

User Emotional Characteristics

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5.1 - Introduction and Background

Our senses act as the interface between our thoughts and the activity generated by the world around us. The perception of that activity is processed and results in an appropriate response. In that regard, our cognitive process is like that of a computer's computational process, but the similarities end there. What people have that computers lack is the ability to learn and take action when given *implicit* direction. These actions are heavily influenced by human emotions. Engagement, attention, successful retrieval of information, and long-term retention of the information perceived through our senses are all affected by the individual's current emotional status (Tyng, C. M., Amin, H. U., Saad, M., & Malik, A. S., 2017). The relevance of emotion in the domain of software development may not be obviously apparent until one takes into consideration the ubiquity of digital user interfaces in the modern day. Every day, people are processing more and more information through a digital medium: a set of driving directions, an application to monitor insulin levels, or entertainment on an online media platform. When digital user interfaces are examined as an add-on pipeline for perceived thought—an extension for our natural senses—the importance of engineering towards user emotional engagement begins to present itself.

When developing client-facing software, the presentation of the user interface has become as important to the commercial success of the product as the operations and subroutines that form the backbone of the underlying service. The Apple Macintosh debuted in 1984 as the first commercially accessible personal computer and found great success largely due to the company's major decision to present systems navigation through a GUI-driven operating system (Johnson, Katherine; Li, Yang; Phan, Hang; Singer, Jason; and Trinh, Hoang, 2012). To this day, graphical user interfaces remain the *de facto* form of presenting the information and input layer to users of digital content, largely because of the high level of abstraction created between the visuals perceived by the user and the low level programs and subroutines being performed by systems. Apple as a company continues to innovate in the area of user-experience-oriented development and retains a large consumer following as a result of those methodologies. Following Apple's example, the inclusion of an organic front-faced experience has become highly prioritized among software companies. This is because the interface exposed to clients serves as a frame through which users perceive not just the software, but the face of the entity responsible for producing the software (Zhang, P., Carey, J., Teeni, D., & Tremaine, M., 2005). It is critical, then, that developers accept this notion when entering the product development cycle and incorporate consideration of user design elements as the project develops and not as an afterthought.

5.2 – The Human Action Cycle

Having briefly introduced the importance of emotion when interfacing with information exchange layers and the impact of public perception of development organizations based on user experiences with branded products, this module aims to share insights on how to better design client-facing information exchange interfaces with user emotional characteristics in mind. This module will first survey the Human Action Cycle (HAC) in detail, which is a directed psychological framework for designing around typical

user interactions first presented by Don Norman in his revolutionary text, *The Design of Everyday Things*. In brief, when people interact with responsive objects, they analyze the behavior in two processes. The first process takes into consideration the aspect of evaluation during which the user dissects the steps to be taken in order to operate the objects, also known as interfacing, while the second process is concerned with evaluation of the response in which they discover the action resulting from their input (Norman, D. A., 2013). These two processes are broken down into seven individual steps to form a model that can be directly applied to an individual's interaction with any object or set of instructions, whether they be physical or digital. Understanding the cognitive steps taken when presented with a new system helps when designing such a system to be as organic and implicit as possible and lays down the foundation to apply the interfacing techniques discussed in the following section.

The human action cycle focuses mainly on the behavioral aspect of emotional design. One of the basic tenets of this design model is that there are no bad users, only poor design; any errors that the user commits during their interaction with an interface can be traced back to a problem in the user interface itself (Norman, 2013). The model is split into three main phases: the goal formation stage, in which the user decides on an end result or product to achieve; the execution stage, in which the user determines, orders, and executes a set of tasks necessary to complete the goals in phase 1; and the evaluation stage, in which the user finalizes, interprets, and evaluates the product or result that was achieved relative to what the user wishes to receive or achieve.

