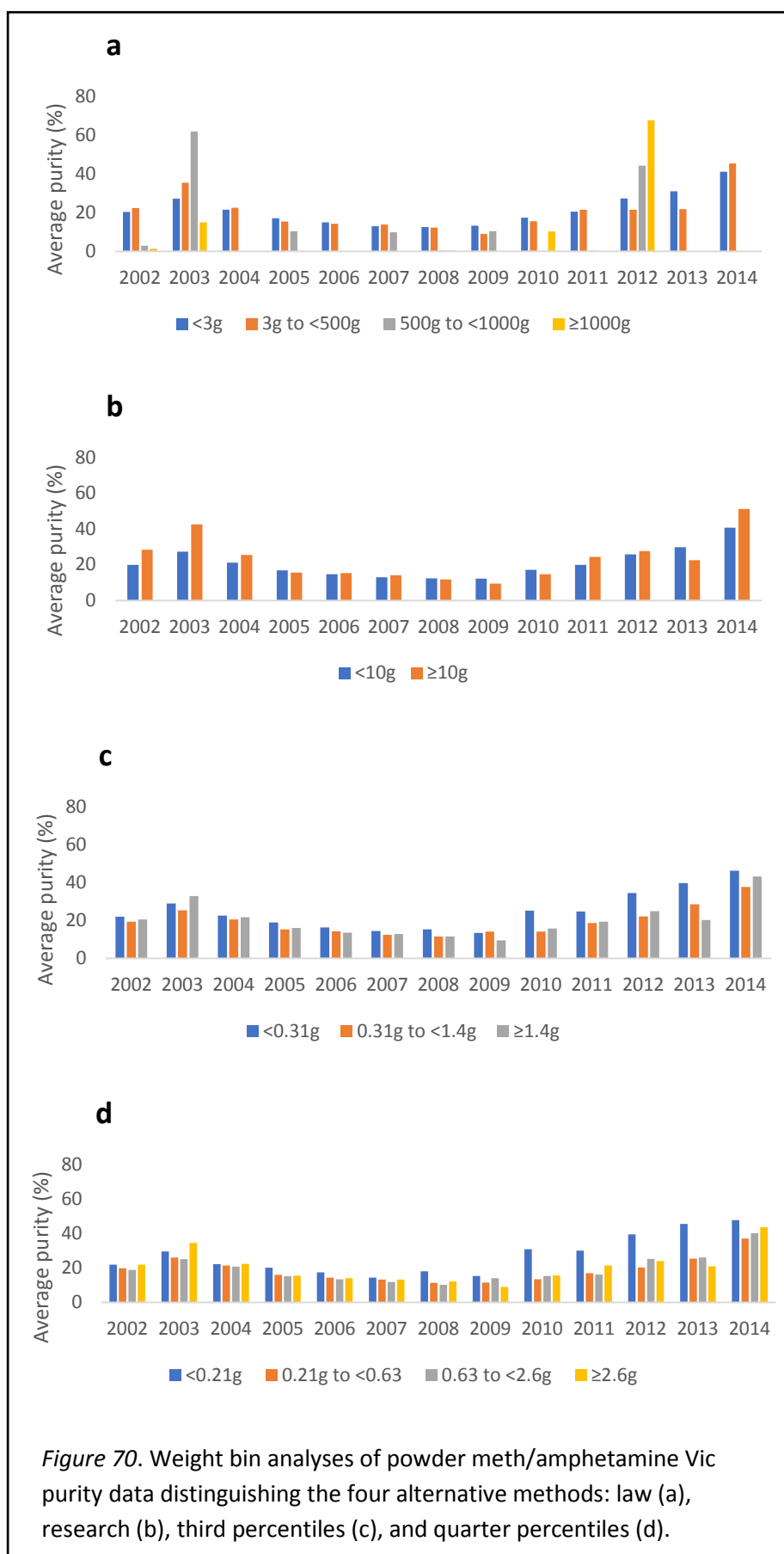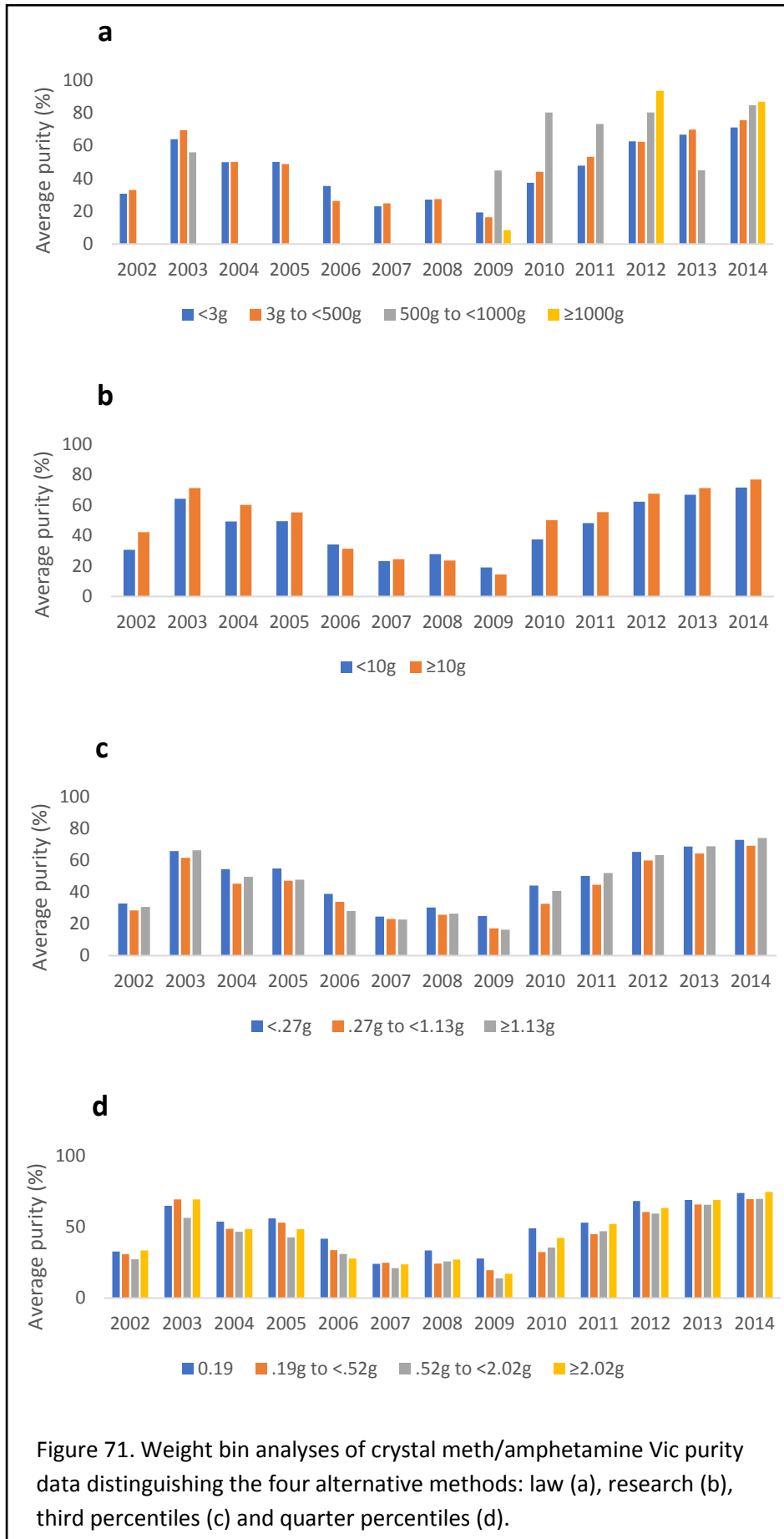
Appendix B: Example Transcript of Sentencing Comments, Downloaded from Australasian Legal Information Institute

R v Rustom; R v Vernon [2017] NSWDC 245 (2 August 2017)

Last Updated: 7 September 2017

District Court

New South Wales

Case Name:	R v Rustom; R v Vernon
Medium Neutral Citation:	[2017] NSWDC 245
Hearing Date(s):	31 July, 1 – 2 August 2017
Date of Orders:	2 August 2017
Decision Date:	2 August 2017
Jurisdiction:	Criminal
Before:	Neilson DCJ
Decision:	R v Rustom: I set a NPP of 3 years, 3 months, commencing 18/11/15 and expiring 17/2/19. I impose a further period of imprisonment of 2 years to commence upon the expiration of the NPP and expiring 17/2/21. The total sentence is, therefore, 5 years and 3 months comprising the NPP and the balance of the sentence.

R v Vernon: I set a NPP of 2 years, commencing 18/09/15 and expiring 17/9/17. I impose a further period of imprisonment of 1 year, 9 months to commence upon the expiration of the NPP, and expiring 17/6/19. The total sentence is, therefore, 3 years and 9 months comprising the NPP and the balance of the sentence.

Catchwords:	CRIME – SENTENCE – co-offenders – supply of prohibited drug, namely cocaine – commercial quantity
Legislation Cited:	Crimes (Sentencing Procedure) Act 1999
	Drug Misuse and Trafficking Act 1985
Category:	Sentence
Parties:	Regina (Crown)
	Waeil Rustom (Offender)
	Robert Max Vernon (Offender)
Representation:	Counsel:
	Mr K Gilson (Crown)
	Mr B Walker SC with Mr E James (Rustom)
	Ms A Francis (Vernon)
	Solicitors:
	Solicitors for ODPP (Crown)
	Kiki Kyriacou Lawyers (Rustom)
	Kiki Kyriacou Lawyers (Vernon)

File Number(s):   2015/273894 (Rustom)2015/274045 (Vernon)

Publication Restriction: Nil

JUDGMENT

1. HIS HONOUR: Each of Waeil Rustom and Robert Max Vernon stands before me for sentence as a consequence of having pleaded guilty to a charge contrary to s 25(2) of the *Drug Misuse and Trafficking Act 1985*. Each has pleaded guilty to supplying a prohibited drug in a commercial quantity. The amount in question is 355 grams of cocaine. The maximum penalty for this offence is twenty years imprisonment and/or a fine of 3500 penalty units. There is a standard non-parole period of ten years. The two offenders currently before me appeared before me last Monday and yesterday for sentence with four other offenders but their sentencing hearing has been adjourned until September.

Facts

2. The relevant facts are these. In March 2015 the Middle Eastern Organised Crime Squad and the NSW Crime Commission commenced an investigation into a number of participants identified as Waeil Rustom, Robert Vernon, Abdul Rustom, the younger brother of Waeil Rustom, Cabdiqure Gure, Ahmed Naaman and Denial Sfeir. Through the use of lawful telephone intercepts, a surveillance device, controlled drug purchases, and physical and covert surveillance, police identified what they considered to be an organised drug syndicate involving the supply of cocaine to numerous customers at street level. Waeil Rustom was responsible for directing the activities of the supply of cocaine. He supplied cocaine to Robert Vernon who advertised his working hours as being between 3pm and 12 midnight. If Vernon needed further bags of cocaine for supply he would make telephone contact with Waeil Rustom. Waeil Rustom had supplied Vernon with a motor vehicle, firstly a Toyota Aurion and later a Subaru Liberty, to assist with the transportation of the cocaine and he also supplied a mobile phone allowing customers to send text messages or to make telephone calls to Vernon to arrange for the purchase of cocaine. Vernon's role within the group was to transport and supply prohibited drugs to customers with the irregular assistance of the four other members of the syndicate. Vernon would seek approval from Waeil Rustom to determine whether cocaine should be supplied to a particular customer. This included contact during the late hours of the night, including after midnight, and he also needed to seek approval as to whether a particular supply should take place.

3. An undercover officer (UCO) utilised by the New South Wales Police, using drug code, placed an order with Vernon for one ounce of cocaine. A further conversation with another undercover agent revealed that Vernon had spoken to Waeil Rustom who had told Vernon that the supply should not take place to that UCO, although that UCO's role was then unknown to each of Waeil Rustom and Vernon. If any customer complained, such complaints were conveyed by Vernon to Rustom who would direct Vernon to stop supplying cocaine, if the quality of cocaine became a problem. On occasions Waeil Rustom instructed Vernon as to where to drop off the takings of a

night's trade and any unused or unsold cocaine. Eventually all proceeds of sale and any unused cocaine were returned to Waeil Rustom.

4. Requests were made from time to time by Vernon to Waeil Rustom to be permitted to take days off from supplying drugs so that he could attend to family business. 27 July 2015 was one such night. Vernon and his brother were lawfully recorded discussing the brother's intention to purchase cocaine from Vernon for $100. Vernon advised his brother that the cheapest price for which he could supply cocaine was $250. Vernon told his brother that it was his night off and that Waeil Rustom would not even give him one bag of cocaine. Vernon told his brother that Waeil Rustom was not happy because there had been a $2000 shortfall from the weekend sales which were meant to amount to $17,000. Vernon also told his brother that "the big fella", meaning Waeil Rustom, had gone to Melbourne and as a result Vernon had to run the operation. Police obtained evidence that Waeil Rustom did fly to Melbourne on 24 July 2015 and returned to Sydney on 26 July 2015.

5. On busier nights Vernon would contact Rustom and arrange a driver. They would call upon others such as Naaman, Abdul Rustom and Denial Sfeir to drive. Gure, a taxi driver, was also utilised to transport cocaine. The other four participated and assisted in this criminal enterprise of supplying cocaine. They would act as drivers and sometimes acted as couriers to take cocaine from Waeil Rustom to Vernon, as Vernon was selling it throughout the Sydney metropolitan area. The assistance provided by Abdul Rustom, Gure, Naaman and Sfeir was irregular, its depending upon Vernon taking days off or evenings becoming busy.

