Evolution of Emotion Driven Design

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Abstract

Our thoughts, behavior, experiences, and relationship with the world are all influenced by our emotions, which are a central component of what makes us human. Emotions are forces that help us make sense of our interactions with the world. Human behavior is a direct consequence of emotions, with the emotions directly affecting perception, cognition, personality system, body language, and the mind. While some emotions are innate, others are learned and synthesized from accrued knowledge. This chapter looks at the evolution of emotion driven design and the related theories and research. It also offers a glimpse of what is to come in this field with the latest technological advances.

Keywords: emotion driven design, emotional design, emotional response, positive emotions, emotional data.

Background

As per Solomon who suggested that emotions are the meaning of life (Solomon, 1976) and Van Gogh’s quote (1889) “Let’s not forget that the little emotions are the great captains of our lives and we obey them without realizing it”, emotions influence our thoughts and behavior and are as such central to all human behavior and experience. Indeed, emotions form an essential part of our interactions with other people, environments and products.

The origin of the word emotion has evolved from Latin and French, starting with the Latin verb movere implying ‘to move’ with the prefix ex, meaning ‘out’ – exmovere – émovere - émouvoir (12th Century French meaning ‘stir up’), to émotion (16th Century French word denoting social disturbance). All these permutations of the word denote some kind of action/reaction.

Meyers (2009) states that emotionality, the observable behavioral and physiological component of an emotion, is connected with an array of psychological phenomena, involving "...physiological arousal, expressive behaviors, and conscious experience" (Meyers, 2009). Furthermore, according to Plutchik, during their evolutionary history, emotions have worked to support animals and humans deal with crucial survival issues. These emotions have evolved and derived into myriads of expression forms with a small number of these being ‘primary emotions’ having identifiable basic common elements or patterns (Plutchik, 1980).
In the product design realm, one conference has been instrumental in shaping the direction of design and emotion research from 2002 onward: the Design & Emotion Conference (www.de2016.org/). This initiative has originated from the combined disciplines of product design and design research and is now an interdisciplinary field of interest. This is noticeable in the themes of the 2016 Design & Emotion Conference that now encompass many more disciplines: ambiguity (designing rich experiences, irony, and uncomfortable interactions); provocation (design activism, future prototyping, and positive speculation); well-being (design for social behavior, ethics, happiness, and personal values); beauty (design aesthetics, materials, and the senses); embodiment (design ubiquity, internet, tangibility, and embedded computing); poetry (designing openness, drama, emotional durability, and storytelling); empathy (design for inclusion, participation, and co-design); and finally spirituality (design for mindfulness, memories, trust experiences, and awe) (Design, 2016).

How Emotional Experience Works

Cherry (2016) classifies the main theories of emotion in three as, physiological, neurological, and cognitive. In brief, according to physiological theories, emotions are generated by reactions inside the body. Neurological theories on the other hand advise that emotions are engendered by activity inside the brain. Lastly, cognitive theories claim that emotions are mainly created by thoughts (Cherry, 2016). The way emotions work has been debated in different disciplines for centuries, and in the past two decades, there has been an increasing interest in researching emotions. A quick Google Ngram viewer search charts the frequencies of the words: emotion driven, emotional design, emotional response, positive emotions, and emotional data, found in printed sources between 1800 and 2012 in American English and British English (see Figure 14.1). The frequency in use for the terms emotional response and positive emotions has been increasing steadily, with positive emotions peaking after 2000.

Figure 14.1. Frequencies chart for: emotion driven, emotional design, emotional response, positive emotions, and emotional data (1800 – 2012). Screen shot from Google Ngram viewer graph based on Google Books. https://books.google.com/ngrams
Some of the latest research has synthesized this body of knowledge, and shown that our behavior is a direct consequence of our emotions, with the emotions directly affecting our perception, cognition, and personality system (Lizard, 2001); that emotions and feelings affect one’s perception and mind (Russell, 2003); that some emotions are learned and synthesized from accrued knowledge (Stets, 2010); that emotions are ‘forces’ (Kövecses, 2003); and that body language is another outlet for communicating emotions (De Gelder, 2006; Carney, Cuddy, and Yap, 2010; Cuddy, Kohut, and Neffinger, 2013). Other studies looked at the physical manifestation of emotions in the body, such as a Finnish study that generated coloured body maps showing the various regions of the body where (773) participants reported that activation was happening or not, when they were asked to feel certain emotions (Nummenmaa, Glerean, Hari, and Hietanen, 2014). In this study, Nummenmaa et al. suggest that distinct emotional responses that are also somewhat overlapping maps of bodily sensations could be fundamental to the emotional experience (See Figure 14.2).


