

Investigating Emotions in Creative Design

Corina Sas

Chenyan Zhang

Department of Computing, Lancaster University
Infolab21, South Drive, Lancaster, LA1 4WA, UK
+44 1524 510318

corina@comp.lancs.ac.uk; c.zhang6@lancaster.ac.uk

ABSTRACT

A wealth of research has suggested that emotions play a significant role in the creative problem solving process, but less work has focused on investigating the role of emotions in the design process. This is surprising given that creative problem solving lies at the heart of the design processes. In an exploratory study we interviewed 9 expert designers about their emotions during the design process. The content analysis allowed us to identify the various types of emotions relevant in the design process and to extend Wallas' model of creative problem solving with emotional components for each of its stages. In addition, we identified two important roles of emotions in design and several ways in which expert designers regulate their emotions. We discussed the theoretical and practical applications of our work.

Key Words:

Emotions, arousal, valence, creative problem solving, design process, Wallas' model, emotion regulation

INTRODUCTION

Our emotions are a valuable source of information. Whether we try to solve creatively a problem or decide to engage with an interactive system, our emotional experiences can have a significant impact. A wealth of findings in creativity research has showed that emotions play a significant role in creative problem solving, by facilitating for instance cognitive flexibility [4] and global processing [19]. The importance of emotions in decision making is further supported by findings in neuroscience showing that decisions made in the face of uncertainty are in fact aided by emotions [17].

In interaction design, much research has focused on users' experience [53] and their emotions while interacting with digital artifacts. However, there has been surprisingly little work investigating the emotions experienced by the designers during the design process.

We argue that the research into the emotional design should be extended to include also the research about the emotional designer, because the nature of creative problem solving in design can be better understood by investigating not only the designers' cognitive but also their emotional processes.

A better understanding of emotions and their role should contribute to the areas of creative problem solving in design, design thinking and design expertise, and to the development of more suitable design methods and tools for facilitating designers' emotions, training novice designers and supporting reflective practice. In order to address this research gap, the work presented in this paper aims to ambitiously intersect four research areas such as emotion research, creativity research, experience design, and creative problem solving in design.

Our work aims to address the following research questions:

- What kind of emotions do designers experience during the design process? Are they predominantly positive, negative or ambivalent, and how do they vary across the design stages?
- What roles do designers assign to their emotions? Are they facilitative or detrimental?
- How do designers work with their emotions? Do they attempt to regulate their own emotions and the emotions of the others they work with?

The paper starts by reviewing relevant work in the research areas we are drawing from. The study involves interviews with expert designers and the findings are reported to address each of the above research questions. The contributions of our findings are also discussed. This paper builds on previous work [62], and extends it into several directions including a broader literature review, an additional research question, and a more in depth data analysis and discussion of the findings.

RELATED WORK

Emotion research

In emotion research there has been a long standing distinction between the opposing discrete and dimensional models of emotions. On the one hand, the proponents of discrete models [55, 33] view them as a limited set of discrete emotions such as Ekman's list [24] of the six basic

emotions of happiness, sadness, fear, surprise, anger, and disgust, which was later extended to include amusement, contempt, contentment, embarrassment, excitement, guilt, pride in achievement, relief, satisfaction, sensory pleasure, and shame [23]. On the other hand, the proponents of dimensional models view emotions as variables along several dimensions, the most common ones including valence (pleasant-unpleasant), arousal (high-low), and approach-avoidance (response towards reward-punishment). For instance, in Russell's [61] circumplex model, emotions which are similar are spatially close on the circumference of the circle, while those which are opposite such as happiness and sadness face each other. In the analysis of our findings both the discrete and dimensional models of emotions will be used.

A wealth of emotion theories have been developed including somatic, behavioral and cognitive ones [56]. Within cognitive theories, particularly relevant for our work are processing modes theories capturing the interaction between emotions on the one hand, and memory, attention or reasoning, on the other hand [46]. For instance, positive emotions support reasoning which is open-minded and creative (see, [29], for the "Broaden-and-Build" theory of positive emotions), whereas negative emotions promote a more narrow attentional focus [22, 20]. Our working definition of emotions aligns with the one proposed in processing modes theories that emotions are short-lived, intense phenomena with a clear cognitive content and a salient cause that is accessible to the person experiencing the emotion [46].