6. It was the habit of this syndicate to sell cocaine for $300 a bag or a ball of cocaine for $1000. Larger quantities of up to 15 bags, which amounted to 11 grams, were also supplied to individual customers on rare occasions. The agreed facts set out a large number of individual supplies. These supplies would be well-known to the two prisoners standing for sentence. On Friday 17 July 2015, 13 bags of cocaine were supplied. On Saturday 18 July 2015 14 bags of cocaine were supplies. On Sunday 19 July, 2015, five bags of cocaine were supplied. On Friday 24 July 2015, 11 bags of cocaine were supplied. On Saturday 8 august 2015, 28.5 bags of cocaine were supplied. On Thursday 20 August 2015, 11.5 bags of cocaine were supplied and on Thursday 27 August 2015, two bags of cocaine were supplied.

7. During the investigation of this criminal syndicate a UCO obtained three supplies of cocaine and obtained an agreement to supply on a further occasion. During meetings between the UCO and Vernon, Vernon advised the UCO that she was required to use code when organising the purchase of cocaine to avoid police detection. Furthermore, Vernon advised that if he were unable to supply her or was busy, he would send it and it would arrive with his taxi driver who he named "Absolutely" which was a coded name for Gure. Furthermore Vernon informed the UCO that he could supply a ball of cocaine for $1000 and that such a supply amounted to four and a half bags. A ball is therefore 3.6 grams as each bag was said to weigh 0.8 grams. Between 10 July 2015 and 17 September 2015, a total amount of 355 grams of cocaine was supplied by Vernon within the contemplation of the joint criminal enterprise to supply cocaine. Despite Vernon's statement that a bag was .8 grams, each bag contained 0.75 grams of cocaine.

Form 1 matters

8. Each of the offenders asks me to take into account matters on Forms 1. Waeil Rustom asks me to take into account a supply of a prohibited drug namely cannabis. He also asks me to take into account the crime of dealing with property suspected of being the proceeds of crime. That property was $10,205 in cash. He also asks me to take into account the supply of another prohibited drug, heroin, in the amount of 54.4 grams. On Sunday 21 June 2015 in the late afternoon, Waeil Rustom contacted another person asking whether he had "any weed" and, having obtained a positive response, he asked that person to drop past the home of a lady who was known to be a girlfriend of Waeil Rustom and supply cannabis to her. At the time of Waeil Rustom's arrest police found $10,205 in cash in a bedside drawer. By asking me to take that matter into account on a Form 1, Waeil Rustom is in fact admitting that that $10,205 was the proceeds of supplying drugs. At the time of the same search police located in a pillowcase in the basement of Waeil Rustom's premises, a brown coloured powder inside a clear resealable bag. Forensic analysis showed that to be 54.4 grams of heroin with a purity of 59%. DNA testing conducted on each of the plastic bags detected the DNA of Vernon as well as of Rustom.

9. Vernon asks me to take into account three matters on his Form 1. They are the supply of the prohibited drug cannabis, dealing with property suspected to be the proceeds of crime, namely $400 in cash, and supplying a prohibited drug namely the same 54.4 grams of heroin that was found in the basement of Waeil Rustom's premises at the time of the police search. The supply of cannabis in which Vernon was involved was different to that which Waeil Rustom asks me to take into account. On 15 July 2015 Vernon informed a male customer that he had picked up some cannabis which he supplied to a customer. The code name for cannabis was "green smelly sock". There was reference to a quarter sock, meaning seven grams of the prohibited drug cannabis. After the arrest of Robert Vernon at Monterey, police searched the Subaru Liberty sedan which he had then been using in the supply of cannabis and police found within it $400 in cash and plastic resealable bags. By his asking me to take that into account on the Form 1, Vernon admits that the $400 found in his car was the takings from the sale of drugs.

Gravity of the offence

10. A number of things need to be said about the business of this drug syndicate. The syndicate was neither sophisticated nor overly elaborate. The "codes" used for description of drugs are obvious codes and ones with which the Courts and law enforcement agencies are quite familiar. Secondly little attempt was made to disguise those involved. The person whose disguise was greatest was, of course, he who did not deal with members of the public, but was the actual supplier, Waeil Rustom. However, police would have found it easy to work out what was happening from intercepted telephone calls and the like. The third point to note is that this syndicate was not the importer nor the manufacturer nor the ultimate supplier of the drugs. From what I shall discuss when pointing out the personal factors of Waeil Rustom, he had been a user of cocaine who found it convenient to become a supplier because in that fashion he could obtain drugs for "nothing". He would appear to have bought in bulk from someone higher up a distribution network and then formed this syndicate in order to sell cocaine in the Sydney metropolitan area.

11. The maximum penalty as I already stated for this offence is 20 years imprisonment. However 20 years imprisonment is designed for a worst type of case. It is easy to postulate a worst type of case. The small amount of cocaine is 1 gram. The trafficable

amount of cocaine is 3 grams. The indictable quantity of cocaine is 5 grams and the commercial quantity of cocaine is 250 grams. A large commercial quantity is 1 kilogram. A worst type of case for an offence contrary to s 25(2) would be, for example, the supply of 990 grams of cocaine. In this case we are dealing with 355 grams of cocaine about one-third of a large commercial quantity and roughly a third of the maximum permissible for a commercial quantity of drugs. Secondly, a worst case would involve an elaborate or sophisticated scheme, which this hardly was. Thirdly, a worst case would be one where the motive for the sale of the cocaine or the distribution and supply of the cocaine was pure, economic gain, the cynical sale of drugs to make money, where those involved in the drug supply were not themselves users or drug addicts. A worst type of case might also include one where there was a second or third offence of the same type. In considering the objective seriousness of this supply, such matters must be taken into account.

12. It has been submitted on behalf of both Waeil Rustom and Vernon that this present supply was below the midrange of objective seriousness. With that submission I concur.

Personal circumstances – Waeil Rustom

13. I turn now to the circumstances of Waeil Rustom. There are a number of sources from which I can ascertain that background. The first is Waeil Rustom's criminal record. The second is a pre-sentence report prepared by Community Corrections on 27 July 2015. The third is an affidavit sworn by the offender himself, on 29 July 2017 and the fourth is a report from a psychologist, Danielle Hopkins, who interviewed the offender at Long Bay Gaol on 20 June 2017 for one hour and 40 minutes.

14. Waeil Rustom was born in Sydney on 24 December 1974. He is currently 42 years old. He is the eldest of nine children. His brothers and sisters currently are aged between 40 years and 20 years. His parents are both still alive. Each is aged 63 years. He attended primary school in Greenacre and then went on to high school at Punchbowl Boys High. Because he was struggling at school he repeated year 11, but it soon became obvious to him that he would not succeed in year 11 and he then left school to start work.

15. His family were involved in the fruit and vegetable markets at Flemington. He had first started working there at the age of 13. The family stall at the Flemington markets was owned by an uncle, Abdul Rustom, who is not to be confused with the offender's younger brother. Apparently all members of the offender's family had worked at this stall at various times. The offender worked in the family business until he married in 1996 when he would have been 22 years old. About that time he commenced working for Woolworths Supermarkets as the manager of a fruit and vegetable department at one of its supermarkets. He worked for Woolworths for about six years. In or around 2002 he left Woolworths and opened up a fruit shop with his brother Omar. That fruit shop operated for about four or five years and when it was operating the offender was working seven days a week and up to 16 hours a day. The business was sold in either 2006 or 2007. The offender then opened a stall at the Flemington Markets which he described as "an expanded venture from my uncle's business". According to the offender's affidavit that business has been successful and is still running at the current time despite the offender's incarceration. It is being run by his brother, Omar. This business employs four or five workers. The offender in his affidavit said that when he

was working in the business he was still working five or six days a week and up to ten hours per day, starting work at 1am.

16. The offender admits to have a gambling addiction. He started gambling in 1992 when he was 18 years old. He commenced placing bets on horses in the Melbourne Cup. In his affidavit the offender stated that that led to an addiction to gambling which he has now had for some 22 years. Because of gambling losses he said that he is behind with his mortgage repayments, personal loans and payments for credit card debts incurred by his wife. Nevertheless in 1998 and 2001 the offender bought investment properties in Busby which had been refinanced on a number of occasions but still have outstanding mortgages of $450,000. In [31] of his affidavit the offender said that when he was working at Woolworths and at the markets his whole wage was basically being spent on poker machines and on horses.

17. In his affidavit the offender sought to attribute the onset of his illicit drug habit to an industrial accident at Woolworths in 2002 when he injured his back when he slipped off a ladder. That led to his being off work for six to eight weeks and then he returned to work on light duties. He said that he worked on light duties for about 12 months. He said that he was told that after that 12 month period he was told to return to normal work. In 2002 he was advised by a "work colleague" to take the drug "speed", that is amphetamine, which would help in relieving his pain and stress and could make him work faster. One must take such self-serving statements with a large grain of salt, especially when there is no corroborative evidence. The problem for the offender is that there is a hiatus, a causal hiatus, between what he attested to in paragraphs [32] to [35] of his affidavit with the contents of the following paragraph which is this:

"Several months later I remember going to a friend's bucks party and accepted cocaine."
He may have attended a bucks party and he may have been offered cocaine but there is no causal relationship between that and having a back injury. The use of some form of stimulant is usual at bucks party, although in our society the normal stimulant is alcohol.

18. The following paragraphs of the offender's affidavit are these:

"When taking cocaine it made me feel alive. I had no stress. I was relieved from all the work drama and family problems I was having.

After the bucks party I started to consume about a gram every few weeks. It got to the stage where I was consuming one gram of cocaine a week at home just to relax.

Before I knew it, years had passed and I was consuming 3 - 4 grams a day."
By the time that the offender was consuming three to four grams of cocaine daily he was taking Xanax to help him go to sleep.

19. In 2012 and again in 2014 the offender travelled to Lebanon "to get away from my drug addiction". The history suggests that when he was in Lebanon he did not take illicit drugs. However the offender never sought any professional help for his drug addiction when in Australia. Although he contacted Gambling Anonymous on about two occasions he never followed up his contact with that organisation in order to assist him in giving up his gambling addiction. The offender asks me to accept that his becoming involved in the supply of cocaine followed upon his personal addiction. This is not uncommon, unfortunately. In his affidavit he said this:

"The first time I got involved in the supply of drugs was in late 2014 to early 2015.

A friend of mine asked me if I could provide him with 2 grams of cocaine. I said, 'Yes', as at this time I was already an addict and had a regular contact that would provide me with cocaine on a daily basis.

I contacted my contact and organised 2.5 grams of cocaine for the price of 2 grams. I remember it cost around $500-$600. I lied to my friend and gave him the 2 grams and kept the .5 of a gram to myself for personal use.

The first time I supplied a drug wasn't even for money but for a drug gain."

It is common for those who take up supplying drugs to have previously been supplied by others and for such persons to supply to others in order to obtain their drugs for nothing or to pay off an acquired drug debt.

20. In [57] of his affidavit the offender said that towards the end that "All day, every day, drugs were on my mind. The sensation of consuming cocaine provided me with such a high that I thought I was invincible and I didn't want to come down".

21. When interviewed by Ms Danielle Hopkins, a psychologist, on 20 June 2017 the offender stated that one of his younger brothers was sentenced to imprisonment for 17 years in around 2004. This would appear to be his younger brother Mohamed who is currently 38 years. Other evidence before me indicates that Mohamed was sentenced to such a lengthy term of imprisonment for a murder within the gaol system. According to the history obtained by Ms Hopkins the offender's brother's sentence was a pivotal point in his life because it started him on daily use of the drug thereafter. However, there is no such averment by the offender himself in his affidavit. Furthermore, he appears to have first taken up using cocaine in 2002. It is a common fallacy for psychologists, psychiatrists and many medical practitioners to argue that because something occurs after another thing that it is caused by it: post hoc ergo propter hoc. That is a fallacy in medicine as well as in logic and in law. It may have caused him to take more drugs than he had been before that time. That was not the genesis of his drug addiction which appears to have arisen in a social context.

22. The psychologist's report makes it clear that not only was the money earned by the drug syndicate used to service the offender's cocaine habit and also his gambling habit, but also to pay for prostitutes. Those were the offender's priorities rather than repaying his mortgages or using the money to care for his family. As a result of the offender's marriage to his wife Joanne, they have four children who are currently aged between 16 and 8.

23. Ms Hopkins has a history that the offender was introduced to cocaine by friends in his late 20's and his initial use of the drug was moderate, one gram once or twice weekly. However, by the age of 30 and leading up to his being arrested he had increased his dosage up to 5 grams a day. She also recorded a history of the need to take Xanax for sleeping, but also that the offender was drinking 10 to 20 standard drinks of alcohol in bi-weekly alcohol binges and that he used the drug ecstasy once a month until his arrest. Ms Hopkins diagnosed a substance use disorder, which is hardly surprising, bearing in mind the offender's addiction to cocaine.

24. The history she obtained confirms what comes through from all of the material before me that the offender became involved in drug supply to support his own significant cocaine use and to reimburse him for his gambling debts and his dissolute lifestyle.

25. The offender has a criminal history. On 12 January 1993 he was charged with hindering police and resisting arrest. Fines were imposed and a sentence of imprisonment until the rising of the Court. He committed similar offences on 22 May 1998 as well as driving whilst disqualified. On 26 November 2000 he committed an offence of having goods in personal custody reasonably suspected of having been stolen. For that he was fined. On 30 March 2001 he was charged with possessing a prohibited drug for which he was fined. On 17 June 2004 he was found guilty of a number of driving offences which are of no great moment except that one of them was driving on an expired licence for which he was fined. There was a further conviction for possessing a prohibited drug on 22 December 2012 for which he was placed on a bond to be of good behaviour for 12 months pursuant to s 9 of the *Crimes (Sentencing Procedure) Act 1999*.