Decision-making relies heavily on emotional feedback. Damasio (2006) asserts that emotions dominate and guide the decision-making process by allowing us to discern if things are good, bad or indifferent, and in this way, also strengthen and support our memory. He also states that humans “… are not thinking machines.” They “… are feeling machines that think.” This has also been supported by studies of MRI scans that allowed to demonstrate that the decisions we make are not solely made within the reason oriented cognitive parts of our brain, but that they are heavily influenced by both the amygdala in the limbic system (identified as the emotional governing centre) and the pre-frontal cortex for contemplation (Bechara, Damasio and Damasio, 2000; Graves, 2015).

Furthermore, the process of experiencing an emotion occurs outside our conscious awareness (Weinschenk, 2009) and is often complex and layered. This process is being
simultaneously biochemical and neurological involving the heart, the brain, nervous and hormonal systems, and sensory organs (Barrett et al., 2007; Izard, 2013). Working together with the brain, the senses allow human beings to experience the events and environments they interact with, and mostly to determine how they will perceive any stimuli.

This is also described by Merle-Ponty as "être au monde", meaning simultaneously to be in the world, and to belong in it. This act of belonging involves having a connection and a rapport with the world, as well perceiving all of its dimensions (Merleau-Ponty, 1958). During our daily interactions with the world, we perceive its dimensions with the help of all our senses, our thinking, our memories, and skills. Phenomenologists and pragmatists describe personal knowledge creation as the result of “reflection upon action”; meaning that reflection is preceding the action to be taken – both on the action and within it – a concept also described by Schön (1983) as fundamental to human-centered design practice.

Two studies (Gross and Thompson, 2007; Mauss, Bunge, and Gross, 2007) summarize the emotional response as below:

1) having contact with a stimulus (event, object, situation, sensation, or thought).
2) focusing attention to this stimulus.
3) interpreting the stimulus.
4) having an emotional/physiological reaction to the stimulus.

(Figure 14.3).

**Emotion Driven Design**

Designers designing for emotional response are interested in designing the context in which emotions are perceived and the meanings they create or foster. To this end, they perform design research activities to understand the personal values and meaning for their target market of user. Desmet (2002) states that due to emotional reactions being personal and different for each individual, foretelling or even influencing the emotional impact of a design to induce targeted emotional responses is difficult.

**The Three Layers of Human Nature and Abilities**

As stated in an early work by Buxton (1994), human nature and abilities can be separated in three layers: physical (including human senses), cognitive and social (relation to, and interaction with our social environment). These are also the layers where the interaction with things and environments happen. The physical layer has dominated this interaction, corresponding to the *look & feel* of products. To this, *sound* has been a more recent and still timid addition. Products’ *look & feel* only engages two of our main senses and the addition of *sound* feedback activates a third human sense (Buxton, 1994). Buxton describes how most product interaction happens around these three senses, sight, touch and hearing, using the font size to describe the magnitude of the interaction in Figure 14.4.

![Figure 14.4. How we interact with products: through sight, touch and hearing (Buxton, 1994: 2).](image)

Look, feel and sound, proportionally represented in Figure 14.4, are three important senses to consider in emotion driven design. They are emotion triggers allowing us to experience and connect with the products and environments we interact with. For a more complete and successful user interface, the proportional unbalance between what our senses (sight, touch and hearing) get exposed to has to be resolved (Buxton, 1994).