The role of human emotion is well-documented at each step of the human action cycle. An individual using an interface with no clearly defined goals will quickly become discouraged or disinterested. A user that is frustrated by the presentation or accessibility of an end product may disengage from an interface in search of a better alternative. Additionally, an interface design must take into account the fact that individuals very often do not seek individual items or aspects of an interface, but rather are in search of positive experiences (McDonagh, 2004). A smooth, comfortable user interface offers more to an end user than specific features, such as a chat window or user calendar, separate from other aspects of the application. With this in mind, it is important to design the interface in a manner that is most conducive to the user's ability to decide on goals, identify the steps required to achieve them, and perform those steps, without significant pauses or roadblocks between phases or individual steps.

For example, the user may visit a library website with the intention of acquiring references for a research project, only to be hampered by a lack of immediately available citations listed on the website itself. While the feature itself may exist and be easily accessible once the steps to reach it are known, the interface may be designed in such a way that a new user is required to halt their progress towards their goals to explore many seemingly unrelated areas in the interface to achieve their goal. This is a frustrating experience to an end user, and will usually result in a negative overall view of the interface, regardless of the technical functionality provided. Alternately, should the feature be made immediately apparent and accessible to users unfamiliar with the interface, productivity is increased, the workflow remains uninterrupted, and the user will likely perceive the interface as superior to the aforementioned alternative, even in the face of evidence that the current interface lacks the same scope of functionality of the other. The user evaluates the interface at least partially by whether the design was sufficiently easy to use and learn (Norman, 2013).

5.3 - Interface and Emotional Invocation

The concept of emotionally driven interaction is a significant influence on user perception and the learning of new interfaces for data exchange. When users interact with software applications, they can feel a variety of emotions ranging from the excitement of waiting for a television premier to buffer, anticipation when opening an academic decision letter, betrayal when their internet browsers tell us our Wi-Fi isn't working, or even anger when a user authentication form locks them out of the system for entering the wrong password too many times. These responses stem from a set of basic, core emotions which humans have developed while pursuing goals that are of a similar structure (as detailed in the Human Action Cycle) or when solving commonly recurring problems (Ekman, P, 2004). These responses can be heightened or suppressed depending on the program's implementation. A service that is expected to be delightful can become cumbersome if the user is faced with too many blockers such as server response time, unresponsive interactive elements, or the required submission of redundant information. Likewise, an experience can be made more pleasant by implementing a fast and lightweight interface. The second section of this module takes a deeper dive into understanding the core human emotions and how proper direction of those emotional experiences can lead to more intuitive navigation of a digital interface.

Possibly the most lucrative field of user interface design is the science behind how interface design can invoke emotions in a user, entirely separate from the user's opinions on usability and functionality as discussed above. Certain colors, for example, are known to invoke specific sets of emotions subconsciously. Interestingly enough, the colors themselves, while important, may be overshadowed by the choice of hue and shadow across the interface (Fugate and Franco, 2019). Traditionally, colors have been assigned certain emotional response ranges using very simple criteria. For example, one would assume red signifies anger, white signifies purity, and blue, sadness. These are well-known tropes throughout Western culture. However, those same emotions may take on a much less appealing tone simply by traveling across a few geographical boundaries. In China, for example, white signifies death rather than purity, and red is associated with much more positive emotions. Again, these are traditional associations and not necessarily ingrained in the human psyche. As Fugate discusses, hue and shadow seem to play a much more significant role in the invocation of emotions than previously considered. Indeed, there seems to be a rather significant lack of research that establishes highly specific and consistent pairings between colors and emotional response. One example noted is the disparity in emotional response evoked between a bright, sunny yellow, and a darker or brown-tinged mustard yellow in the same scenario. Facebook, Inc., famously spent large sums of money rebranding their entire platform with a shade of blue not too distant from their established color scheme when their own internal research indicated a greater degree of user engagement was achieved with the new hue.

Aside from color, layouts may also influence emotion in much more easily defined ways. Visual designs characterized by large, blocky layouts convey a sense of stability, and sometimes authority, whereas curvilinear designs and delicate patterns convey a sense of organic origin. To complicate matters further, placing opposing designs in close proximity can create visual tension within a visual area (Samara, 2012). When applied properly, and in moderation, this visual tension can serve to introduce feelings of excitement into a visual layout; however, over-application of contrasting designs may introduce excessive tension and inadvertently induce feelings of discomfort to the user. Tension may be used to quickly engage a user, but too much tension held for too long may serve to make a user feel unwelcome within an interface.