26. On 23 November 2009, that is before that offence, he was found guilty of driving on a road while his licence was suspended. For that he was fined and disqualified from driving for 12 months commencing 3 February 2010. However, on 6 May 2010 he was found guilty of driving whilst disqualified from holding a licence, that is, within a number of months of his having been disqualified from driving he was found to be driving, but he was dealt with under s 10 and placed on a bond for two years. However, he breached that bond and was called up on 20 January 2011 and was placed on a s 9 bond for 18 months and disqualified from driving for 2 years commencing on 20 January 2011. The breach was caused by his driving whilst disqualified on 17 November 2010. For that offence he was ordered to perform 200 hours of community service and the same disqualification period (2 years commencing on 20 January 2011) was imposed. On appeal to this Court at Parramatta, the second disqualification period was to commence two years later, that is, on 20 January 2013. He again drove whilst disqualified on 17 October 2012 and on this occasion he was fined $2,000 and sentenced to imprisonment for two years which was suspended pursuant to s 12 on condition he enter into a good behaviour bond for two years commencing on 24 January 2013. On appeal to this Court at Parramatta the term of the suspended sentence and, therefore, of the bond was reduced to 6 months but this Court confirmed the earlier imposed disqualification period of 2 years commencing on 19 January 2015. Fortunately for the offender the good behaviour bond expired before the commission of the current offences.

27. Generally speaking driving offences are of little moment in a case such as this. However, the offender's continuing to driving whilst disqualified shows contempt for the legal system, contempt for the law, and displays an arrogance which is reprehensible.

28. Since being incarcerated the offender has committed two offences, each an offence of possessing a prohibited drug. For those offences he appeared before the Local Court at Lithgow on 4 May 2017 and was sentenced to two months imprisonment commencing on 4 May 2017. I know from cross-examination by the learned Crown Prosecutor that one of the drugs involved was methyl amphetamine and the other was buprenorphine. The offender said in cross-examination that they were not for his personal use, that he accepted them into his custody following a visit by family members and friends in order to pass those drugs on to some other inmate at Lithgow Gaol. I was highly

sceptical about that explanation bearing in mind that the offender has not undergone any drug or alcohol rehabilitation since his arrest, but the same matter was deposed to in cross-examination by his brother Omar Rustom. There being some, albeit hearsay, corroboration for the offender's explanation, I am prepared to accept that he did take possession of these drugs in order to hand them on to another inmate. This does not display arrogance, but stupidity, putting himself in harm's way in order to big note himself with another gaol inmate.

29. Despite the fact that the offender has provided little, if any, physical support to his wife and children in recent times the offender's wife Joanne is prepared to stick by him despite the evidence before me of his dissolute lifestyle. His wife and children are now living in rental accommodation in Greenacre, dependent on government support and charity, in particular assistance from the offender's brother Omar. However, the presence of a supportive wife and children is positive for the future. The offender has a wife and children to whom to return, a wife and children to whom he owes much morally, and whose presence should work for the good in encouraging the offender to rehabilitate himself.

30. The offender is also supported by his brother Omar who is prepared to have him back working at the Flemington Markets in the business that he and the offender co-own. Omar Rustom also has a criminal history, but it is clear that he last offended in 2010 and for the last seven years has been living a law abiding and worthwhile life. Again, the presence of a business to return to and the support of his business partner, his brother, is again positive for the future, provided this offender rehabilitates himself. If I give credence to what he says in his affidavit that is his intention. He admits frankly to the fact that "I honestly believe the coming to gaol saved my life".

Consideration

31. It is well established that only in exceptional circumstances will a non-custodial sentence be appropriate for drug traffickers whether a profit has been obtained or not, although position is worse where there has been commercial exploitation. Learned senior counsel for Mr Rustom, Mr Walker SC, with whom Mr James appeared, on the first day of the sentencing hearing essentially conceded that that principle applied to Waeil Rustom.

32. I am prepared to accept that the offender's intentions at the moment are good and that he has not sought to mislead me as to how he presently feels about his position. He clearly wants to rehabilitate himself. He clearly wants to be free of his gambling and drug addictions, but it is easy to be abstinent of drugs and to refrain from gambling when one is in prison. There must be some form of positive reinforcement so that when released from custody the offender will have the physical and psychological resources to resist the temptation to take drugs and to gamble or to adopt other dissolute forms of behaviour such as drinking excess alcohol and the like.

33. I accept Mr Walker's submission that the need for specific deterrence should be considered to have been reduced because of the offender's intention to pursue a path of rehabilitation. Unfortunately, he has not been able in the gaols run by New South Wales Corrective Services to undertake any courses designed to rehabilitate him. It appears from the experience of Mr Vernon, who has been in privately run gaols, that courses are available to him, albeit that he has not yet been sentenced. The rehabilitation to which Mr Walker SC referred was a fact the offender has stopped

taking drugs and stopped gambling and stopped using prostitutes since his incarceration. However, as I said, that is not the sole answer to the question of rehabilitation. It depends upon what courses and formal rehabilitation the offender may undergo that will keep him on the straight and narrow once he is released from custody.

34. Keeping the offender on "straight and narrow" has been the cause of another submission put to me by Mr Walker SC that I ought make a finding of special circumstances because the offender will need the assistance of Community Corrections when released from custody to stay on the straight and narrow and that is the best way of ensuring his rehabilitation.

35. Mr Walker SC in his written submissions listed a number of possible aggravating factors, but when one considers those aggravating factors carefully one can see that in essence they are a mere regurgitation of the underlying facts and elements of the offence that the offender committed.

36. On the other hand Mr Walker SC submitted that the offender is unlikely to reoffend and has good prospects of rehabilitation, but again that in my view is dependent upon the offender's undertaking meaningful formal rehabilitation whilst in custody.

37. It has been submitted on his behalf that the offender is also remorseful. Clearly he is ashamed of himself and cares for the shame he has brought upon his family, that is his parents and siblings, and on his wife and children. However, the Court is more concerned not with such matters, but with whether he realises the extent to which that he has hurt the community, the extent to which the supply of drugs hurts the community. Use of illicit drugs destroys lives. There may be many who use cocaine and only a small number of them may develop real social problems, but even a small number who develop real social problems is too many. Furthermore, the drugs are often supplied to people who pass them on to others who do not know how to use them or overdose. No supply of drugs is in any way justified, nor is the fact that cocaine might be thought to be a "party drug" or a drug for wealthy users is any adequate excuse or explanation for involving oneself in supply.

38. It is common ground between the Crown and the offender that the offender pleaded guilty at the earliest available opportunity in the Local Court and is therefore entitled to a 25% discount for the utilitarian value of his plea of guilty.

39. Although I accept that the question of specific deterrence is attenuated in this case by reason of the circumstances in which the offender came to be supplying and because the effect of his arrest and incarceration has had on him, the Court must still apply other principles of sentencing. Those principles include general deterrence, that is deterring others who might be tempted along the same path as this man, to commit the like offence. The Court is also required to pass a sentence which punishes the offender for his conduct and to adequately express our society's disapproval of his conduct.

40. There is a standard non-parole period of ten years. Such would need to be considered much more closely if this offender had pleaded not guilty, had been found guilty after trial and where the Court could find that this case was in the mid-range of objective seriousness. However, according to the usual principles of sentencing a case in mid-

range should call for a head sentence of around ten years, not a non-parole period of ten years. This is another flaw in the system of standard non-parole periods. Such flaws are not uncommon in the standard non-parole period system.

41. I have reached the conclusion that the starting point for the sentencing exercise for Waeil Rustom is a sentence of seven years imprisonment. I discount that by 25% because of the offender's plea of guilty at the earliest available opportunity. That reduces the head sentence to five years and three months. The question then becomes what should be the non-parole period. Applying the statutory ratio, the non-parole period should be three years and 11 months. I have determined that the non-parole period should be three years and three months leaving the offender with two years to be under the direction and control of Community Corrections to ensure that the offender does maintain his resolution to stay clear of drug addiction, gambling addiction and a life of crime.

42. The offender must realise, however, that it is not automatic that he will be released from imprisonment after three years and three months. That is because it will be up to the Parole Board to make such a decision and no doubt the Parole Board will want to know that the offender has undertaken all such courses as could be provided to him to ensure that he does not relapse to drug and alcohol use or gambling addiction when released from custody.

Sentence

43. Waeil Rustom on the charge that between 16 June 2015 and 18 September 2015 in and around the Sydney area in this State you did supply an amount of prohibited drug, namely 355 grams of cocaine, being an amount which was not less than the commercial quantity applicable to that prohibited drug, you are convicted. I sentence you to imprisonment. I set a non-parole period of three years and three months commencing on 18 November 2015 and expiring on 17 February 2019. I impose a further period of imprisonment of two years to commence upon the expiration of the non-parole period and expiring on 17 December 2021. The total sentence is, therefore, five years and three months comprising the non-parole period and the balance of the sentence. I have found special circumstances. You are eligible to be considered for release to parole at the expiration of the non-parole period. I have taken the Form 1 matters into account in passing that sentence.

44. You were arrested on 18 September 2015, but I have commenced the sentence on 18 November 2015 to account for the two month period of imprisonment imposed by the Local Court at Lithgow earlier this year.

SHORT ADJOURNMENT

Personal circumstances – Robert Max Vernon

45. Robert Max Vernon was born on 18 March 1975. He is currently 42 years old. His father is an Englishman with an Armenian background. His mother is a Swiss National who migrated to Australia in her childhood. His mother currently lives in a small town near Kempsey on the Mid North Coast of this State where she works as a part-time school teacher. Two and a half years after the offender's birth his parents separated. That was also shortly after the birth of his sister Natasha who currently lives in Darwin. The separation of his parents was not an harmonious one. There was substantial

animosity between his parents and there was constant "fighting" regarding custody of the offender and his sister. The offender referred to the relationship between his parents as being "very volatile". His father has married on three further occasions and has divorced on three further occasions. In his childhood the offender came to live in Sydney with his maternal grandmother and his mother in Wollstonecraft. He attended the North Sydney Demonstration School. At the age of 10 he was struck by a motor vehicle whilst crossing the road and had a severe fracture in his right leg and was in a cast for the next six months. There were complications from the fracture and there is still a residual twisting of his right leg.

46. When the offender was nine or ten years old, he and his sister went to live with their father in Queensland for one year. During that one year the offender attended Elanora State School. This was not an easy period for the offender. He attests in his affidavit to his father having no experience in raising children and that might have been because he himself grew up without knowing his own father. The offender and his sister did not like living with their father and they returned to Sydney. Some two years later their father had relocated to Canada where his then wife had been born. The offender went there for a holiday but again there was a clash between the father and the offender. The offender in Year 7 was living with his mother, they had moved to live in Earlwood with her new partner Eric. His sister Natasha returned to living in Wollstonecraft after the visit to Canada, living with her grandmother. In Year 7 the offender attended Kingsgrove North High School. In the following year his mother and Eric moved to Guildford where the offender attended the Granville South High School. It was only after moving to Guildford that the offender was exposed to children from different ethnic backgrounds to his own ethnic background, that is a European background.

47. The offender completed High School in 1992. His better subjects were mathematics, engineering and English. At about the time that he finished school the offender's mother and her second partner separated. His mother moved to the country and the offender moved to live with friends. The offender's affidavit says this;

"Between 1993 and 1998 I just 'lived'. I didn't have any goals or job aspirations or even a steady girlfriend. However, in 1993 I completed an Engineering Drafting Certificate at Granville TAFE. At the end of 1993 I was one of six people recommended for positions with Telstra. During this time I was accepted into Architectural Drafting Associate Diploma course at TAFE. I remember feeling torn between advancing my tertiary study and working.

I decided to choose work and earning money over further education, and took a job at Telstra from 1994-1996 as a Data Entry Operator. Then from 1996-1998 I worked at Pickford's Records Management as a store-person. I then returned to Telstra from 1998-2012. I have always had a strong work ethic which is why I have always maintained stable employment. I was reliable and well-liked by my employers."

48. As could be expected the offender had immense freedom when he was living on his own. He attests that during that period he was earning good money but never saved any. He experimented with cannabis and smoked it for about 18 months but then stopped using that substance. In 1998 when he was working with Pickford's he met Caterina Fazio to whom he refers as "Cathy". They eventually married. Cathy was from a "very strict", southern Italian family. They married in 2000. After they were married they moved to live together at Chester Hill and, in 2002, their first child was born, a

daughter who is now aged 14. Another daughter was born in 2004 and is now aged 12 and a third daughter was born in 2009, who is now aged eight.

49. The offender's wife's second pregnancy was very difficult. At five months gestation there were problems and Cathy was placed on bed rest by the doctor to avoid a premature birth. During that period he was responsible for running the household and looking after his first child as well as working for 11 to 13 hours each day at Telstra. The offender attested to being under a lot of pressure.

50. The offender said that about three months after the birth of his second daughter in 2004 he began to suffer from depression. He was referred to see Dr John Albert Roberts, a psychiatrist. A report of Dr Roberts is before me and attests to the facts that the offender was referred to him by his then general practitioner and has been under Dr Roberts' care since 23 November 2004. The history recorded by Dr Roberts at that time is this:

"... Mr Robert Vernon had presented with a history of depression, he referred to having had a rough preceding six months during which his wife had given birth to their second child, that it was a difficult pregnancy; that he felt that he had not dealt with the stress too well; he referred to experiencing dizzy spells but not true vertigo.

A variety of medications had been trialled in relation to the dizzy spells without success; that the experience of being dizzy was a further stressor. Mr Vernon stated that he had a responsible position of being in charge of 50 staff at Telstra.

When depressed, Mr Vernon described himself as withdrawing from people, that he did not want to go out or be around his daughters and that he was uncomfortable with groups of people."

Dr Roberts also obtained a history that the offender had tried various medications but prescription of Zoloft had given positive results and improved the offender's ability to sleep. Symptoms at that time included diurnal mood variation which is a pattern of depression.

51. Dr Roberts diagnosed a mood disorder of the bipolar type. He prescribed a course of antidepressants, an atypical antipsychotic as a mood stabiliser and a benzodiazepine anxiolytic. According to the offender's affidavit he continued to see Dr Roberts every six weeks after his initial referral to him. The offender stated in his affidavit that over the following two years he slowly learned to live with depression, recognising the triggers for that symptom and taking medication to control its onset.

52. In 2007 the offender and his wife and daughters moved to the suburb of Ashbury to be closer to his wife's parents. At the time he made the move to Ashbury the offender was doing well financially and he was able to keep hold of the Chester Hill property as well.

