CERN IdeaSquare Journal of Experimental Innovation, 2022; 6(1): 2-6
DOI: https://doi.org/10.23726/cij.2022.1322

ORIGINAL ARTICLE

Experiencing emotions in design thinking: How positive and negative affects play their part in the innovation process

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ABSTRACT

Emotions have been recently recognized to have a significant impact on the innovation process and its outcomes. However, little is known regarding how teams are experiencing distinct emotions throughout the varying stages of the innovation process. This study analyzes design thinking teams' self-reported emotional states and explores the emotional spectrum associated with various innovation activities. The Geneva Emotion Wheel instrument is used to map relations between 20 emotions and nine generic innovation activities that occurred during a two-week project.

Keywords: Team-based innovation; emotions in innovation; design thinking; design process.

Received: June 2021. Accepted: February 2022.

INTRODUCTION

"How are you doing?" might not just be small talk, but an important question to determine what kind of innovation activities you are most capable of at this moment. Emotional states have been recently recognized to have a significant impact on the innovation process and its outcomes (Vuori & Huy, 2016) (Zietsma & Toubiana, 2019). Furthermore, emotional states have an effect on people's choices, behavior and social processes. (Vuori & Huy, 2016). Knowing the influencing capability of emotions, how do they specifically show up, shape and affect the innovation process?

So far, positive emotions have been established to be linked with creativity. Researchers seem to agree that positive affect or positive emotional states such as joy and gratitude, correlate positively to creativity and discovery of novel ideas (Fredrickson 2001) (Amabile et al, 2005) (Pillay & al, 2020). It has been proposed that positive emotions broaden the mindsets and that e.g. feeling *contentment* can induce an integrative mood and experiencing joy a playful mood (Fredrickson 2001). Hence experiencing joy might stimulate ideation and cultivate a divergent mindset which is an important part of the innovation process (Design Council, 2007). Furthermore, previous studies suggest that positive emotional states can facilitate both taking personal initiative and innovative behavior (Rank & Frese, 2008).

Contrastingly, negative emotions have been suggested to constrain divergent thinking and lead to narrowed mindsets (Fredrickson 2001) (Madjar et al., 2002). Though some studies suggest a negative relationship between negative emotions and innovation, it has also been proposed that negative emotions such as *dissatisfaction* can contribute towards higher levels of creativity and innovation (Madjar et al., 2002). Indeed, negative emotions might create a fertile ground for challenging the status quo and breaking down old paradigms. However, special circumstances and a higher emotional sensitivity might be required for the negative emotions to have a positive effect on innovation. (Rank & Frese, 2008).

Varying emotional states might be beneficial from other points of view as well. It has been proposed that decision makers revisit important decisions inhabiting different emotional states before making the final call (Rank & Frese, 2008). Furthermore, having mixed emotional states including simultaneously both positive and negative emotions might support creativity and the ability to make unusual associations, that is an important of creativity (Fong 2006).

When it comes to innovation, emotions have been studied extensively on the field of user experience and how a specific design of a product or a service might evoke emotional responses from the users (Desmet & Hekkert 2009) (Meiselman, 2015) (Coyne et al, 2020), March). However, we have a very limited understanding of how emotions affect the innovation process and the innovation team itself even though emotions are recognized as important predictors for innovation (Rank & Frese, 2008) (Vuori & Huy, 2016). "Very few, if any,

empirical field studies have examined how various groups' emotions emerge during the innovation process", Vuori states. Recent studies are starting to enter this area e.g. examining stress levels associated with different design phases (Nolte & McComb, 2021). This still leaves the majority of the emotional spectrum associated with innovation phases in the dark.

It is hence the aim of this study to empirically explore the richness of emotional states in the distinct stages of the innovation process. This explorative study was conducted as a part of a two-week team-based innovation program organized at IdeaSquare, CERN.

THEORETICAL BACKGROUND

In order to assess what is happening during an innovation process, some kind of a framework is needed to distinguish its unique phases. The design thinking approach for innovation is non-linear and iterative by nature (Dam & Siang, 2018). Hence, looking at individually emerging *design activities* can provide a useful way to understand the process of the design innovation team, instead of a linear and fixed process model (Lindberg et al, 2010). Nine distinct design activities have been already used to understand aspects of the process (Utriainen, 2017) and they were further applied in this study. The activities capture generic elements that occur for teams in human centered design thinking process: (Re)defining the problem, Grasping external knowledge, Knowledge pooling, Synthesis, Making decisions, Ideation, Concept specifying, Making it tangible and Testing and user feedback.

For the purpose of this study, we chose to use the Geneva Emotion Wheel (GEW) to assess the participants' emotional states. The model offers a selection of 20 distinct categories of emotions as well as the intensity of how deeply they were felt. In addition, GEW allows the selection of multiple emotions that may have been simultaneously present in an experience. The model is based on theoretical considerations and has been empirically validated, and it maps the emotions on a visual wheel against two main axes; Positive/Negative valence and Low/High level of control (Scherer, 2005).