Emotions may be deliberately invoked in an interface with a much more overt intent than the examples listed above. Whereas the previous examples primarily focused on the general level of comfort and engagement that a user experiences overall, a much more direct approach can be used for individual sections of an interface. As noted by Muhlberger et. al. (2011), the quality of decisions made by users in an interface may be influenced by emotions evoked by the interface. This effect can be used for several purposes, including providing a more substantial warning to a user of the possible negative effects of an action, or possibly helping a user feel more comfortable in an interface, which may lead to increased productivity.

An example of a warning provided by an interface would be large block letters in a red font, which easily stand out from the surrounding cool hues of most modern interfaces. Functions that may have irreversible negative impacts if used in a cavalier manner are often labeled in this manner to help encourage users to pause momentarily and put additional thought into their workflow. As mentioned in the previous section, users can easily fall into routines and rely on muscle memory to complete tasks, and such jarring contrasts as described here may help to shake the user out of said routines when necessary. This effect may be desired at all times for hazardous functions, or it may be used specifically to alert a user that a longstanding workflow has been subjected to changes recently which may require a certain degree of reeducation in the interface. Generally speaking such changes to a user interface are to be avoided when possible, but when changes are made, it is better to alert the users than to leave them to fend for themselves and be surprised by the changes.

The second use noted is based on the idea that a more comfortable user interface can lead to increased productivity. As noted by Norman (2004), “Happy people are more effective in finding alternative solutions and, as a result, are tolerant of minor difficulties.” The implications here are that users that are led to feel secure in the usage of an interface may easily disregard minor complications, which, over a long period of usage, leads to increased productivity and efficiency. To this end, the method of applying tension to a user interface as described above may be best left out of interfaces that will be used for large portions of time at once, such as productivity and office software. This directly leads to the “safe” design patterns commonly used by large software firms such as Microsoft, Adobe, and Apple.

An important aspect of interface design is balancing functionality with aesthetics. As noted by McDonagh, style or attractiveness can be a strong motivator, but bland or unattractive design is not nearly as strong of a demotivator. On the other hand, functionality and usability are equally motivating when present as they are demotivating when lacking (McDonagh, 2004). This is, however, in contrast with long-standing industry knowledge in web design that a user decides whether a page is worth staying on within roughly five seconds of navigating to said page. An interface that is capable of capturing new users, and retaining existing ones, must be both attractive and highly functional to achieve both goals. A lack of attractiveness leads to a stable but slow-growing user base, whereas a highly attractive but unusable interface leads to rapid user turnover.

5.4 - Models and Technologies of Emotion

Models and technologies of emotion tie together the outlined framework of the Human Interaction Cycle with implicit, emotionally driven directive abstracts by highlighting the technologies, models, and techniques that best leverage emotion in user interface engineering. There are three main factors to consider in emotional design: visceral, behavioral, and reflective. Visceral is how someone acts when “the user first

encounters a product,” behavioral is when the user uses the product, and reflective refers to the impact the product has on the user (What is Emotional Design). The mixture and use of all three of these factors is combines to make the most desirable product for users. Many guidelines for leveraging this model exist today. Examples such as redirection, multi-sensory stimulation, and the various pipelines accessed by different parts of the brain will be examined in the context of visceral, behavioral, and reflective analysis by a user. Understanding how to use these three factors together is essential to create the desired effect for the user. This can be the difference between an amazing and an average product.

There have been many different ways that developers have attempted to create emotional responses to their interfaces. Originally developers would add in some sort of character or try to use different colors or animations to make the user feel like the computer is interacting with them. A good example is the feathers twitter app developed by Aral Balkan. Aarron Walter describes how the bird-like character will begin to fill with color as you type out a tweet to show the number of characters you have remaining of the 140 allowed; however, if you exceed the 140 allowed-characters the bird will turn red and show how many you are over the limit (2012). This type of interface, while adding a needed emotional component, still lacked an important part of the equation: true interaction between computer and user.