53. However, in 2008 the offender had a major relapse into depression and was hospitalised at a private clinic. This is not referred to by Dr Roberts in his reports but it is likely that he was admitted to that clinic by another psychiatrist. There is reference elsewhere in the material to his being admitted to the Sydney Clinic for that bout of depression. In his affidavit the offender deposed to two further stressors. In late 2009 his father came to live with him and his family briefly and in the same year his sister

Natasha was separated from her partner. The offender was helping his father with his legal problems and supporting his sister during her estrangement from her partner which in itself put a strain on his own marriage. Furthermore, throughout the offender's marriage to Cathy there was ongoing conflict between Cathy and his mother. It is not unusual for there to be conflict between a lady and her mother-in-law. Because of their differing views over a number of things, the offender felt drawn into the conflict and tried to distance himself from his mother and his birth family in order to appease his wife.

54. In 2010 the offender and his wife decided to commence a limousine car hire business. The offender's affidavit continues thus:

"We both remained working in our respective jobs, me at Telstra with Cathy at Pfizer. I used our savings of $100,000 and the equity in our house to start up Eclipse Limousines. I was warned to go slow and to be careful. Despite this advice, I was so full of confidence that I went all in and invested $500,000 (with loans) in the company. My business plan was that in five years the loan and our house would be paid off. I had my accountant and Cathy both look at the business plan carefully. They both gave the go-ahead, despite the risks involved.

I met my business partner, Russell, through a friend. He ran a car company called Eco-taxi so through his contacts and assistance, I purchased three Lexus hybrid vehicles for $102,000 each as well as top of the range limousine for $232,000. My business partner convinced me to lease the vehicles to him as he would provide the drivers and work to cover his lease costs.

Things started to go wrong immediately when Russell started doing illegal things with my cars, such as switching number plates, submitting fraudulent insurance claims, not providing the work and I later found out he was using the cars to deal drugs."

The affidavit goes on to then point out that the business partner, Russell, borrowed $25,000 from the offender on the basis that it would be repaid within three months but it was not. In order to try to recover the $25,000 the offender engaged a "bikie" to seek to recover the money, obviously by some unlawful means. He paid the bikie $45,000 over a period of six months but never saw either the $25,000 again let alone have any return on the $45,000 paid to the "bikie". The business rapidly lost money. There were $2,400 weekly business costs that he needed to cover from the initial investment. After three months the offender removed his cars from Russell's business, from Eco-taxi, and ran the company himself, putting huge pressure on his Telstra job. He was missing days at work because he was too tired to attend work because he was driving one of the cars each evening as well as working fulltime with Telstra. The offender found it difficult to find a reliable driver for his vehicles.

55. The offender's affidavit continues thus:

"It was at this time I began dealing cocaine to clients. I would often get asked by clients for cocaine. I always said 'No, sorry'. But when I was experiencing financial problems, I changed my mind and made the fatal mistake of getting involved in dealing. I began to make money.

Cathy found out about the money I had leant out to both Russell and the "bikie" associate, and we began to fight about it, a lot. Together with me barely being at home due to the hours I was working, I moved out of the family home in October 2011 and in June 2012 we officially divorced. I have been going downwards ever since. I love my kids so much but cocaine was so

addictive, it took over everything.

It was in February 2011 I began using cocaine. It was a gradual use at first but by July of that year I would disappear for two days at a time. I was addicted.

I lost my family, my home, I had severe debt, I was having problems at work and I had developed a cocaine habit which was out of control. I moved in with my younger sister for a bit who had no knowledge of my habit. So I was single, a drug addict with a lot of cash on me. I began gambling, spending money on partying and on girls, buying useless items. The bills were mounting from the people I was purchasing drugs from.

In April 2012 I relapsed into depression and was admitted to the Sydney Clinic in Bronte and underwent a three week program. I went in with the wrong attitude and ended up just meeting more people who became customers and people to party with when I left."

56. According to Dr Roberts' report, he saw the offender on 28 June 2011 when the offender told him he had been using cocaine for 3 to 4 months. The offender told Dr Roberts that he was nasally ingesting cocaine, rather than using it intravenously. The offender told the doctor that the cocaine was "very weak" although the offender had attributed a decline in his libido secondary to the use of cocaine. Dr Roberts' report says this;

"I cautioned Mr Vernon most strongly in regard to his 'experimental use of cocaine', since the inevitability is that such experimental use becomes addiction."

Dr Roberts' advice was accurate but was clearly ignored. Dr Roberts saw the offender again on 25 January 2012 when the offender admitted that he had developed an addiction to cocaine. He told the doctor that the cocaine was offered to him by certain of his clients and he was now using cocaine two or three times per week. On 21 February 2012, four weeks later, the offender told Dr Roberts that he was using cocaine on a daily basis and trying to maintain contact with his wife and children. The offender told the doctor that he believed that his position at Telstra was in jeopardy as he was being "watched" and he thought that his employer intended to dismiss him.

57. The offender's affidavit says that he was made redundant by Telstra, that his younger sister, the fruit of the his mother's relationship with her second partner, moved out of the accommodation that she and her fiancé were sharing with the offender, when she found out about his drug use, and then, in February 2013, he was evicted and at the time that he was evicted, his limousines were repossessed. Without motor vehicles, he could no longer run a limousine car hire business.

58. By the beginning of 2013 the offender had acquired a large number of debts. He had borrowed $80,000 from his former wife Cathy to pay legal fees and loans and that money was still outstanding. He owed his sister, Natasha, $27,000, $6,000 to the State Debt Recovery Office, $25,000 on his credit card, $35,000 on his former business loan, he still owed $13,000 to drug dealers and still owed $2500 in rent.

LUNCHEON ADJOURNMENT

59. HIS HONOUR: Mr Crown, just going back to Mr Waeil Rustom's matter, there was a 166 certificate and you wanted one of the offences to be dismissed.

[Discussion]

In the matter of Waeil Rustom, sequence 6 the allegation of possess prohibited drug on 18 September 2015 at namely, 54.4 grams of heroin is dismissed.

60. Eventually, Mr Vernon's cocaine habit brought him into contact with the law. On 27 October 2011, he committed the crime of possession of prohibited drugs. For that offence the Local Court at Balmain gave him the benefit of s 10 on condition that he enter into a bond to be of good behaviour for 12 months. However he breached that bond by another possession offence and on being called up for breach of the s 10 bond was fined $200. The second possession offence occurred on 2 March 2013 when he was given a bond to be of good behaviour pursuant to s 9 for 12 months and for an attempt to possess a prescribed restricted substance, was fined $200. Earlier, on 22 December 2012, he had again committed the offence of possession or attempting to possess a prescribed restricted substance for which he was fined $500 by the Local Court at North Sydney.

61. Prior to the offences now in question the offender committed a number of offences on 19 June 2015. The first was driving whilst under the influence of alcohol for which he was fined $300 and placed on a s 9 bond for 12 months. The second was another charge of possession of prohibited drug for which he was fined $200. The third offence was goods in personal custody suspected of being stolen for which he was fined $200 with the order that the property in question be returned to the owner. He was dealt with by the Downing Centre Local Court on 9 October 2015 for those offences after his arrest. The offences were charged by the Rose Bay Police Station, so I assume that he committed those offences on a visit to the Eastern Suburbs.

62. For the offences of 2 March 2013 the offender was remanded in custody at Surry Hills on 2 March 2013 before being admitted to bail. The offender's affidavit continues thus:

"Once out on bail, I basically ran away and went to live with my mum on her property on the mid-north coast. It was a remote property and in order for me to report to police, I would have to hitch a ride into town [Kempsey]. But during this time, I made a huge effort to go straight. I applied for at least one hundred jobs whilst on bail. I went to a few interviews but basically never heard back from anyone. I initially applied for jobs in the areas I had previous experience in, but with no luck. I kept trying and trying. I knew I was smart with a strong work ethic, and managed large amounts of people before, but nobody would employ me. I would have taken anything just for the opportunity to work again. After being thoroughly frustrated with the whole situation, I ended up completing a certificate in Aged Care, just so I could get some work.

While staying at mum's property, seeing my kids became difficult because they were in Sydney, which was 450 kilometres away and also because people who I owed money to were looking for me. I would sneak into Sydney to see my kids, then returned to the mid-north coast.

I got a job at Bupa working as a nurse looking after elderly people with dementia. The pay was pretty good as I was employed as a casual. I was slowing getting my life back together including getting out of debt. I was repaying my sister $50 per week, SDRO $50 per fortnight. All other debts were still on hold but I managed to save $2000 to buy a cheap car. I was very thrifty with my money once I started working again.

The friends I owed money to in Sydney contacted me to ask me to come and help out with some business things that were happening. It turned out that nobody was mad with me, but actually concerned when I disappeared. My friend, Waeil Rustom, was starting a new business and wanted someone with a business mind to run it. It was a convenience store in Wentworth Point. I thought it was a good idea as I would be close to my kids and so in September 2014 I started. My job was to set up the business for Waeil doing things like pricing, communications, advertising, negotiating lease agreements with contractors, et cetera. Within three month or returning to Sydney I was back on drugs, dealing, gambling, drinking and taking Xanax. Next thing I know, the police are knocking at my door to arrest me".

63. Another person who was working at this convenience store at Wentworth Point was the younger brother of Waeil Rustom, Abdul Rustom who is yet to be sentenced. I infer from the opening of the last paragraph of the offender's affidavit which I have just quoted, that those to whom he owed money in Sydney is a reference to those to whom he owed money for drugs, in essence, the co-offender, Waeil Rustom.

64. It is clear from the offender's affidavit, which is supported by the history given by the offender to Ms Caroline Hare, a forensic psychologist, who interviewed the offender for these sentencing proceedings at Parklea Correctional Centre on 20 June 2017 and conducted a second interview with him on the telephone on 10 July 2017, that the offender was a law abiding, hardworking man until his experience in the limousine hire car business was complicated by an unreliable business partner, Russell and opportunities to engage in dealing with those who used cocaine and that his use of that drug and his agreeing to supply that drug at that time in his life was due to the enormous financial difficulties in which he found himself because of his risky business venture. The pressure was such that his drug habit escalated, his indebtedness escalated and his marriage failed. Then in 2013, he left Sydney and moved to the mid north coast where he attempted to straighten himself out, to be abstinent from drugs without the assistance of any experts in the field. He did so. He found work as a nurse but then was tempted to return to Sydney to be near his children and fell in with Waeil Rustom and the other members of the drug syndicate, the subject of this sentencing hearing.

65. The offender has been in custody since his arrest on 18 September 2015, a period of almost two years. In his affidavit, the offender said this:

"This is my first time in gaol. It has been a frightening first experience. To be told what to do and when to do it was a shock to the system. I felt the weight of the loss of my liberties that I had taken for granted.

Upon arriving at Parklea, I immediately applied for work. Out of the 620 mainstream inmates here, I am one of 40 who works, as the only industry available is Engineering.

I began working six weeks after arriving here and continue to do so. I start work at 7am and finish at 2pm, Monday to Friday. In the 17 months of working, I have only missed four days due to sickness.

I now have attained the position of Health, Safety and Environment Representative for the Engineering Work Shop. My responsibilities include daily pre-start check lists of equipment, assist with inducting new workers and assist corrective service officer with the general running of the workshop.

I have additional responsibilities including distributing lunches, a position only given to the most trustworthy of inmates in gaol. I am fully trusted to be in the officer's station at any given time.

Another duty I have is to assess incoming work for what needs to be done, then document it for the officers and inmates before it can be worked on. I also cook the bi-monthly BBQ, another duty based on trust.

Since arriving at Parklea, I put my name down for any courses available. I have now completed and attained three TAFE Certificates:
(i) Work Ready Course;

(ii) Barista;

(iii) Manual Handling and OHS....

I have also commenced a course called, "Addictions" which is to help with identifying how you can become addicted to anything including drugs. I am also listed to participate in any new courses as they become available."

The affidavit goes on to tell me how the offender has tried to do other positive things whilst in custody but then records that the greatest detriment of being in custody is not being able to see his children.

66. The offender has plans. He intends on his release from custody to return to live on his mother's property and recommence his job at Bupa as an aged care dementia nurse. He intends to try to re-establish his relationship with his children and his former wife and her extended family. He also states that he wishes to re-pay the money that he has borrowed from so many people. He believes that he will be able to do so in the future because he has been able to do so in the past.

67. In the affidavit, the offender tells me that he has had much time to think about what he has done that has brought him to be in custody. He then expressed remorse or, as he calls it, "regrets". There was the break-up of his marriage which he attributes, in part, to his depression. His other regrets, of course, is missing his children and missing married life. He acknowledges that the law exists to protect individuals and to ensure harmony and that in breaking the law he has broken a provision of the law which is designed to protect the members of the public - to protect members of the public from illicit drug use.

68. The offender's efforts to rehabilitate himself in custody are attested to by certificates from TAFE. The offender was not required for cross-examination on his affidavit and therefore I accept what he tells me about his own attempts in custody to rehabilitate himself and the positions of trust that he has achieved whilst in custody. However, what the offender said about his own activities in custody is corroborated by the pre-sentence report dated 20 July 2017 prepared by Community Corrections officer at the Parklea Correction Centre. Part of that pre-sentence report is this:

"The Corrective Services New South Wales records indicate he has been employed in the metal shop at Parklea Correctional Centre since 18 November 2015 and has recorded consistently to be a core worker, with a strong work ethic. The records also state he is polite to staff, compliant within metal shop routine and often provides assistance in training new employees in the shop. Mr Vernon has not received any institutional misconduct charges."

It could be said that the current offender is a model prisoner. The Corrective Services assess the offender as having a medium risk of re-offending. It records that since his incarceration the offender is prescribed an antidepressant medication which he takes in accordance with the prescription. The offender has been assessed as being suitable for community service.