GEW was designed to be used in a large variety of contexts. Currently, it has various applications in the field of emotional design e.g. regarding human robot interactions (Coyne et al, 2020) and it has been also used to study emotions linked in virtual environments (Scherer et al, 2013) as well as decision making processes in teams (Tran, 2004).

The 20 emotions as well as the two main axes of the GEW model creating four main emotional quadrants are illustrated in Fig 1.

Emotions can be seen as responses to external stimuli (Scherer, 2005). The design thinking process offers a particularly rich context of diverse social interactions and a wide variety of settings (Meinel & Leifer, 2012). Being in the process can thus evoke various emotional states and the experienced emotions evolve dynamically during a design thinking process (Peslak, 2005). Each design activity is accompanied by specific cognitive experiences and varying levels and types of stress (Nolte & McComb, 2021).

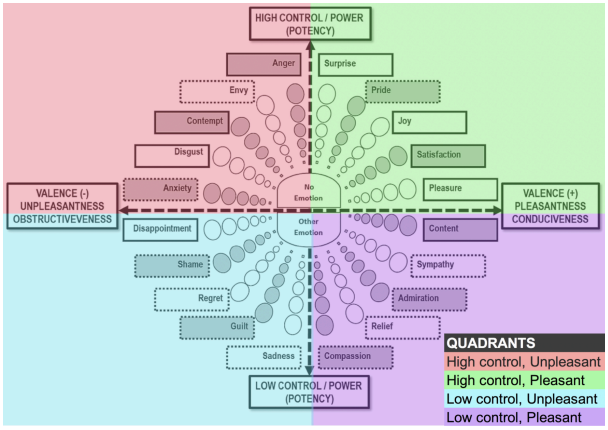

Fig. 1. Adapted illustration of the GEW and the four emotional quadrants.

Emotions associated with teamwork have been found to affect team success and performance (DeDreu & Weingart, 2002). McColl-Kennedy and Anderson (2002) found that emotions such as frustration and optimism have a direct influence on team performance. Even individual team member emotions can have an effect: Sy et al. (2005) found out that team leaders emotions correlate with the emotion of the whole team and that a leader's positive emotions, and correlated team emotions, lead to a better performance. Clarke (2010) demonstrates that the emotional awareness of project management can alter the choices made in similar settings. Being aware of the emotions' effects on these types of various levels enables innovation leaders, managers and facilitators to make more emotionally intelligent decisions leading to more successful outcomes.

METHOD AND DATA

The study was conducted as a part of a two-week program organized at IdeaSquare, CERN. During the Design the Future course, multidisciplinary and -cultural student teams build future world scenarios in which social aspects and technology interlink and propose transformative technology concepts and create corresponding technology prototypes for these scenarios. The course activities correspond to conventional design thinking activities with a focus on gathering knowledge at the beginning of the program which aims to expand conventional design thinking. The partaking student

teams are given an engineering design challenge, which they are to solve without considering current technological constraints and rather imagine what might be possible in the future. The students were guided to reflect on the emotions linked with distinct design activities as a part of the pilot program in autumn 2018.

To assess the emotions linked with different design phases GEW model 1.0 was introduced and used to collect data from the participants (n=14). The participants were mostly from Spanish and Finnish cultural backgrounds and were in mixed teams of 5-6 students.

At the end of the two-week project, the students self-assessed which emotions emerged for them within each of the nine design thinking activities. The method of collection was a paper survey, that each of the students filled in with a pen. The participants were free to indicate as many or few emotions associated with an activity as desired and the intensity ranging from 0 (not present) to 6 (intense emotion) on a Likert scale.

In the analysis phase, the paper surveys were converted into a digital form and basic statistical analysis tools applied across the individual data points. In order to provide a basic overview across the emotions, means were calculated over the group and analysis about the four distinct quadrants of emotions applied for further understanding.

RESULTS

The overall emotions present in the sample group are summarized in Table 1. The intensity of experienced emotions over design activities are considered. The strongest emotion was Satisfaction linked with the design activity Making it tangible. The least felt emotion was Regret which was not present in the emotional spectrum of the group in any of the activities. The High control, Pleasant quadrant is the most present (indicated with green), and the Low control, Unpleasant the least present (indicated with blue).

These findings are supported when looking at the three most prevalent emotions associated with each design activity as summarized in Table 2. The majority of the emotions can be found in the pleasant quadrants with the exception of two activities which have unpleasant emotions associated with them: Concept specifying and Making decisions. For example, with Making decisions, the strongest associated emotions were Anxiety and Satisfaction, which can be found from the opposite ends of the pleasantness spectrum. This indicates that particular activities were the source of mixed feelings, ranging across quadrants.

In Table 3 we see each of the 20 emotions listed next to the activity that was most likely to cause this particular emotion. If two design activities shared highest correlation with an activity (e.g. Compassion occurred equally in both Synthesis and Ideation), the emotion was marked to be linked with both of the activities.