**Look**

The external appearance of products and environments dictates most of how we sense and control them. The look of something is defined by its form, geometry, colour, proportion, material, and texture. These are all important visual design elements that dominate the look of things, which in turn affects the way we perceive all things and interact with them. The following quote “80% of what people see is behind their eyes” (Dan Buchner, Vice President Innovation and Design) is still valid for most products on the market and environments we live in.

**Colour**

Colour is one of the most important visual design elements. “Colours, like features, follow the changes of the emotions” Pablo Picasso (Spanish Artist and Painter, 1881-1973). This quote from Picasso points to the close connection between colours and emotions. Colours
are also said to boost memory by allowing us to process and store visual images in a more effective way (von Goethe, 1810; Kaya, and Epps, 2004; Cherry, 2010). Moreover, colours have physiological and emotional effects and can impact our emotional well-being. Colours can carry symbolic meanings and be perceived as having positive or negative traits, depending on who the target audience is, and also as specific emotions, such as happiness (yellow), invigorating (red), calming (light blue), exciting (orange), tired (purple), depressing (blue), irritating (red) and annoying (green-yellow) (Morris, 2006). Nevertheless, every person will perceive colour differently, depending on their past experiences, culture, gender, nationality, race and religion; which makes it hard to classify common responses to different colours.

**Feel**

**Touch**

The very first sense to develop in the human baby embryo is touch; which then allows babies to learn about their environments through touch (Field, 2014; Montagu, 1971). In adulthood, tactility is important for us, as our physical interactions with most products and environments occur typically through our hands. Furthermore, Filed (2014) says that touch is the social sense, and is different from all the other senses, as it is the only one that involves connecting with something or someone physically. All other senses can be experienced alone, whereas touch allows us to establish social connections.

How something feels in our hands is very important. This could be about the weight (a heavy car door would suggest good quality and luxury, for example), the material and temperature (a cold metal surface would be less inviting than a warm wooden one to seat on), the texture of a surface (which might indicate where and how we can interact with it), or the softness and smoothness of a surface finish. In relation to the last one, Tsakiris et al. (2010) report a phenomenon called the social softness illusion, which is our innate ability to perceive other people’s skin as softer than ours. Researchers explain this automatic and unconscious tactile mechanism as an important survival phenomenon (Silk et al., 2003) that promotes social bonds through touch, and demonstrate the hedonic benefits of social touch.

This phenomenon is also supported by psychophysical research done on stroking or gently caressing pets, which reports physical and mental health benefits to the touch providers (Cascio, 2010; Gallace, and Spence 2010). This also demonstrates that, compared to other tactile elements, softness and smoothness are considered as pleasant and rewarding tactile prompts (Gentsch, Panagiotopoulou, and Fotopoulou, 2015). This is the main reason why we usually prefer soft and smooth textures over rough ones.

**Sound**

The third vital sense for us is hearing, which is also an essential form of communication and human interaction. We hear through the information created by pressure variations in the air generated by vibrating objects (Plack, 2013). Özcan argues that product sounds are fundamentally ambiguous and that people would perceive what a sound signifies and make a cognitive evaluation of its meaning within its context (Özcan, 2008). Van Egmond (2008) classifies product sounds as intentional (distinct musical sounds designed into a product as part of its functionality or interface) or consequential (mechanical sounds as a
result of a product’s functioning). Intentional sounds communicate special messages and meanings. Jekosh (2005) says that appropriate sound design involves looking at it from an auditory communication and sign theory perspective - a field supported by semiotics. Jekosh (2005) also notes that sound design has gained importance in the last decade and has been promoted from being considered as something secondary and sometimes as unwanted noise; to something supporting the product’s quality, and even becoming part of the product identity.

**Positive Emotions**

Norman’s famous statement: “Attractive things work better” (Norman, 2005) has also been supported by many other researchers (Desmet, 2009; Chawda et al., 2005; Petersen et al., 2004; Crilly, Moultrie, and Clarkson, 2004). One reason why attractive things would indeed work better could be that, as theorized by Aspinwall, positive emotions expand our attention and cognition on the one hand, and facilitate flexible and creative thinking on the other. This is an alpha state of mind that would also make it easier to deal with any stress and/or difficulty (Aspinwall, 1998: cited in Fredrickson and Joiner, 2002).