Adaptive interfaces are attempting to overcome this limitation by creating user interfaces that can accurately read what the user is currently feeling through multiple different sensors and forms of data collection, such as cameras or microphones. These sensors can read the user’s body language or listen to the user’s voice to determine how they are feeling while using the software. Once the software has begun to analyze the data it receives, it is then able to alter itself naturally to improve the user’s experience without their really noticing. The end result should be that the user has a very positive experience after using the program, so that they will hopefully return to the program or the developers behind it in the future (Polzin and Waibel, 2000).

A paper written by Thomas S. Polzin and Alexander Waibel in 2000 discussed how user interfaces have used different emotive characters to try and connect with the user on an emotional level. People are polite to their computers and interact with them as if they are another living being. That is why they find it important that user interfaces have some way of responding to the user so that the emotional connection established can be even stronger and result in a more positive user experience. This cuts down on the divide between user and interface that can be caused by an emoting character that is vastly different than what the user is currently feeling. Polzin and Waibel go on to state that the divide becomes more apparent when the user is allowed to speak to the computer with voice recognition software that only cares about what is said and not how the user says it, which makes the system lose out on important information that the user is trying to convey in their speech (Polzin and Waibel, 2000).

Another study that began to explore how the human voice could be used to gauge emotion was conducted by Kostov and Fukuda. They explain how the future focus of user interfaces shifted towards a state where more attention is paid to the subjective user experience as opposed to functionality (Kostov and Fukuda, 2000). The different papers that are in this section are in agreement with that sentiment. An interesting point that they make early in their introduction is that humans don’t need a complex artificial intelligence or virtual character to invoke an emotional response. The purpose of their paper is to explore how they can recognize or predict the emotional state of the user and then respond accordingly (Kostov and Fukuda, 2000). Similar to Polzin and Waibel, they utilize a voice-based interaction system, focusing on different aspects of speech such as pitch, formants, tempo and power of the voice (Kostov and Fukuda,

2000). They do acknowledge the importance of non-verbal communication and how it factors into understanding the emotion being displayed. However, faces and characters within the interface can potentially make the interaction worse instead of better, especially when the face being presented to the user becomes more realistic as at that point humans begin to be more critical of them. The more realistic the face, the more people expect it to behave like a human, thus leading to the divide when it doesn't (Kostov and Fukuda, 2000).

Their system requires that users first record themselves speaking naturally and remain neutral when doing so. The primary factors they are analyzing would be extracted from this recording and then compared to their database comprised of 100 different utterances from both male and female actors to determine the emotional state of the user (Kostov and Fukuda, 2000). Below in figure 1 is the emotion engine used by Kostov and Fukuda. It shows how the interaction data was processed in their system. They would extract the speech information then utilizing a set of rules they developed, the engine would make a decision on the emotional state of the user and adjust the interface accordingly.

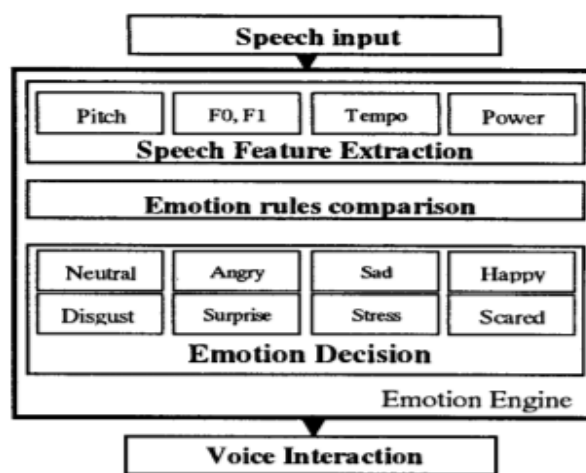


Figure 1(Kostov and Fukuda, 2000)