Emotion researchers have developed a variety of methods for measuring emotions including facial, autonomic, voice-based and brain-based measures of emotions [49]. However, the most widely used method is self report of subjective experience. This requires participants not only to experience emotions but also to reflect accurately their phenomenal awareness through rating scales. It has been argued that this method is particularly suited for allowing access to subjective experience which otherwise could only be inferred. Self reports can take place either on-line as the emotion is first experienced, or retrospectively when the original experience is replayed using for instance video-recall technique.

Emotions in creativity research

Among the different models of emotions those directly related to creativity include Bower's associative network theory [10], Getz and Lubart's emotional resonance model [38], Sternberg's model of non-random associations in idea generation and divergent thinking [66], and Russ' model of affect-laden cognition in creativity [58] (for a review see [59]). Associative network theory proposes that each emotion is a memory unit whose activation triggers the retrieval of the event associated with it [10]. Getz and Lubart [39] proposed the emotional resonance model, where emotions facilitate associations of cognitively remote concepts in memory. Sternberg referred to three

types of processes involved in idea generation: selective encoding for deciding the information relevant for a goal, selective combination for deciding how disparate information can be combined, and selective comparison for deciding how disparate information can be related. In line with this model, Russ further proposed that the search processes involved in divergent thinking and idea generation are likely to be guided by emotions [59].

Previous studies have successfully replicated findings indicating the significant role of emotions in both creativity in general [44, 52], and creative problem solving in particular [6]. The reliability of such findings relates to the valence of the emotions experimentally induced. Whereas most of the work on positive emotions replicated findings suggesting their facilitative role in creative problem solving, possibly mediated by increased cognitive flexibility [4], and fast, global processing [19], there are two strands of contradictory findings regarding the impact of negative emotions on creativity. One line of research shows that negative emotions promote creative performance [1, 11, 13], even to a greater extent than do positive emotions [8, 35]. For instance anger seems to produce more creativity than relaxed moods [18], and comparable levels of creativity to happiness [60]. In contrast, another line of research suggests that negative emotions are detrimental to creative performance. For example, fear was associated with lower levels of flexibility because of increased cognitive persistence and analytical probing of alternatives [19], whereas sadness was not found to be related to creativity [6].

Most of the work reviewed above has two limitations. On the one hand, most of the previous studies dealt with experiments where emotions were induced or manipulated *a priori* to the creative problem solving process and through means that have no relationship with the problem at hand, i.e. videos or gifts. Although emotions were acknowledged as being both antecedents and consequents of the creative processes [5], there is a surprising lack of interest into the emotions arising spontaneously during the creative problem solving processes. On the other hand, the role of emotions on creativity has focused mostly on discrete emotions [24, 23] such as anger, disgust, fear, happiness, sadness, or contentment. Only recently have researchers started to investigate the impact of mixed emotions consisting of a simultaneous co-existence of both positive and negative emotions, i.e. ambivalent emotions.

This lack of interest is regrettable because preliminary findings suggest that ambivalent emotions can be particularly facilitative for creative performance. They allow for increased sensitivity to unusual associations, which is a measurement of both convergent and divergent thinking [26]. Our research aims to address these gaps by focusing on emotions naturally arising during the various stages of the creative problem solving, with an emphasis on capturing both discrete and ambivalent emotions.

Emotions in interaction design

The last decade has witnessed an ever increased interest in emotions and their role in interaction design, particularly for developing more engaging user experiences. For instance, in their experience framework, Forlizzi and Ford [28] captured four dimensions of user experience: subconscious, cognition, narrative and story telling; while McCarthy and Wright's framework [51] described four threads of experience: emotional, sensual, compositional and spatio-temporal. In his seminal account of emotional design, Norman [53] distinguished between the visceral, the behavioral and reflective aspects of user experience and argued that aesthetically pleasing objects appear to the user to be more effective, by virtue of their sensual appeal.

Because emotions are particularly relevant for deciding how artifacts are to be used [57], emotions' role in artifact sense-making makes them strong candidates for design aids. Spillers [65] suggested that understanding how cognitive artifacts interchange with affective artifacts will better support user interaction.