Both positive and negative emotions cause complex reactions (involving tension in muscles, release of hormones, cardiovascular fluctuations, facial expression, attention and perception - among many others) that occur very fast. These emotional reactions help us create meaning, thus allowing us to connect to what makes sense in our lives; and to pay more attention to the things that impact our lives. Some emotions are deemed pleasant or positive and others as unpleasant or negative.

In one study that only looked at the appearance of certain products, Desmet (2002) developed a tool based on images, to assess seven unpleasant (indignation, contempt, disgust, unpleasant surprise, dissatisfaction, disappointment, and boredom) and seven pleasant (desire, pleasant surprise, inspiration, amusement, admiration, satisfaction, and fascination) emotions. Desmet demonstrated that physical products would elicit different layers of emotional responses to create meaning, some more predictable than others.

Positive emotions allow us to have better experiences overall and in this way, play an important role in our well-being. Fredrickson posits that experiencing positive emotions extends the inventory of our temporary reactions, which in turn strengthens our long-term physical, psychological intellectual and social resources (Fredrickson, 2001); contributing in the long run to the improvement of our overall well-being (Fredrickson, 2004). Furthermore, Van Hout (2007) also supports the view that positive emotions elicited through design increase general well-being.

**Pleasure**

Positive emotions are often confused with related affective states, such as sensory pleasure and positive mood (Fredrickson, 2004). Pleasure is a positive affective state, and sensory pleasures act as instigators for people to detect biologically useful stimulus for them (Cabanac, 1971; cited in Fredrickson, 2001). The Oxford English Dictionary (1989) defines pleasure as the “condition of consciousness or sensation induced by the enjoyment or anticipation of what is felt or viewed as good or desirable; enjoyment, delight, gratification. The opposite of pain” (Simpson and Weiner, 1989: 1031). In the
context of artifacts and products, pleasure comes in three types of benefits: emotional, hedonic and practical (Jordan, 2000). Moreover, pleasure comes through the relationship and the enjoyment taken by interacting with a product.

Lionel Tiger’s four Pleasure model (Tiger, 1992) describes a framework for the different types of pleasure enjoyed by people, such as Physio-pleasure (touching, hearing and smelling), Psycho-pleasure (cognition, discovery, knowledge), Socio-pleasure (feeling of belonging, signaling, conversation-starter, social self-identification, social awareness) and Ideo-pleasure (signaling or reinforcing ideological standpoints or values).

As a real life example, some people love the smell of a new car, which is, in fact, nothing else but the scent of harmful volatile chemicals. The pleasure we might get from a smell is an olfactory pleasure classified under Physio-pleasure, and the example above demonstrates that it is a perceived pleasure.

**Positive Emotion Triggers**

Affordances, functionality and ease of use are certainly very important in any design, yet the experience(s) and delight we get from the interaction would both support and strengthen the context for meaningful experiences to unfold and increase desirability. The same applies to the aesthetic appearance of a product, an environment, or an interface; all needing to respond exquisitely when we interact with them (Overbeeke et al., 2003). Design elements from the physical layer of human nature and activities, that can help trigger positive emotions and sensory pleasure are fun, cuteness, familiarity, and colour (Demirbilek and Sener, 2003).

*Embedding fun in design*

Products, environments and most interfaces are static, and on the other hand, experiences are fluid. A product, an environment, or an interface that we experience and perceive as funny would have particular characteristics. It would firstly be intuitive (helping us to retrieve cues from our memories or our past experiences), meaning that it is easy to understand or discover without instructions. Secondly, it could have humor imbedded. Thirdly, it could have elements of personification or expressiveness in human qualities (mirroring or abstracting the human body parts and posture, gestures, and facial expressions for familiarity), and as such, would convey enjoyment and/or feelings of happiness. Doyle says that funny, warm or friendly objects are engaging and would initiate a kind of ‘dialogue’, creating an emotional connection with people (Doyle, 1998).