69. The formulation of the forensic psychologist Ms Hare is that the offender is not currently experiencing symptoms of a clinically diagnosable mental disorder. However it was possible that his symptoms were being adequately managed by his ongoing antidepressant medication. In other words the offender might be suffering from depression but that is masked by his medication. It is highly likely that the offender still does suffer from depression. There are two obvious reasons for that. The first is the fact that he is incarcerated. The second is the fact that he awaiting sentence. Not to be depressed in such circumstances would, in my view, be abnormal. However, it has to be acknowledged that the offender has a long history of a depressive illness and it may be that that is yet another episode of a major depressive disorder. The ultimate diagnosis of Dr Roberts, is the same as his initial diagnosis, that of a "mood disorder of the bipolar type". Dr Roberts expressed this view:

"Mr Vernon's downfall is associated with his business venture, of starting a luxury hire car business in which he made contact with certain people who were substance users; this substance use took place in Mr Vernon's car and Mr Vernon was introduced to such substance use by these persons who gave the substances to him without payment.

A progressive addiction has developed over time with tragic consequences and aberrant behaviour.

The end result of this [addiction] has been a cluster of problems including the ending of his marriage, business difficulties, unusual behaviour in terms of becoming extensively tattooed and a general disintegration in function."

Dr Roberts appears to be of the view that being extensively tattooed is somehow aberrant behaviour, but if that were the case there would be thousands upon thousands of people in our community who were behaving in an aberrant fashion, including most professional footballers.

70. Affidavits have also been sworn and admitted into evidence from the offender's mother, Ruth Muller, from his sister Natasha Vernon, from his half-sister Naomi and

from his half-brother Elijah. They all support the offender and believe that he is contrite and will not re-offend.

Consideration

71. I accept that the offender has in the past suffered from a depressive illness and was therefore prone to recurrence of that illness. The vicissitudes of life and the failed business venture, the limousine hire car business, contributed a large amount of stress which increased the depression and probably made it likely that the offender would succumb to the attraction of mind altering sensations of an illicit drug such as cocaine. The offender's moral culpability for becoming addicted is attenuated by those various vicissitudes.

72. However, the offender did participate as a loyal lieutenant in Waeil Rustom's drug supply syndicate. He clearly managed it when Waeil Rustom was in Melbourne, but the evidence does suggest that it was fairly strictly controlled by Waeil Rustom who had the ultimate say in who was to be supplied, what was to be supplied and when the drugs were supplied.

73. I accept that the offender is contrite. I accept that he has insight into his behaviour. I accept that he is well supported by his family and has responsible plans for the future which will assist him in living a law abiding life in the future, preventing him from involving himself in a criminal enterprise such as Waeil Rustom's drug supply syndicate.

74. The place of this offender in this criminal syndicate is clearly lower than that of Waeil Rustom, However he was essential for its continued existence. I am confident that there is no need here for further personal deterrence. However, general deterrence still must have its place, as must the community's desire for punishment and retribution.

75. I accept that the offender's prospects of rehabilitation are excellent. It is highly unlikely that he will re-offend. The offender's efforts whilst in custody to rehabilitate himself are rarely seen in this Court's experience and augur well for the future, bearing in mind what he has done in the past both in 2013 when he left for Sydney for the mid-north coast and managed eventually to obtain training to be an aged care nurse and finding such work, and his intention is to return to that milieu where there will be no temptation to relapse to drug use.

76. The sentence of imprisonment to be imposed upon this offender must clearly be less than that imposed upon Waeil Rustom. This offender does not seek to avoid the inevitability of a gaol sentence, bearing in mind the principles that I cited earlier when sentencing Waeil Rustom, that anybody who is actively involved in drug trafficking should expect a full time custodial sentence. The real issue is how long should be the custodial sentence.

77. Having carefully weighed all the matters and bearing in mind what I consider to be very good personal circumstances for this offender I determine that the appropriate starting point for this sentencing exercise is five years imprisonment. That is to be discounted by 25% for the offender's early plea of guilty and the utilitarian value of that plea. That reduces the head sentence to three years and nine months imprisonment. Applying the statutory ratio that would result in a non-parole period of

33 months. However, as I found with Waeil Rustom there are good reasons to vary the ratio between the head sentence and the non-parole period, that is special circumstances.

78. The circumstance here is the offender has done much to rehabilitate himself in custody. The experience in custody has been an unwelcome one for this offender, but such is most often the case. However, he needs firm assistance when released from custody to stay abstinent from drugs and other addictions, such as gambling and alcohol addiction. Fortunately, the offender has been able to commence a course in custody which will assist him in that regard but with a lengthy period on parole, the offender will be able to undertake, in Kempsey, further courses to assist him in staying free of drugs and alcohol. I should point out that there is a correctional centre at Kempsey so the Department of Corrective Services is well established in Kempsey and no doubt can provide courses in that town. I have determined that the appropriate non-parole period is two years imprisonment.

79. Robert Max Vernon, on the charge that between 16 June 2015 and 18 September 2015 in or around Sydney in this State you did supply an amount of a prohibited drug namely 355 grams of cocaine, being an amount which was not less than the commercial quantity applicable to that prohibited drug, you are convicted. I sentence you to imprisonment. I set a non-parole period of two years commencing on 18 September 2015 and expiring on 17 September 2017. I impose a further period of imprisonment of one year and nine months to commence upon the expiration of the non-parole period and expiring on 17 June 2019. The total sentence is therefore three years and nine months comprising the non-parole period and the balance of the sentence. I have found special circumstances. You are eligible to be considered for release to parole at the expiration of the non-parole period. In passing that sentence I have taken into account the matters on the Form 1.

80. HIS HONOUR: Now the 166 Certificate?

GILSON: The same as for Mr Waeil, just if your Honour would dismiss possess prohibited drug which is the back-up charge to the matter on the Form 1.

HIS HONOUR: That is sequence 13 is it?

GILSON: That's correct your Honour.

HIS HONOUR: Sequence 13 possess prohibited drug on 18 December 2015 namely 5.4 grams of heroin is withdrawn and dismissed.

[Further submissions]

81. MFI #X FIRST FORFEITURE ORDER

MFI #Y SECOND FORFEITURE ORDER

HIS HONOUR: Pursuant to s 35 of the *Drug Misuse and Trafficking Act 1985* I make the following orders with the consent of the solicitor for each of the six offenders who appeared before me on Monday. The following mobile telephones are now forfeit to the Crown:

(1) one white/silver iPhone, seized during the execution of a search warrant at 69 Maiden Street, Greenacre on 18 September 2015, being police exhibit X0002142713.

(2) one Samsung mobile phone seized during the execution of the search warrant at 69 Maiden Street, Greenacre on 18 September 2015 being police exhibit X0002142714.

(3) one Medion E4002 mobile phone seized from Cabdiqure Gure on 15 October 2015 being police exhibit X000890999.

Appendix C: Coding Schedule for the Research in Chapter 7

Part 1 – Data cleansing and coding phase

For each transcript in the sample, code the following according to the coding book below. All codes should be made in reference to the offender or offenders presently being judged/sentenced. That is, do not code any items for traffickers referenced in the transcripts who are not presently being judged/sentenced (e.g. co-offenders who were referenced but sentenced in another hearing), and do not code information relating to precedent cases mentioned in the transcripts.

Coding book

Code	Definition / how to code	Notes / examples
Include	This codes whether the transcript is included or excluded Inclusion criteria: 1. The offender(s) presently being judged/sentenced within the transcript must be *convicted* for one of the following: trafficking, supplying, manufacturing, possessing with intent to supply, or attempting to possess a **commercial / large commercial quantity of ecstasy and/or ecstasy precursors, in Australia**. (note: the offender's convictions do not need to be exclusively these – for eg they can also be simultaneously convicted for other drug and non-drug offences). 2. The judgment was made no earlier than the 1st of January 2002 and no later than the 19th of October 2016. Exclusion criteria: 1. If any one of the inclusion criteria are not satisfied	

	2. The commercial ecstasy trafficking/manufacturing conviction was quashed in the transcript 3. The commercial ecstasy trafficking/manufacturing offence is not yet a conviction (e.g. the offender is applying for bail while awaiting trial for a commercial ecstasy charge). 4. The commercial ecstasy trafficking/manufacturing conviction belongs only to a co-offender who is not presently being sentenced/judged in the transcript. If the transcript satisfies for inclusion then code 1 and then continue to code all items below, otherwise code 0 and exclude it. IF 0 IS CODED STOP HERE AND START NEXT TRANSCRIPT	
Transcript demographics		
Year judged	The year the delivery of the judgement was made **(select from drop down menu)**	The year is always stated in the transcript file name
Court jurisdiction	The jurisdiction the judgment was made in **(select from drop down menu)**	If judgment was made in the 'high' or 'federal' court then code 'com' (meaning commonwealth) otherwise code the state or territory the judgment was made in.
Case demographics		
Present ecstasy offences	These codes capture whether the offender was involved in any of the following activities associated with ecstasy during the present offending. Can code multiple activities and it must be for at least a trafficable quantity to be coded (note however, at least one offence must be a commercial quantity as per study inclusion criteria).	

Manufacture	1 = yes	
Product (manufacture)	1 = end-product 2 = precursor 3 = Both 4 = unclear	If yes code whether associated with end-product, precursors or both
Import	1 = yes	
Product (import)	1 = end-product 2 = precursor 3 = Both 4 = unclear	If yes code whether associated with end-product, precursors or both
Supply / traffic /possess	1 = yes	
Product (supply)	1 = end-product 2 = precursor 3 = Both 4 = unclear	If yes code whether associated with end-product, precursors or both
Concurrent criminal offences	These codes capture whether there were any concurrent criminal convictions (including both other drug trafficking convictions and non-drug convictions)	
Any concurrent offence?	1 = yes	

		0 = no If yes, code if any of the following are true	
	Concurrent non-drug	1 = yes	Any conviction that is not drug trafficking / manufacturing offence. E.g. are they convicted for gun trafficking, burglary, property crime etc…
	Concurrent drug	1 = yes If yes, code which of the following activities were associated with the drug conviction(s)	Note: if convicted for possession it must be for at least a trafficable quantity (possession of smaller quantities for personal use should not be coded as a concurrent drug conviction).
	Meth/amphetamine (supply/possess)	1 = yes	
	Meth manufacture	1 = yes	
	Cocaine (supply/possess)	1 = yes	
	Heroin (supply/possess)	1 = yes	
	Other drug (supply/possess)	1 = yes	e.g. cannabis, NPS or a precursor for drugs other than ecstasy
Prior offences		These codes capture whether the offender had any prior criminal convictions (distinguishing drug vs non-drug offences)	
Any prior?		0 = no: it is clear the offender does not have any priors	Note: do not equate prior good character with an absence of criminal history. It is possible for an offender with minor driving offences or some other

		1 = yes: it is clear the offender has at least one prior 2 = NA: there is no mention of whether the offender has priors or not If yes, code whether prior is drug related, other, or if both code both	minor offence to be judged as being of prior good character. Note: If the offender committed the present commercial ecstasy trafficking offence whilst out on parole / a suspended sentence for an assault offence (for eg) then code the assault charge as a prior.
	Prior drug	1 = yes	Can be for supply / manufacture / cultivate / possess but must be convicted of at least a "trafficable quantity". Possession of smaller quantities for personal use does not count.
	Other prior	1 = yes	Any non-drug related conviction or drug use offence e.g. murder, break and enter, cannabis use offence. Note: if the judge says "the offender had no criminal record of any significance" then assume this means he/she had a non-drug supply related criminal record, and code yes here. Note: if the judge says that the offender had a lengthy history and as an eg lists a couple of drug supply offences, then assume he/she also had non-drug priors. Eg: "the applicant had what was described as a lengthy relevant criminal history including one conviction with imprisonment in the United Kingdom for a conspiracy to supply drugs in 1990 and another conviction for importing illegal drugs in 1991"

Unclear prior	1 = yes	E.g. judge says "you have a criminal record" but doesn't specify which offences were involved.
Other	The remaining miscellaneous demographics	
Offence years	What year or years did the present drug offending happen in? (i.e. this includes any drug offending, not just ecstasy)	If the first drug offence occurred in March 2007 and the last occurred in June 2009 then code "2007, 2008, 2009". If not clear then code "unknown".
Multiple jurisdictions?	1 = yes	This captures whether there was mention of trafficking across multiple states or territories.
Code	**Definition / how to code**	**Notes / examples**
Drug user	0 = no: it is clear the offender did not use drugs 1 = yes: it is clear the offender used drugs 2 = NA: there is no mention of whether the offender used drugs or not	Drug use can either be occasional or habitual
Group	This code groups transcripts together if they refer to members of the same syndicate or trafficking network. Give each group of transcripts a unique number to link them.	Note: this code is to assist with the analysis of the qualitative analysis of syndicates (it will not be used in the quant content analysis).
Supply changes		
Ecstasy - **E**		
Ecstasy purity / quality	The following codes capture whether the offender was aware of an ecstasy end-product or ecstasy precursor purity/quality	

		shift prior to his/her arrest, and if so the cause and direction of the shift, the responses/adaptations made by the offender in both the short term (within 1 month) and long term (1 month or longer), and the outcomes that followed.	
EPQ		Did the offender become aware of a purity/quality shift to his/her ecstasy end-product or ecstasy precursor supply prior to being arrested? 1 = yes **Ecstasy purity/quality shift definition:** There is evidence that the purity or quality of an ecstasy end-product or ecstasy precursor had changed to a degree relative to an earlier point in time. If 1 was coded, then continue coding below. Otherwise skip to the yellow code titled "ecstasy availability".	Eg when to code 1: there is evidence that cutting agents were added to the offender's ecstasy substance (e.g. from a forensic analysis), the offender received ecstasy tablets that had crumbled / broken into pieces, or the offender had successfully improved the quality of an ecstasy or precursor substance in his/her possession.
EPQ multiple		Was there more than one occasion where the offender became aware of a purity/quality shift to his/her ecstasy end-product or ecstasy precursor supply prior to being arrested? 1 = yes	

	If so, insert a new line in the excel document underneath the line you are working on for each additional ecstasy end-product or ecstasy precursor purity/quality shift that the offender became aware of prior to arrest. Code each of the following sub-items below separately on each line for each purity/quality shift you have identified. If only one purity/quality shift was identified then leave this code blank and continue coding below	
Sub-EPQ	This codes the subcategory of the ecstasy end-product or ecstasy precursor purity/quality shift: i.e. what caused the shift. Code 1, 2 or 3.	
	1 = Law enforcement intervened and caused an ecstasy end-product or ecstasy precursor purity/quality shift within the offender's supply chain	**e**.g. Law enforcement seized imported ecstasy at the border and replaced the drugs with an inert substance, then delivered the package to the offender.
	2 = Cause of the ecstasy end-product or ecstasy precursor purity/quality shift was unknown	e.g. The offender received ecstasy from a supplier that was of a higher purity to normal, but it is unclear what caused the purity to be higher.