The acknowledged significance of user's emotions in interaction design has led to methods aimed to allow designers to understand and empathize with their users. Alongside the traditional methods such as personae [14], and cultural probes [47, 36, 45], novel ones such as emotional probes [48] aim to infuse the design process with even more emotional content.

While most of the theoretical and field work outlined above has focused predominantly on user's emotions, both on how they can be accounted for in the design process, and how they can be elicited by the design outcomes, it is surprising that no efforts have been made to investigate designer's emotions and how they as well can influence the design process and decisions. We argue that an exploration into the emotional world of designers can lead to a richer understanding of the design process itself, which can pave the way towards developing design expertise.

Creative problem solving in design

Creative design involves creatively solving problems which are ill-defined, complex and uncertain. As opposed to well defined problems, ill-defined ones are ambiguous in the definition of their initial states, final states or operations [64]. In addition, design problems require complex information to be iteratively gathered, selected, analyzed and integrated in order to disambiguate and solve them.

There has been a wealth of cognitive models of creative problem solving aiming to identify various stages of the process such as presentation, preparation, generation, validation, and assessment [2]; or fact finding, problem finding, idea finding, solution finding, and acceptance finding [54], or problem exploration, concept generation, concept evaluation, detailed design and communication [15].

Most of this work has been inspired by the original

multi-stage model of creativity developed by Wallas [67]. The model involves five stages: preparation, incubation, intimation, illumination and verification. Preparation stage involves a preliminary analysis, defining and setting up the problem. Once an impasse is reached, during incubation the problem is put on the side so that there is no conscious work on it. However, unconsciously the mind continues to process the problem through forming and evaluating associations. In intimation stage there is an intuitive feeling that the promising idea is coming, while in illumination stage, this idea suddenly appears in the conscious awareness. The verification stage involves sustained conscious work for evaluating, refining and developing the promising idea. The stages can be revisited iteratively and can co-occur for different aspects of the problem.

We argue that Wallas' model is an appropriate methodological tool for exploring the design process mainly because creativity is an integral part of the design process [43, 42, 41]. In addition, through a comparison of 23 design process models and 19 creative process models (which include Wallas' model), Howard [43] concluded that creative process models could be interpreted as extremely generic design process models. Earlier design researchers have proposed similar ideas [3, 9].

Wallas' model defines the four cognitive phases of the creative process [50, 37], and according to Shah et al. [63], it is a model that explains technological creativity. Hill [42] argues that technological design process has an intrinsic link to such creative process as Wallas' model.

Classical models of problem solving were primarily given by Dewey [21] and Wallas [67]. Dewey's approach essentially articulates the scientific method for problem solving, while Wallas' approach represents the non-systematic, creative view of problem solving, and especially emphasizes on the conscious and unconscious aspects of information processing. From this respect we could see that Wallas' model is particularly suited to explore the design process and to be extended with emotional components. This in turn will lead to research outcomes specific to design and designers, although our findings may well be extended to the much broader sphere of creative problem solving in domains other than design.

METHODOLOGY

Our fieldwork aims to investigate the emotions and their roles in the creative design process. The research method was ethnographical interviews which took place in designers' working environment. We expected that such places will allow designers a better recollection of their emotional experiences. In order to limit the recall biases associated with global reports of emotional events, i.e. the recall of most intense and final moments [30], designers were asked to recall their most recent design project, i.e. its activities, timeframe and outcomes, and we further broke down this entire episode into the stages of Wallas' model.

In this way, even if not equally remembered, we enabled participants to focus upon each stage and recall its details. This approach was consistent throughout the entire semi-structured interviews, where subsequent questions about the emotional aspects of each stage of Wallas' model were also linked to the most recent design project.

We designed a question for each one of the creative stages of Wallas' model (including impasse), and the questions introduced below are the result of an iterative process during which we became aware of its challenges. On the one hand, we had to identify the essence of each stage which can succinctly be communicated to designers who may not be familiar with Wallas' model. On the other hand, we had to ensure that the description of each stage is as emotional neutral as possible in order to avoid additional biases.