Fun is experienced and is situational, whereas happiness is built and can last longer, no matter what the situation is. Happiness and fun are not synonymous. The following quote from Aristotle reinforces the importance of focusing on feelings of happiness: “happiness is the meaning and the purpose of life, the whole aim and end of human existence”. To this, Van Hout adds that “Design cannot cause happiness, but good design can be an occasion for and manifestation of happiness” (van Hout, 2007).

**Cuteness**

Cuteness triggers feeling of warmth and protectiveness, feelings that are also associated with love. The best example for this is the way we react to baby features. Dissanayake
writes about the power of a baby smile in giving happiness and strength to go on in life (Dissanayake, 1988). Baby features are considered as naive, honest and helpless, compared to more mature features (Lidwell, Holden, and Butler, 2010) and this would trigger a desire to protect, nurture and care for a product having baby features.

Familiarity

Familiarity involves anthropomorphic (human like) and zoomorphic (animal like) design, which is the creation of forms suggesting human or animal-like qualities. This is about humanizing products, websites and environments by including human aspects that will allow people to relate and connect; in other words, to design “the relationship someone has with his or her environment” (Tromp and van den Berg, 2014: 15). This includes physical characteristics (posture, shape and size), personality and behavioural qualities. Familiarity can also help in conveying human values.

The key to good anthropomorphic design is to keep the human characteristics abstract, simple and subtle. “Abstraction reduces the chance of directly evoking negative emotions, while preserving the positive associations”. Zoomorphic design on the other hand is easier to implement, as people would be more tolerant when a product does not perform as it should, and amazed when it exceeds their expectations (NextNature.net, 2011).

Facial expressions for six basic human emotions, including anger, fear, happiness, surprise, disgust, and sadness (See Figure 14.5) have a very high ratio of recognition (90%) (Goleman, 1995). This recognition happens very fast through our visual system and is based on minimal cues, and would occur regardless of nationality, culture, or age group (Goleman, 1995; Hadjikhani et al., 2009). Facial expressions also involve more subtle cues as eye blinking patterns and changes in pupil size for the eyes. Our innate instinct for recognizing facial expressions as well as imitating them allows us to empathize with other people.

![Facial expressions for six basic human emotions](author's sketches)
Smile

Humans are attracted to smiles, and smiling faces are perceived as friendly and unthreatening in most cultures. Furthermore, research has shown that smiling is in itself contagious, and that the use of genuine smiling (also called Duchenne smiling) in advertisement elicits positive moods and emotions in viewers (Scanlon and Polage, 2011; Soussignan, 2002; Surakka & Hietanen, 1998). This simple yet effective phenomenon has to do with the mirror neurons in our brain that help us empathize and experience emotions replicating the ones displayed in ads. The use of authentic smiling and even suggestions of smiles have been a particular focus in advertisement for a long time.

Technological Advances and the Collection of Emotional Data

Emotional Data

Whether we like it or not, we are rapidly heading towards a new era of insight into ourselves. For now, this data can be collected in two ways. One is through sentiment analysis software looking at linguistic patterns in written content and the other way is through data collected via wearable devices (emotional arousal - quicker pulse, self reported mood). Emotions are contextual and complex, both psychological and biological; and as such, would require a combination of biometric data from pulse rates, hormone production, facial expressions, and self reported moods and emotions – to truly reflect what is actually happening.

Emotional data covers everything that signifies state of mind. It has been used to track people’s self-reported emotional reactions and mood to specific events; such as joy, delight, surprise, excitement, fear and sadness. As new technology is developed, wearable technology and biofeedback will continue to flourish.

Recent technological advances such as brain scans, endocrine systems, and wearable technologies have allowed the collection of vast amounts of biometric as well as emotional data. This has in return allowed uncovering a great deal about human emotions. However, some of these technologies have also transformed the way we do many things. A majority of people will agree that their smart devices can take over their lives. It all comes down to the experience one has with any such device.