	3 = The present offender caused a purity or quality change to an ecstasy end-product or ecstasy precursor whilst the drugs/precursors were in his/her possession	e.g. The offender cut his or her ecstasy with a cutting agent, or the offender successfully improved the purity of his or her ecstasy.
EPQ direction	This codes the direction of the ecstasy end-product or ecstasy precursor purity/quality shift: i.e. whether the ecstasy or precursor purity/quality improved or worsened. Select either 'increase' or 'decrease' from the dropdown box	
Short term (within 1 month)	This code captures all responses/adaptations made by the offender within the first month after the ecstasy end-product or ecstasy precursor purity/quality shift took place and also captures the outcome that followed (i.e. whether drugs were sold during the first month in spite of the supply change). You can code one or multiple responses/adaptations if multiple were referenced. If multiple were referenced, code each response/adaptation in the order they occurred over time, by coding the 1st response coded under "R1", the 2nd under "R2", the 3rd under "R3" and the 4th under "R4". The outcome is coded under "Outcome" (see below). **Response/adaptation codes** 1 'Attempt to improve the purity/quality' 2 'Reduce the purity / quality' 3 'Increase price to customer' 4 'Decrease price to customer' 5 'Attempt to expand business by selling more of the same drug(s) or precursor(s)'	

| | 6 'Attempt to expand business by selling a different drug or precursor in addition'
7 'Find/switch to an alternative supplier of the same drug or precursor of same drug'
8 'Find/switch to an alternative supplier of a different drug or precursors of a different drug'
9 'Cease trafficking that drug or precursor'
10 'Regard the drugs/precursors as waste and dispose of them'
11 'Attempt to return drugs/precursors to supplier'
12 'No adaptation - receive drugs and pass them on'
13 'Attempt to locate missing drugs/precursors'
14 'Response/adaptation unclear'
15 'Attempt to source manufacturing equipment / chemicals and/or manufacture the drug'
16 'Become inactive'
17 'Become re-active'
18 'Attempt to sell new form'
19 'Buy more drugs than usual'
20 'Buy less drugs than desired'
21 'Attempt to sell higher purity/quality drugs'
22 'Attempt to sell lower purity/quality drugs'
23 'Attempt to import or order more of the same drug type from the supplier'
24 'Attempt to import a different drug type'
25 'Attempt to import more of both same and different drug type'
26 'Attempt to import more drugs but unclear whether same or different drug type'
27 'Purchase more drugs at an inflated price'.

Outcome codes

1 = Evidence that drugs were sold (can be any drug sold, does not have to be the drug associated with the supply change) | |

		2 = No evidence that any drugs were sold	
	R1		Code 1st response here
	R2		If applicable code 2nd response here (if not leave blank)
	R3		If applicable code 3rd response here (if not leave blank)
	R4		If applicable code 4th response here (if not leave blank)
	Outcome		Code outcome here (i.e. whether drugs sold or not within 1 month)
Long term (1 month or more)		Is there evidence that the ecstasy end-product or ecstasy precursor purity/quality shift lasted 1 month or longer? If so, code "1" under "EPQ long term?" then code all responses/adaptations that the offender made and the outcome that followed once 1 month of time had elapsed (i.e. whether drugs were sold despite the change lasting at least 1 month) **Response/adaptation codes** 1 'Attempt to improve the purity/quality' 2 'Reduce the purity / quality' 3 'Increase price to customer' 4 'Decrease price to customer' 5 'Attempt to expand business by selling more of the same drug(s) or precursor(s)'	

		2 = No evidence that any drugs were sold	
	R1		Code 1st response here
	R2		If applicable code 2nd response here (if not leave blank)
	R3		If applicable code 3rd response here (if not leave blank)
	R4		If applicable code 4th response here (if not leave blank)
	Outcome		Code outcome here (i.e. whether drugs sold or not within 1 month)
Long term (1 month or more)		Is there evidence that the ecstasy end-product or ecstasy precursor purity/quality shift lasted 1 month or longer? If so, code "1" under "EPQ long term?" then code all responses/adaptations that the offender made and the outcome that followed once 1 month of time had elapsed (i.e. whether drugs were sold despite the change lasting at least 1 month) **Response/adaptation codes** 1 'Attempt to improve the purity/quality' 2 'Reduce the purity / quality' 3 'Increase price to customer' 4 'Decrease price to customer' 5 'Attempt to expand business by selling more of the same drug(s) or precursor(s)'	

6 'Attempt to expand business by selling a different drug or precursor in addition'
7 'Find/switch to an alternative supplier of the same drug or precursor of same drug'
8 'Find/switch to an alternative supplier of a different drug or precursors of a different drug'
9 'Cease trafficking that drug or precursor'
10 'Regard the drugs/precursors as waste and dispose of them'
11 'Attempt to return drugs/precursors to supplier'
12 'No adaptation - receive drugs and pass them on'
13 'Attempt to locate missing drugs/precursors'
14 'Response/adaptation unclear'
15 'Attempt to source manufacturing equipment / chemicals and/or manufacture the drug'
16 'Become inactive'
17 'Become re-active'
18 'Attempt to sell new form'
19 'Buy more drugs than usual'
20 'Buy less drugs than desired'
21 'Attempt to sell higher purity/quality drugs'
22 'Attempt to sell lower purity/quality drugs'
23 'Attempt to import or order more of the same drug type from the supplier'
24 'Attempt to import a different drug type'
25 'Attempt to import more of both same and different drug type'
26 'Attempt to import more drugs but unclear whether same or different drug type'
27 'Purchase more drugs at an inflated price'.

Outcome codes

1 = Evidence that drugs were sold (can be any drug sold, does not have to be the drug associated with the supply change)

		2 = No evidence that any drugs were sold	
	EPQ long term?	1 = yes the ecstasy end-product or ecstasy precursor purity/quality shift lasted at least 1 month	
	R1		Code 1st response here
	R2		If applicable code 2nd response here (if not leave blank)
	R3		If applicable code 3rd response here (if not leave blank)
	R4		If applicable code 4th response here (if not leave blank)
	Outcome		Code outcome here (i.e. whether drugs sold or not once 1 month had passed)
Ecstasy availability		The following codes capture whether the offender was aware of an ecstasy end-product or ecstasy precursor availability shift prior to his/her arrest, and if so the cause and direction of the shift, the responses/adaptations made by the offender in both the short term (within 1 month) and long term (1 month or longer), and the outcomes that followed.	
EA		Did the offender become aware of an availability shift to his/her supply of ecstasy end-product or ecstasy precursors prior to being arrested? 1 = yes	**Eg when to code 1:** The present offender's regular ecstasy supplier was unavailable; the present offender was introduced to a new supplier of ecstasy; law enforcement seized the offender's ecstasy at a point in time prior to his/her arrest but did not replace it when an inert substance.

	Ecstasy availability shift definition: There is evidence that the offender's access to ecstasy end-product or ecstasy precursor changed to a degree relative to an earlier point in time. If 1 was coded, then continue coding below. Otherwise skip to the brown code titled "ecstasy form".	
EA multiple	Was there more than one occasion where the offender became aware of an availability shift to his/her ecstasy end-product or ecstasy precursor supply prior to being arrested? 1 = yes If so, insert a new line in the excel document underneath the line you are working on for each additional ecstasy end-product or ecstasy precursor availability shift that the offender became aware of prior to arrest. Code each of the following sub-items below separately on each line for each availability shift you have identified. If only one availability shift was identified then leave this code blank and continue coding below	

Sub-EA	This codes the subcategory of the ecstasy end-product or ecstasy precursor availability shift: i.e. what caused the shift. Code 1, 2 or 3.		
	1 = Law enforcement intervened and caused an ecstasy end-product or ecstasy precursor availability shift within the offender's supply chain	**e**.g. Law enforcement seized imported ecstasy at the border, but the offender was not arrested at that time.	
	2 = Cause of the ecstasy end-product or ecstasy precursor availability shift was unknown	e.g. The offender's regular supplier of ecstasy became unavailable and it is unclear why	
	3 = The present offender caused a change to the ease of access to his/her ecstasy end-product or ecstasy precursor supply	e.g. The offender actively sought to find a new ecstasy supplier and was successful in doing so. The offender could now purchase ecstasy through that supplier.	
EA direction	This codes the direction of the ecstasy end-product or ecstasy precursor availability shift: i.e. whether the offender found ecstasy or ecstasy precursors easier or harder to access. Select either 'increase' or 'decrease' from the dropdown box.		
Short term (within 1 month)	This code captures all responses/adaptations made by the offender within the first month after the ecstasy end-product or ecstasy precursor availability shift took place and also captures the outcome that followed (i.e. whether drugs were sold during the first month in spite of the supply change). You can code one or multiple responses/adaptations if multiple were referenced. If multiple were referenced, code each response/adaptation in the order they occurred over time, by		

coding the 1st response under "R1", the 2nd under "R2", the 3rd under "R3" and the 4th under "R4. The outcome is coded under "Outcome" (see below).

Response/adaptation codes

1 'Attempt to improve the purity/quality'
2 'Reduce the purity / quality'
3 'Increase price to customer'
4 'Decrease price to customer'
5 'Attempt to expand business by selling more of the same drug(s) or precursor(s)'
6 'Attempt to expand business by selling a different drug or precursor in addition'
7 'Find/switch to an alternative supplier of the same drug or precursor of same drug'
8 'Find/switch to an alternative supplier of a different drug or precursors of a different drug'
9 'Cease trafficking that drug or precursor'
10 'Regard the drugs/precursors as waste and dispose of them'
11 'Attempt to return drugs/precursors to supplier'
12 'No adaptation - receive drugs and pass them on'
13 'Attempt to locate missing drugs/precursors'
14 'Response/adaptation unclear'
15 'Attempt to source manufacturing equipment / chemicals and/or manufacture the drug'
16 'Become inactive'
17 'Become re-active'
18 'Attempt to sell new form'
19 'Buy more drugs than usual'
20 'Buy less drugs than desired'
21 'Attempt to sell higher purity/quality drugs'
22 'Attempt to sell lower purity/quality drugs'

	23 'Attempt to import or order more of the same drug type from the supplier' 24 'Attempt to import a different drug type' 25 'Attempt to import more of both same and different drug type' 26 'Attempt to import more drugs but unclear whether same or different drug type' 27 'Purchase more drugs at an inflated price'. **Outcome codes** 1 = Evidence that drugs were sold (can be any drug sold, does not have to be the drug associated with the supply change) 2 = No evidence that any drugs were sold		
	R1		Code 1st response here
	R2		If applicable code 2nd response here (if not leave blank)
	R3		If applicable code 3rd response here (if not leave blank)
	R4		If applicable code 4th response here (if not leave blank)
	Outcome		Code outcome here (i.e. whether drugs sold or not within 1 month)
Long term (1 month or more)	Is there evidence that the ecstasy end-product or ecstasy precursor availability shift lasted 1 month or longer? If so, code "1" under "EA long term?" then code all responses/adaptations that the offender made and the		

outcome that followed once 1 month of time had elapsed (i.e. whether drugs were sold despite the change lasting at least 1 month)

Response/adaptation codes

1 'Attempt to improve the purity/quality'
2 'Reduce the purity / quality'
3 'Increase price to customer'
4 'Decrease price to customer'
5 'Attempt to expand business by selling more of the same drug(s) or precursor(s)'
6 'Attempt to expand business by selling a different drug or precursor in addition'
7 'Find/switch to an alternative supplier of the same drug or precursor of same drug'
8 'Find/switch to an alternative supplier of a different drug or precursors of a different drug'
9 'Cease trafficking that drug or precursor'
10 'Regard the drugs/precursors as waste and dispose of them'
11 'Attempt to return drugs/precursors to supplier'
12 'No adaptation - receive drugs and pass them on'
13 'Attempt to locate missing drugs/precursors'
14 'Response/adaptation unclear'
15 'Attempt to source manufacturing equipment / chemicals and/or manufacture the drug'
16 'Become inactive'
17 'Become re-active'
18 'Attempt to sell new form'
19 'Buy more drugs than usual'
20 'Buy less drugs than desired'
21 'Attempt to sell higher purity/quality drugs'
22 'Attempt to sell lower purity/quality drugs'

	23 'Attempt to import or order more of the same drug type from the supplier' 24 'Attempt to import a different drug type' 25 'Attempt to import more of both same and different drug type' 26 'Attempt to import more drugs but unclear whether same or different drug type' 27 'Purchase more drugs at an inflated price'. **Outcome codes** 1 = Evidence that drugs were sold (can be any drug sold, does not have to be the drug associated with the supply change) 2 = No evidence that any drugs were sold	
EA long term?	1 = yes the ecstasy end-product or ecstasy precursor availability shift lasted at least 1 month	
R1		Code 1st response here
R2		If applicable code 2nd response here (if not leave blank)
R3		If applicable code 3rd response here (if not leave blank)
R4		If applicable code 4th response here (if not leave blank)
Outcome		Code outcome here (i.e. whether drugs sold or not once 1 month had passed)

Ecstasy form	The following codes capture whether the offender was aware of an ecstasy end-product form shift prior to his/her arrest, and if so the cause of the shift, the responses/adaptations made by the offender in both the short term (within 1 month) and long term (1 month or longer), and the outcomes that followed.	
EF	Did the offender become aware of a form shift to his/her supply of ecstasy *end-product* prior to being arrested? Note: form shifts that occur during an ecstasy precursor to ecstasy end-product conversion do not count (e.g. the "crystallisation process" during initial ecstasy manufacture). Precursor form shifts also do not count. 1 = yes **Ecstasy availability shift definition:** There is evidence that the form of the offender's ecstasy end-product supply changed relative to an earlier point in time. If 1 was coded, then continue coding below. Otherwise skip to the non-ecstasy supply change codes: specifically, begin with the purple code tilted "non-ecstasy purity/quality"	**Eg when to code 1:** The present offender received ecstasy end-product in a different form than usual from his/her regular supplier; the present offender converted end-product ecstasy from powder to tablets whilst the drug was in his/her possession.