Table 1. Overall emotional experiences across design activities

Emotion type	Intensity in group
Satisfaction	271
Pleasure	182
Joy	167
Surprise	143
Content	126
Relief	125
Anxiety	125
Pride	102
Admiration	79
Disappointment	76
Sympathy	47
Anger	45
Disgust	29
Compassion	26
Sadness	20
Contempt	20
Shame	13
Guilt	11
Envy	3
Regret	0

Table 2. Top three emotions associated with individual design activities

Design activity	1st emotion	2nd emotion	3rd emotion
(Re)defining the problem	Satisfaction	Joy	Content
Concept specifying	Pleasure	Content	Anxiety
Grasping external knowledge	Pleasure	Satisfaction	Surprise
Ideation	Joy	Pleasure	Satisfaction
Knowledge pooling	Satisfaction	Surprise	Content
Making decisions	Anxiety	Satisfaction	Relief
Making it tangible	Satisfaction	Pride	Joy
Synthesis	Satisfaction	Content	Relief
Testing and user feedback	Satisfaction	Pleasure	Pride

Table 3. All of the 20 emotions listed next to the design activity that was most likely to cause this emotion

Making desicions	Anxiety	Disgust	Anger	Relief	Guilt
Ideation	Envy	Disappointment	Joy	Compassion	
Making it tangible	Pride	Satisfaction	Shame		
Grasping external knowledge	Surprise	Pleasure	Admiration		
Synthesis	Content	Compassion	Sadness		
Knowledge pooling	Sympathy	Contempt			
(Re)defining the problem	Contempt				
Testing and user feedback	Sadness				
Concept specifying					

We find that when engaged in Making decisions the emotions of Anxiety, Disgust, Anger and Guilt occur, making the activity associated with many of the unpleasant emotions felt during the project. We also notice how the activities can give rise to opposing emotions. For instance, Making it tangible was highly associated with both Satisfaction and Shame, which can be found at the opposite ends of the emotional spectrum in GEW. Concept specifying did not induce any specific emotion, hence being the most neutral design activity.

DISCUSSION AND CONCLUSIONS

As we can see from the results, positive emotions were present in many design activities including ideation, grasping external knowledge, making it tangible and testing and user feedback. This supports previously reported connection of joy towards creativity and production of novel ideas. It seems as though engaging in ideation as a design activity can spark joy in the participants, giving a hint of some sort of co-evolution of the activities and emotional states. This would mean that not only can a feeling "prime" a design activity and make doing it easier, but a design activity can induce specific emotional responses in the participants. This might explain why ideation exercises are commonly used in group settings as energizers in order to create a positive atmosphere. Indeed, ideation and prototyping might both be key parts of design thinking because of their ability to keep the novice innovators engaged and motivated during the occasionally demanding process. Virtual environments can pose challenges for performing these typically very physical and embodied activities. Before digitally native versions of these activities are developed, they might put the motivational emotional support for the innovation teams at risk.

According to the results, decision making was the cause of many negative, as well as positive emotions and was a source of mixed emotional states. As proposed earlier, this can be a sign of innovativeness, as decisions should be visited from various perspectives and emotional states. Having negative emotions associated with decision making might be a sign of novelty of the ideas and their ability to change status quo as pointed out by theory. The results also support prior findings where negative emotions are linked with a narrowed mindset, decision making being a convergent activity. What kind of emotional composition of intense or neutral, positive and/or negative emotions unfolding over time would lead to best results and how might the awareness of the emotional dimensions change how we facilitate innovation?

To improve the study, the GEW instrument could be adapted to be better suited for low effort data collection for the participants as well as processing for the researchers. Some of the wording could be made simpler to understand from various cultural backgrounds by perhaps using images, symbols or well-established language. For example, the emotions of "Contempt" and "Content" might not be as familiar for all the participants than "Joy", making them less likely to be selected and identified correctly. In order to accurately look at the experience of emotions present in the individual as well as teams, novel and less invasive real time data gathering techniques (perhaps combining facial recognition with confirming self-assessment) could be applied in the future.

Themes for future research could focus on aspects of the rich and messy innovation context and its effects on the experienced emotions. For example, we might look at differences between cultures, professional fields, teams and physical and virtual environments where the design activities take place. As mentioned before, a temporally accurate, high fidelity understanding of the emotional landscape would be needed for a deeper introspection and to meaningfully look at these various elements of the design thinking contexts.

Emotional contamination could be studied further to see if and how specific individuals are able to shape the team's emotional state by infecting others. We might also look at the awareness and strategies associated with this influence in the present and make implications for future practices. We might ask, how the heightened awareness of the emotional states might lead to an elegant navigation through the innovation process and how it can be consciously utilized by the design team and/or the facilitators to compose a desired outcome. Finally, exploring the role of negative emotions as a part of breakthrough innovation and seeing their worth might change how we are able to accept them and use them to benefit the process.

ACKNOWLEDGEMENTS

Authors deeply thank Santeri Repo and the CBI and IdeaSquare teams in their help in data collection, Helinä Pohjola for her help in data conversion and Saku Mäkinen for the advice and encouragement. The research was supported by Finnish Foundation for Economic Education.

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