A badly designed user interface will require users to focus and concentrate too much of their attention, for too long, with information and feedback that compete for their attention – which has brought the concept of calm technology back on the table (Weiser, and Brown, 1995; http://www.calmtech.com/). Bakker et al. (2010) talk about designing for the periphery of our focus, to encalm. Weiser was among the first to coin the term calm technology. He argues that technologies can firstly encalm when they allow easy movement for our focus, from center to periphery and back (Weiser, 1995); and secondly, by bringing more details into the periphery - without causing information overload. Calm technology does not demand more of our attention, as it works in the background. Calm technology brings back familiarity and ease of use to help us connect to the world and
tune into what is occurring around us, without being overwhelmed by the amount of information.

Health related wearable devices now allow us to log how we feel at particular times of the day, after certain achievements (see Figure 14.6). This collected data is then analysed by data scientists specialising in mood data, and the results show rough approximations of which sections of our daily routine influence how we feel (See Figure 14.7).

**How do you feel?**

![Figure 14.6. Icons helping to collect self reported emotional data in a brand of wearable device (Available from http://www.warriorwomen.co.uk/2013/05/28/jawbone-up-another-geeky-bracelet-review/, warriorwoman, 2013).](image)

**Effect of Time of Day on Mood**

![Figure 14.7. Emotional data plotted against the time of the day in a brand of wearable device Source: Mohan, S., 2015. What Makes People Happy? We Have The Data, Available from: https://jawbone.com/blog/what-makes-people-happy/](image)

**Reading Human Emotions**

**Facial Expressions**

Recent advances in the fields of machine learning (Microsoft Research, 2016) and artificial intelligence have allowed computer scientists to make smarter apps that can identify sounds, words, images, and even facial expressions.

An *Application-Programming Interface* (API) is a set of programming commands and standards for accessing a Web-based software application or Web tool. The Microsoft Project Oxford Emotion API identifies emotions in facial expressions in images, using
machine learning techniques, and returns the confidence by allocating a set of emotions for each face in an image (see Figure 14.8). This can detect cross-cultural and universally communicated emotions such as anger, contempt, disgust, fear, happiness, neutral, sadness, and surprise.

![Figure 14.8. Emotions identified in the author’s face on the Microsoft Project Oxford website (screen shot taken after uploading the image on https://www.microsoft.com/cognitive-services/en-us/emotion-api-detection).](image.png)

**Voice Recognition**

New software and app developments are also now targeting emotion recognition in voices, through speech. One such app is Moodies Emotions Analytics (an ios app) that analyzes mood and emotions from voice. The app allows for recording real time speech and immediately extracts, decodes, and measures the “full spectrum of human emotions”, one voice at a time.

**Concluding Remarks**

Design is omnipresent, as almost everything around us is designed. With the advances of technology, a range of the products we use will fade in the background and even disappear, and some will be reduced to an interface. All other devices will be connected via the Internet, which will allow them to learn from each other and even share functionality. This will also allow better ways to include people into any design process, as co-designers, in real time.

Design has an important role in the enhancement of well-being and the quality of life (Van Hout, 2007). Products and environments are usually specifically designed for a specific purpose, to solve a problem or meet an unmet need, and/or provide an answer or a solution to a real need. As Norman notes, any product is always greater than the sum of its parts or components, providing a “cohesive, integrated set of experiences” (Don Norman, 2009).
Important aspects of interaction design will still be usability, the way things work and fulfill needs, but also how it informs and guides, and above all, how en calming it is. To this end, when designing a new product, system or interface, it is important to take into consideration how people experience, perceive and connect with what they consider important and meaningful in their day-to-day environments. Emotion driven design revolves around our needs as humans to bond and create a connection between people, and man and machine (product, interface, space, etc.). At the end of the day, this is about establishing better relationships between humans and the world we live in. We need to promote the design of products and environments that enhance people’s lives, inspire them, and elicit positive emotions.

All of this has the potential to be done in a way to provide quality of life and independent living for all ages and ranges of mobility, with age friendly accommodating and “caring” products and environments. Emotion driven design is also designing with empathy to create more responsive and appropriate products and environments in terms of people’s cultural, emotional, spiritual and practical requirements.

References


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Further Reading