EF multiple	Was there more than one occasion where the offender became aware of a form shift to his/her ecstasy end-product supply prior to being arrested? 1 = yes If so, insert a new line in the excel document underneath the line you are working on for each additional ecstasy end-product form shift that the offender became aware of prior to arrest. Code each of the following sub-items below separately on each line for each form shift you have identified. If only one form shift was identified then leave this code blank and continue coding below	
Sub-EF	This codes the subcategory of the ecstasy end-product form shift: i.e. what caused the shift. Code 1, 2 or 3. 1 = Law enforcement intervened and caused an ecstasy end-product form shift within the offender's supply chain	e.g. Law enforcement seized imported ecstasy tablets at the border and replaced them with an inert powder substance, then delivered the package to the offender.

		2 = Cause of the ecstasy end-product form shift was unknown	e.g. The offender received a different form of ecstasy to usual from his/her regular supplier, but it is unclear why.
		3 = The present offender caused a form shift to end-product ecstasy whilst it was in his/her possession	e.g. the offender received ecstasy end-product in powder form then converted it to tablets
	Short term (within 1 month)	This code captures all responses/adaptations made by the offender within the first month after the ecstasy end-product form shift took place and also captures the outcome that followed (i.e. whether drugs were sold during the first month in spite of the supply change). You can code one or multiple responses/adaptations if multiple were referenced. If multiple were referenced, code each response/adaptation in the order they occurred over time, by coding the 1st response under "R1", the 2nd under "R2", the 3rd under "R3" and the 4th under "R4. The outcome is coded under "Outcome" (see below). **Response/adaptation codes** 1 'Attempt to improve the purity/quality' 2 'Reduce the purity / quality' 3 'Increase price to customer' 4 'Decrease price to customer' 5 'Attempt to expand business by selling more of the same drug(s) or precursor(s)' 6 'Attempt to expand business by selling a different drug or precursor in addition'	

7 'Find/switch to an alternative supplier of the same drug or precursor of same drug'

8 'Find/switch to an alternative supplier of a different drug or precursors of a different drug'

9 'Cease trafficking that drug or precursor'

10 'Regard the drugs/precursors as waste and dispose of them'

11 'Attempt to return drugs/precursors to supplier'

12 'No adaptation - receive drugs and pass them on'

13 'Attempt to locate missing drugs/precursors'

14 'Response/adaptation unclear'

15 'Attempt to source manufacturing equipment / chemicals and/or manufacture the drug'

16 'Become inactive'

17 'Become re-active'

18 'Attempt to sell new form'

19 'Buy more drugs than usual'

20 'Buy less drugs than desired'

21 'Attempt to sell higher purity/quality drugs'

22 'Attempt to sell lower purity/quality drugs'

23 'Attempt to import or order more of the same drug type from the supplier'

24 'Attempt to import a different drug type'

25 'Attempt to import more of both same and different drug type'

26 'Attempt to import more drugs but unclear whether same or different drug type'

27 'Purchase more drugs at an inflated price'.

Outcome codes

1 = Evidence that drugs were sold (can be any drug sold, does not have to be the drug associated with the supply change)

2 = No evidence that any drugs were sold

R1		Code 1st response here
R2		If applicable code 2nd response here (if not leave blank)
R3		If applicable code 3rd response here (if not leave blank)
R4		If applicable code 4th response here (if not leave blank)
Outcome		Code outcome here (i.e. whether drugs sold or not within 1 month)
Long term (1 month or more)	Is there evidence that the ecstasy end-product form shift lasted 1 month or longer? If so, code "1" under "EF long term?" then code all responses/adaptations that the offender made and the outcome that followed once 1 month of time had elapsed (i.e. whether drugs were sold despite the change lasting at least 1 month) **Response/adaptation codes** 1 'Attempt to improve the purity/quality' 2 'Reduce the purity / quality' 3 'Increase price to customer' 4 'Decrease price to customer' 5 'Attempt to expand business by selling more of the same drug(s) or precursor(s)' 6 'Attempt to expand business by selling a different drug or precursor in addition' 7 'Find/switch to an alternative supplier of the same drug or precursor of same drug'	

8 'Find/switch to an alternative supplier of a different drug or precursors of a different drug'
9 'Cease trafficking that drug or precursor'
10 'Regard the drugs/precursors as waste and dispose of them'
11 'Attempt to return drugs/precursors to supplier'
12 'No adaptation - receive drugs and pass them on'
13 'Attempt to locate missing drugs/precursors'
14 'Response/adaptation unclear'
15 'Attempt to source manufacturing equipment / chemicals and/or manufacture the drug'
16 'Become inactive'
17 'Become re-active'
18 'Attempt to sell new form'
19 'Buy more drugs than usual'
20 'Buy less drugs than desired'
21 'Attempt to sell higher purity/quality drugs'
22 'Attempt to sell lower purity/quality drugs'
23 'Attempt to import or order more of the same drug type from the supplier'
24 'Attempt to import a different drug type'
25 'Attempt to import more of both same and different drug type'
26 'Attempt to import more drugs but unclear whether same or different drug type'
27 'Purchase more drugs at an inflated price'.

Outcome codes

1 = Evidence that drugs were sold (can be any drug sold, does not have to be the drug associated with the supply change)

2 = No evidence that any drugs were sold

EF long term?	1 = yes the ecstasy end-product form shift lasted at least 1 month	
R1		Code 1st response here
R2		If applicable code 2nd response here (if not leave blank)
R3		If applicable code 3rd response here (if not leave blank)
R4		If applicable code 4th response here (if not leave blank)
Outcome		Code outcome here (i.e. whether drugs sold or not once 1 month had passed)

Non-ecstasy drugs - N

Non-ecstasy purity / quality	The following codes capture whether the offender was aware of a non-ecstasy end-product or non-ecstasy precursor purity/quality shift prior to his/her arrest, and if so the cause and direction of the shift, the responses/adaptations made by the offender in both the short term (within 1 month) and long term (1 month or longer), and the outcomes that followed.	
NPQ	Did the offender become aware of a purity/quality shift to his/her non-ecstasy end-product or non-ecstasy precursor supply prior to being arrested? 1 = yes	Eg when to code 1: there is evidence that cutting agents were added to the offender's methamphetamine (e.g. from a forensic analysis), or the offender had successfully improved the quality of cocaine in his/her possession.

	Non-ecstasy purity/quality shift definition: There is evidence that the purity or quality of non-ecstasy end-product or non-ecstasy precursors had changed to a degree relative to an earlier point in time. If 1 was coded, then continue coding below. Otherwise skip to the yellow code titled "non-ecstasy availability".	
NPQ multiple	Was there more than one occasion where the offender became aware of a purity/quality shift to his/her non-ecstasy end-product or non-ecstasy precursor supply prior to being arrested? 1 = yes If so, insert a new line in the excel document underneath the line you are working on for each additional non-ecstasy end-product or non-ecstasy precursor purity/quality shift that the offender became aware of prior to arrest. Code each of the following sub-items below separately on each line for each purity/quality shift you have identified.	

	If only one purity/quality shift was identified then leave this code blank and continue coding below	
Sub-NPQ	This codes the subcategory of the non-ecstasy end-product or non-ecstasy precursor supply shift: i.e. what caused the shift. Code 1, 2 or 3.	
	1 = Law enforcement intervened and caused a non-ecstasy end-product or non-ecstasy precursor purity/quality shift within the offender's supply chain	**e.**g. Law enforcement seized imported cocaine at the border and replaced the drugs with an inert substance, then delivered the package to the offender.
	2 = Cause of the non-ecstasy end-product or non-ecstasy precursor shift was unknown	e.g. The offender received heroin from a supplier that was of a higher purity to normal, but it is unclear what caused the purity to be higher.
	3 = The present offender caused a purity or quality change to a non-ecstasy end-product or non-ecstasy precursor whilst the drugs/precursors were in his/her possession	e.g. The offender cut his or her methamphetamine with a cutting agent, or the offender successfully improved the purity of his or her cocaine.
NPQ direction	This codes the direction of the non-ecstasy end-product or non-ecstasy precursor purity/quality shift: i.e. whether the purity/quality improved or worsened. Select either 'increase' or 'decrease' from the dropdown box	

| Short term (within 1 month) | This code captures all responses/adaptations made by the offender within the first month after the non-ecstasy end-product or non-ecstasy precursor purity/quality shift took place and also captures the outcome that followed (i.e. whether drugs were sold during the first month in spite of the supply change). You can code one or multiple responses/adaptations if multiple were referenced. If multiple were referenced, code each response/adaptation in the order they occurred over time, by coding the 1st response coded under "R1", the 2nd under "R2", the 3rd under "R3" and the 4th under "R4. The outcome is coded under "Outcome" (see below).

Response/adaptation codes

1 'Attempt to improve the purity/quality'
2 'Reduce the purity / quality'
3 'Increase price to customer'
4 'Decrease price to customer'
5 'Attempt to expand business by selling more of the same drug(s) or precursor(s)'
6 'Attempt to expand business by selling a different drug or precursor in addition'
7 'Find/switch to an alternative supplier of the same drug or precursor of same drug'
8 'Find/switch to an alternative supplier of a different drug or precursors of a different drug'
9 'Cease trafficking that drug or precursor'
10 'Regard the drugs/precursors as waste and dispose of them'
11 'Attempt to return drugs/precursors to supplier'
12 'No adaptation - receive drugs and pass them on'
13 'Attempt to locate missing drugs/precursors' | |

		14 'Response/adaptation unclear' 15 'Attempt to source manufacturing equipment / chemicals and/or manufacture the drug' 16 'Become inactive' 17 'Become re-active' 18 'Attempt to sell new form' 19 'Buy more drugs than usual' 20 'Buy less drugs than desired' 21 'Attempt to sell higher purity/quality drugs' 22 'Attempt to sell lower purity/quality drugs' 23 'Attempt to import or order more of the same drug type from the supplier' 24 'Attempt to import a different drug type' 25 'Attempt to import more of both same and different drug type' 26 'Attempt to import more drugs but unclear whether same or different drug type' 27 'Purchase more drugs at an inflated price'. **Outcome codes** 1 = Evidence that drugs were sold (can be any drug sold, does not have to be the drug associated with the supply change) 2 = No evidence that any drugs were sold	
	R1		Code 1st response here
	R2		If applicable code 2nd response here (if not leave blank)
	R3		If applicable code 3rd response here (if not leave blank)

R4		If applicable code 4th response here (if not leave blank)
Outcome		Code outcome here (i.e. whether drugs sold or not within 1 month)
Long term (1 month or more)	Is there evidence that the non-ecstasy end-product or non-ecstasy precursor purity/quality shift lasted 1 month or longer? If so, code "1" under "NPQ long term?" then code all responses/adaptations that the offender made and the outcome that followed once 1 month of time had elapsed (i.e. whether drugs were sold despite the change lasting at least 1 month) **Response/adaptation codes** 1 'Attempt to improve the purity/quality' 2 'Reduce the purity / quality' 3 'Increase price to customer' 4 'Decrease price to customer' 5 'Attempt to expand business by selling more of the same drug(s) or precursor(s)' 6 'Attempt to expand business by selling a different drug or precursor in addition' 7 'Find/switch to an alternative supplier of the same drug or precursor of same drug' 8 'Find/switch to an alternative supplier of a different drug or precursors of a different drug' 9 'Cease trafficking that drug or precursor' 10 'Regard the drugs/precursors as waste and dispose of them' 11 'Attempt to return drugs/precursors to supplier' 12 'No adaptation - receive drugs and pass them on'	

		13 'Attempt to locate missing drugs/precursors' 14 'Response/adaptation unclear' 15 'Attempt to source manufacturing equipment / chemicals and/or manufacture the drug' 16 'Become inactive' 17 'Become re-active' 18 'Attempt to sell new form' 19 'Buy more drugs than usual' 20 'Buy less drugs than desired' 21 'Attempt to sell higher purity/quality drugs' 22 'Attempt to sell lower purity/quality drugs' 23 'Attempt to import or order more of the same drug type from the supplier' 24 'Attempt to import a different drug type' 25 'Attempt to import more of both same and different drug type' 26 'Attempt to import more drugs but unclear whether same or different drug type' 27 'Purchase more drugs at an inflated price'. **Outcome codes** 1 = Evidence that drugs were sold (can be any drug sold, does not have to be the drug associated with the supply change) 2 = No evidence that any drugs were sold	
	NPQ long term?	1 = yes the non-ecstasy end-product or non-ecstasy precursor purity/quality shift lasted at least 1 month	
	R1		Code 1st response here
	R2		If applicable code 2nd response here (if not leave blank)

R3		If applicable code 3rd response here (if not leave blank)
R4		If applicable code 4th response here (if not leave blank)
Outcome		Code outcome here (i.e. whether drugs sold or not once 1 month had passed)
Non-ecstasy availability	The following codes capture whether the offender was aware of a non-ecstasy end-product or non-ecstasy precursor availability shift prior to his/her arrest, and if so the cause and direction of the shift, the responses/adaptations made by the offender in both the short term (within 1 month) and long term (1 month or longer), and the outcomes that followed.	
NA	Did the offender become aware of an availability shift to his/her supply of a non-ecstasy end-product or non-ecstasy precursor prior to being arrested? 1 = yes **Ecstasy availability shift definition:** There is evidence that the offender's access to non-ecstasy end-product or non-ecstasy precursors changed to a degree relative to an earlier point in time.	**Eg when to code 1:** The present offender's regular NPS supplier became unavailable; the present offender was introduced to a new supplier of NPS; law enforcement seized the offender's amphetamine at a point in time prior to his/her arrest.