Thus, the questions used in the interviews were: for the **preparation** stage: *“Were your emotions important in the initial stage of prototyping, brainstorming and idea generation, and how?”*; for the **impasse**: *“When you have tried several possible solutions but still cannot figure out the right one (i.e., when you get stuck in the design process), did your emotions play an important role, and how?”*; for the **incubation** stage: *“During the design process when there seems to be no immediate, foreseeable or clear solution to the design problem, did your emotions play an important role, and how?”*; for the **intimation** stage: *“When you have a feeling that a solution is around the corner, but that it is still vague, did your emotions play an important role, and how?”*, for the **illumination** stage: *“After some twists and turns, you now have a clear idea about what the solution will take shape. On the moment of hitting upon this idea, did your emotions play an important role, and how?”*; and for the **verification** stage: *“How do you usually make design decisions, such as the evaluation of several equally feasible design solutions, and are emotions relevant in this process?”*

To test the validity of the above questions, we invited 5 researchers from the DESIRE network to match each question (presented in a random order) to each of the stages of Wallas' model. These researchers had more than 5 years of training and experience in design, ranging from architectural, software, and industrial design to interaction design. From the overall of 30 matches, 80% were correct, and more than half of the incorrect ones were related to the confusion regarding incubation question/stage, and in particular its relation with the other stages it can temporally be closely linked to, i.e. intimation, illumination or impasse. This is probably due to the fact that incubation is often a lengthy stage where attempts to solve the problem can lead to false solutions, hence the experience of intimation or illumination, and subsequently the experience of impasse, which in turn may lead to another period of incubation. To address this limitation, we performed a two-step analysis of

the interviews, by identifying firstly the stage or stages that the participants targeted while answering each question, and secondly, by matching the reported emotions to its relevant stage.

Therefore, the above questions acted more like prompts for capturing something very fluid both in terms of the stages of the design process, and in terms of emotions experienced during these stages.

Additional questions related to emotions' dimensions such as arousal and valence: *“In your most productive stage or process do you experience intense emotional state or mild one? Are they positive or negative?”* We also inquired on the facilitative and detrimental roles of emotions and how designers manage their emotions in the design process: *“Did you do anything to encourage the facilitative emotions in the design process?”* or *“Did you consciously try to limit or minimise the detrimental emotions in the design process?”*

We focused on expert designers, some of whom are award winners, because we wanted to identify the role of emotions in good design. One of our assumptions is that expert designers have learned to better recognize their emotions and have developed successful strategies to manage them in the design process. Therefore, if emotions are indeed relevant in design, then this will be more easily captured with experts. In an ongoing study, we are already extending this investigation by including novice designers.

DATA COLLECTION AND ANALYSIS

We interviewed 9 expert designers in small and medium sized design companies across the UK. Some of these designers are creative directors of their companies, and all participants have at least 5 years of design experience. The most experienced designers have over 30 years while the sample average is 18 years of design experiences. Participants were recruited through internet search and email and included 2 female designers and 7 male designers. Each of our participants was rewarded with a shopping voucher worth of £30.

The interviews lasted for about one hour and were audio recorded. Their content was later transcribed and systematically classified in types of emotions, their roles in design, and designers' emotion regulation in both oneself and the others. In order to address our research questions, we performed both qualitative and quantitative content analysis and the findings are subsequently discussed.

FINDINGS

Types of Emotions in Design

A significant outcome is that all participants mentioned that emotions are an intrinsic part of the design process, and that they experience a wealth of emotions varying in arousal and valence within each of the design stages.

At a glance, such emotions flow from intense excitement in the preparation stage, to intense frustration and anxiety in

the impasse. In the incubation stage designers could experience the largest range of emotions from frustration and anxiety, to calm and relaxation. Changes of valence occur again in the intimation stage when designers experience intense excitement, followed by intense happiness and relief in the illumination stage, while in the verification stage predominant emotions are happiness and frustration. However, at a closer look, each of the stages offers much richer emotional landscapes which are further detailed alongside with quotes from the interviews.