The study first had english speaking professional actors record utterances and it used those utterances as a baseline for testing their algorithm. The next phase had untrained subjects that spoke many different languages such as Japanese, Italian, Brazilian, Spanish and more record their utterances and those were used as a cross-cultural standardization of relevant emotional factors (Kostov and Fukuda, 2000). They then had a third round of testing that saw untrained subjects speak five to ten sentences in english for all eight emotions that the system was testing for. The voice interaction system, seen below in figure 2, allowed users to choose from several different languages and then had them speak neutrally for 30 seconds in order to extract their personal voice characteristics (Kostov and Fukuda, 2000). The system detects the end of the user's utterance and then pushes the recorded utterance through the emotion engine, which then outputs the emotion decision, and the face on the interface changes shape and color to represent the emotion of the user (Kostov and Fukuda, 2000).

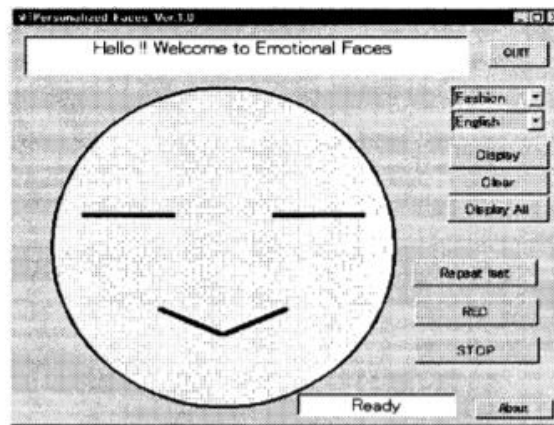


Figure 2 (Kostov and Fukuda)

5.5 - Concise Summary

The topics of Human Computer Interaction, Interface and Emotions Invocation, and Technologies and Models of Emotion are examined in depth within this module. By mapping each of those key concepts to steps in the Human Action Cycle, the importance of emotionally driven user interface engineering as well and a model for proper accounting of the emotional state of a system's users at each step of the development cycle becomes clear. We explored Norman's model and applied it to a typical UI pipeline to prove its applicability in the domain of software. The second section examined the core human emotions themselves and their studied effects on information reception, processing, and retention to prove that invoking specific emotions may be beneficial in user interface engineering. The last section surveyed the technologies being used currently to leverage emotional interaction as well future technologies that will incorporate the emotional characteristics in new ways. In doing so this module aims to reveal the significance of emotion in Human Computer Interaction as well as convince the reader of the importance of accounting for emotion in the design process.

Emotion is an important aspect of interface design, even if it doesn't seem like it at first. It can greatly impact the user's experience while interacting with the product. Even though that is the case, emotion in interface design has only been studied in recent years. In that short time, there have been several papers that have delved into trying to harness the power that emotion can bring to any user interface in order to improve on the experience it can grant its users. There are three different types of emotional responses that users have when interacting with an interface: visceral, behavioral and reflective. Visceral emotion is the first reaction the user has with the system, behavioral emotion refers to the usability of the interface and how well it performs compared to how the user expects, and reflective emotion deals with how the product will affect the user in the future. The human action cycle describes how users can fall into a routine when it comes to using interfaces and shows that interfaces should be designed with the idea of being recognizable in mind. The way that users interact with these interfaces can be heavily influenced by many different factors such as color or shadows. Even the hue of the color chosen can be very influencing to the user. As a result of that, there have been many different forays into attempting to create a user interface that can adapt to whatever emotion the user is feeling in order to improve their experience with the product.

5.6 - Extended Resources

Descriptions & Links

1. The three ways that good design makes you happy | Don Norman:

<https://www.youtube.com/watch?v=RIQEoJaLQRA>

2. Emotional Based Interface Design – Mobile Monday Manchester Mobile UX:

<https://www.youtube.com/watch?v=XINeiAw9vqs>

3. What is User Experience (UX) Design?:

<https://www.interaction-design.org/literature/topics/ux-design>

4. The Action Cycle Explained:

<https://www.youtube.com/watch?v=ahtOCfyRbRg>

5. Emotional Interface Design: The Gateway to Passionate

Users: <https://blog.teamtreehouse.com/emotional-interface-design-the-gateway-to-passionate-users>

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