R3		If applicable code 3rd response here (if not leave blank)
R4		If applicable code 4th response here (if not leave blank)
Outcome		Code outcome here (i.e. whether drugs sold or not once 1 month had passed)
Non-ecstasy availability	The following codes capture whether the offender was aware of a non-ecstasy end-product or non-ecstasy precursor availability shift prior to his/her arrest, and if so the cause and direction of the shift, the responses/adaptations made by the offender in both the short term (within 1 month) and long term (1 month or longer), and the outcomes that followed.	
NA	Did the offender become aware of an availability shift to his/her supply of a non-ecstasy end-product or non-ecstasy precursor prior to being arrested? 1 = yes **Ecstasy availability shift definition:** There is evidence that the offender's access to non-ecstasy end-product or non-ecstasy precursors changed to a degree relative to an earlier point in time.	**Eg when to code 1:** The present offender's regular NPS supplier became unavailable; the present offender was introduced to a new supplier of NPS; law enforcement seized the offender's amphetamine at a point in time prior to his/her arrest.

	If 1 was coded, then continue coding below. Otherwise skip to the brown code titled "non-ecstasy form".	
NA multiple	Was there more than one occasion where the offender became aware of an availability shift to his/her non-ecstasy end-product or non-ecstasy precursor supply prior to being arrested? 1 = yes If so, insert a new line in the excel document underneath the line you are working on for each additional non-ecstasy end-product or non-ecstasy precursor availability shift that the offender became aware of prior to arrest. Code each of the following sub-items below separately on each line for each availability shift you have identified. If only one availability shift was identified then leave this code blank and continue coding below	
Sub-NA	This codes the subcategory of the non-ecstasy end-product or non-ecstasy precursor availability shift: i.e. what caused the shift. Code 1, 2 or 3.	e.g. Law enforcement seized imported cocaine at the border, but did not replace it with an inert

		1 = Law enforcement intervened and caused a non-ecstasy end-product or non-ecstasy precursor availability shift within the offender's supply chain	substance. The offender was not arrested at that time.
		2 = Cause of the non-ecstasy end-product or non-ecstasy precursor availability shift was unknown	e.g. The offender's regular supplier of cocaine became unavailable and it is unclear why
		3 = The present offender caused a changed to the ease of access to his/her non-ecstasy end-product or non-ecstasy precursor supply	e.g. The offender actively sought to find a new heroin supplier and was successful in doing so. The offender could now purchase heroin through that supplier.
	NA direction	This codes the direction of the non-ecstasy end-product or non-ecstasy precursor availability shift: i.e. whether the offender found non-ecstasy end-product or non-ecstasy precursors easier or harder to access. Select either 'increase' or 'decrease' from the dropdown box.	
	Short term (within 1 month)	This code captures all responses/adaptations made by the offender within the first month after the non-ecstasy end-product or non-ecstasy precursor availability shift took place and also captures the outcome that followed (i.e. whether drugs were sold during the first month in spite of the supply change). You can code one or multiple responses/adaptations if multiple were referenced. If multiple were referenced, code each response/adaptation in the order they occurred over time, by coding the 1st response under "R1", the 2nd under "R2", the 3rd under "R3" and the 4th under "R4. The outcome is coded under "Outcome" (see below).	

Response/adaptation codes

1 'Attempt to improve the purity/quality'
2 'Reduce the purity / quality'
3 'Increase price to customer'
4 'Decrease price to customer'
5 'Attempt to expand business by selling more of the same drug(s) or precursor(s)'
6 'Attempt to expand business by selling a different drug or precursor in addition'
7 'Find/switch to an alternative supplier of the same drug or precursor of same drug'
8 'Find/switch to an alternative supplier of a different drug or precursors of a different drug'
9 'Cease trafficking that drug or precursor'
10 'Regard the drugs/precursors as waste and dispose of them'
11 'Attempt to return drugs/precursors to supplier'
12 'No adaptation - receive drugs and pass them on'
13 'Attempt to locate missing drugs/precursors'
14 'Response/adaptation unclear'
15 'Attempt to source manufacturing equipment / chemicals and/or manufacture the drug'
16 'Become inactive'
17 'Become re-active'
18 'Attempt to sell new form'
19 'Buy more drugs than usual'
20 'Buy less drugs than desired'
21 'Attempt to sell higher purity/quality drugs'
22 'Attempt to sell lower purity/quality drugs'
23 'Attempt to import or order more of the same drug type from the supplier'
24 'Attempt to import a different drug type'
25 'Attempt to import more of both same and different drug type'

		26 'Attempt to import more drugs but unclear whether same or different drug type' 27 'Purchase more drugs at an inflated price'. **Outcome codes** 1 = Evidence that drugs were sold (can be any drug sold, does not have to be the drug associated with the supply change) 2 = No evidence that any drugs were sold	
	R1		Code 1st response here
	R2		If applicable code 2nd response here (if not leave blank)
	R3		If applicable code 3rd response here (if not leave blank)
	R4		If applicable code 4th response here (if not leave blank)
	Outcome		Code outcome here (i.e. whether drugs sold or not within 1 month)
Long term (1 month or more)		Is there evidence that the non-ecstasy end-product or non-ecstasy precursor availability shift lasted 1 month or longer? If so, code "1" under "NA long term?" then code all responses/adaptations that the offender made and the outcome that followed once 1 month of time had elapsed (i.e. whether drugs were sold despite the change lasting at least 1 month)	

Response/adaptation codes

1 'Attempt to improve the purity/quality'
2 'Reduce the purity / quality'
3 'Increase price to customer'
4 'Decrease price to customer'
5 'Attempt to expand business by selling more of the same drug(s) or precursor(s)'
6 'Attempt to expand business by selling a different drug or precursor in addition'
7 'Find/switch to an alternative supplier of the same drug or precursor of same drug'
8 'Find/switch to an alternative supplier of a different drug or precursors of a different drug'
9 'Cease trafficking that drug or precursor'
10 'Regard the drugs/precursors as waste and dispose of them'
11 'Attempt to return drugs/precursors to supplier'
12 'No adaptation - receive drugs and pass them on'
13 'Attempt to locate missing drugs/precursors'
14 'Response/adaptation unclear'
15 'Attempt to source manufacturing equipment / chemicals and/or manufacture the drug'
16 'Become inactive'
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18 'Attempt to sell new form'
19 'Buy more drugs than usual'
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21 'Attempt to sell higher purity/quality drugs'
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23 'Attempt to import or order more of the same drug type from the supplier'
24 'Attempt to import a different drug type'
25 'Attempt to import more of both same and different drug type'

		26 'Attempt to import more drugs but unclear whether same or different drug type' 27 'Purchase more drugs at an inflated price'. **Outcome codes** 1 = Evidence that drugs were sold (can be any drug sold, does not have to be the drug associated with the supply change) 2 = No evidence that any drugs were sold	
	NA long term?	1 = yes the non-ecstasy end-product or non-ecstasy precursor availability shift lasted at least 1 month	
	R1		Code 1st response here
	R2		If applicable code 2nd response here (if not leave blank)
	R3		If applicable code 3rd response here (if not leave blank)
	R4		If applicable code 4th response here (if not leave blank)
	Outcome		Code outcome here (i.e. whether drugs sold or not once 1 month had passed)
Non-ecstasy form		The following codes capture whether the offender was aware of a non-ecstasy end-product form shift prior to his/her arrest, and if so the cause of the shift, the responses/adaptations made by the offender in both the	

	short term (within 1 month) and long term (1 month or longer), and the outcomes that followed.	
NF	Did the offender become aware of a form shift to his/her supply of a non-ecstasy *end-product* prior to being arrested? Note: form shifts that occur during a precursor to a non-ecstasy end-product conversion do not count (e.g. the "crystallisation process" during methamphetamine manufacture). Precursor form shifts also do not count. 1 = yes **Ecstasy availability shift definition:** There is evidence that the form of the offender's non-ecstasy end-product supply changed relative to an earlier point in time. If 1 was coded, then continue coding below. Otherwise skip to the orange "Supply change reference?" code.	**Eg when to code 1:** The present offender received methamphetamine in a different form than usual from his/her regular supplier; the present offender converted methamphetamine from powder to tablets whilst the drug was in his/her possession.
NF multiple	Was there more than one occasion where the offender became aware of a form shift to his/her non-ecstasy end-product supply prior to being arrested? 1 = yes	

	If so, insert a new line in the excel document underneath the line you are working on for each additional non-ecstasy end-product form shift that the offender became aware of prior to arrest. Code each of the following sub-items below separately on each line for each form shift you have identified. If only one form shift was identified then leave this code blank and continue coding below	
Sub-NF	This codes the subcategory of the non-ecstasy end-product supply shift: i.e. what caused the shift. Code 1, 2 or 3.	
	1 = Law enforcement intervened and caused a non- ecstasy end-product form shift within the offender's supply chain	e.g. Law enforcement seized imported crystal methamphetamine at the border and replaced it with an inert powder substance, then delivered the package to the offender.
	2 = Cause of the form shift was unknown	e.g. The offender received a different form of methamphetamine to usual from his/her regular supplier, but it is unclear why.
	3 = The present offender caused a form shift to a non-ecstasy end-product whilst it was in his/her possession	e.g. the offender received methamphetamine end-product in powder form then converted it to crystal whilst it was in his/her possession.

| Short term (within 1 month) | This code captures all responses/adaptations made by the offender within the first month after the non-ecstasy end-product form shift took place and also captures the outcome that followed (i.e. whether drugs were sold during the first month in spite of the supply change). You can code one or multiple responses/adaptations if multiple were referenced. If multiple were referenced, code each response/adaptation in the order they occurred over time, by coding the 1st response under "R1", the 2nd under "R2", the 3rd under "R3" and the 4th under "R4. The outcome is coded under "Outcome" (see below).

Response/adaptation codes

1 'Attempt to improve the purity/quality'
2 'Reduce the purity / quality'
3 'Increase price to customer'
4 'Decrease price to customer'
5 'Attempt to expand business by selling more of the same drug(s) or precursor(s)'
6 'Attempt to expand business by selling a different drug or precursor in addition'
7 'Find/switch to an alternative supplier of the same drug or precursor of same drug'
8 'Find/switch to an alternative supplier of a different drug or precursors of a different drug'
9 'Cease trafficking that drug or precursor'
10 'Regard the drugs/precursors as waste and dispose of them'
11 'Attempt to return drugs/precursors to supplier'
12 'No adaptation - receive drugs and pass them on'
13 'Attempt to locate missing drugs/precursors'
14 'Response/adaptation unclear' | |

		15 'Attempt to source manufacturing equipment / chemicals and/or manufacture the drug' 16 'Become inactive' 17 'Become re-active' 18 'Attempt to sell new form' 19 'Buy more drugs than usual' 20 'Buy less drugs than desired' 21 'Attempt to sell higher purity/quality drugs' 22 'Attempt to sell lower purity/quality drugs' 23 'Attempt to import or order more of the same drug type from the supplier' 24 'Attempt to import a different drug type' 25 'Attempt to import more of both same and different drug type' 26 'Attempt to import more drugs but unclear whether same or different drug type' 27 'Purchase more drugs at an inflated price'. **Outcome codes** 1 = Evidence that drugs were sold (can be any drug sold, does not have to be the drug associated with the supply change) 2 = No evidence that any drugs were sold	
	R1		Code 1st response here
	R2		If applicable code 2nd response here (if not leave blank)
	R3		If applicable code 3rd response here (if not leave blank)

R4		If applicable code 4th response here (if not leave blank)
Outcome		Code outcome here (i.e. whether drugs sold or not within 1 month)
Long term (1 month or more)	Is there evidence that the non-ecstasy end-product form shift lasted 1 month or longer? If so, code "1" under "NF long term?" then code all responses/adaptations that the offender made and the outcome that followed once 1 month of time had elapsed (i.e. whether drugs were sold despite the change lasting at least 1 month) **Response/adaptation codes** 1 'Attempt to improve the purity/quality' 2 'Reduce the purity / quality' 3 'Increase price to customer' 4 'Decrease price to customer' 5 'Attempt to expand business by selling more of the same drug(s) or precursor(s)' 6 'Attempt to expand business by selling a different drug or precursor in addition' 7 'Find/switch to an alternative supplier of the same drug or precursor of same drug' 8 'Find/switch to an alternative supplier of a different drug or precursors of a different drug' 9 'Cease trafficking that drug or precursor' 10 'Regard the drugs/precursors as waste and dispose of them' 11 'Attempt to return drugs/precursors to supplier' 12 'No adaptation - receive drugs and pass them on' 13 'Attempt to locate missing drugs/precursors' 14 'Response/adaptation unclear'	

		15 'Attempt to source manufacturing equipment / chemicals and/or manufacture the drug' 16 'Become inactive' 17 'Become re-active' 18 'Attempt to sell new form' 19 'Buy more drugs than usual' 20 'Buy less drugs than desired' 21 'Attempt to sell higher purity/quality drugs' 22 'Attempt to sell lower purity/quality drugs' 23 'Attempt to import or order more of the same drug type from the supplier' 24 'Attempt to import a different drug type' 25 'Attempt to import more of both same and different drug type' 26 'Attempt to import more drugs but unclear whether same or different drug type' 27 'Purchase more drugs at an inflated price'. **Outcome codes** 1 = Evidence that drugs were sold (can be any drug sold, does not have to be the drug associated with the supply change) 2 = No evidence that any drugs were sold	
	NF long term?	1 = yes the non-ecstasy end-product form shift lasted at least 1 month	
	R1		Code 1st response here
	R2		If applicable code 2nd response here (if not leave blank)

R3		If applicable code 3rd response here (if not leave blank)
R4		If applicable code 4th response here (if not leave blank)
Outcome		Code outcome here (i.e. whether drugs sold or not once 1 month had passed)
Supply change reference?	Did you code any purity/quality, availability or form shift references for this transcript? 1 = yes 0 = no	i.e., did you code a "1" under any of the following supply change codes: EPQ, EA, EF, NPQ, NA, NF.