In **preparation stage** besides excitement, other positive high arousal emotions are happiness, passion, and enthusiasm, suggesting high level of motivation in approaching the design process. *“Probably the most exciting is receiving the brief and starting to generate ideas”*. Emotions are particularly important in idea generation and can impact on the success of a brainstorming session. *“The group dynamics in the brainstorming session are sparkling ideas, the electric charges bouncing off and energizing people. It’s quite relaxed and is quite up so the emotions are really sparky, jokey, and creative.”* Alongside these positive emotions, there are also some negative ones such as frustration, anxiety and discouragement. The latter can be triggered by the lack of clarity within the brief, work overload or limited resources: *“there’s never enough time, there’s usually a budget constraint ... and this is part of the frustration”*. It’s not surprising that some emotions in the preparation stage are along the axis of “exploration” in the circumplex model (curiosity, anticipation, hope, and desire). *“It starts with intrigue and anticipation, and part of you is a bit scared.”* A good summary of how preparation stage is experienced is captured by the following quote: *“My most productive stage is right at the beginning. It starts off with anticipation, or apprehension, particularly if I’m meeting a new client, but I usually feel happy, creative and enthusiastic about the new challenge”*.

Impasse is experienced with intense frustration and anxiety: *“I will feel frustrated and dejected, maybe even doubtful of my abilities and therefore not very confident about how to proceed.”* Or *“If you’re struggling to come up with a design, or if you don’t feel that you’re getting somewhere with the design, it can be quite stressful”*. What is interesting is that designers learn to know that anxiety cannot be avoided and in fact may be an important component in the emotional blend for insight: *“Sometimes it maybe takes a degree of anxiousness before you actually get the idea.”*

According to Wallas [67], in the incubation stage the problem is no longer processed consciously but unconsciously, either by doing conscious mental work on other problems, or by relaxation. From the perspective of creativity research, the mix of emotions in **incubation stage** is particularly interesting because calm and relaxation

are prevention-focused emotions, i.e. reflecting desire for security and anticipation of calmness. On the one hand, previous work suggested that prevention-focused emotions (calm, relaxation and fear) can lead to reduced creativity performance because they constrict the scope of attention [6]. On the other hand, findings showed that people in calm and relaxed states do not produce lower levels of creativity because their engagement and avoidance tendencies are reduced [31].

In contrast with these findings, ours suggest that during the incubation stage, designers can in fact greatly benefit from calm and relaxed emotional states. One designer pointed out to the fine line between welcoming emotions while controlling for their arousal: *“I think it’s having that level of head which is really emotional, but you can’t get over-excited, or you can’t get panicky. You need to keep emotions quite calm, considered and open, which comes in with experience.”*

Such findings can be better interpreted when considering the approach motivation, i.e. desire while approaching an attractive object. In this light, calm and relaxation are positive emotions low in approach motivation suggesting a comfortable, stable environment which allows for broadening of attention, as opposed to enthusiasm and desire which are positive emotions high in approach motivation. The latter can lead to action tendencies detrimental to creativity, such as tenacious goal pursuit together with an associated reduction in attentional breadth [34]. In contrast, a calm emotional state allows for broad attention which in turns facilitates idea generation. In the incubation stage, being open is particularly emphasized: *“I think if you concentrate too hard then sometimes nothing comes. The best thing is to let yourself be open and let the ideas flow through you and then you become open to good ideas”*.

Although dominated by high arousal positive emotions, **intimation stage** is probably the most emotionally charged stage because high arousal negative emotions can also be simultaneously experienced. The positive emotions including excitement and happiness are captured in the following quotes: *“When I know an idea is just about there - I feel excited and sometimes physically energetic. It’s almost like the adrenaline kicks in so I feel a surge of happiness and creativity.”* Or *“I get these positive endorphins in me, that give me a rush that gives me that warm feeling like I’m winning here”*. Or *“I think there’s an element of excitement if I carry on this path of thinking, I’m going to actually solve the problem.”* However, the elusive nature of the insightful idea is still out of reach and some designers know that the feeling of knowing may be lost. This can lead to a mixture of excitement and frustration: *“But that vague feeling of ‘ah, yeah, you can almost see it,’ that’s quite frustrating as well. It’s quite tantalizing but if you can almost see it then you know it will come eventually”*. One designer appears to experience particularly intense

ambivalent emotions: *“I go through this black and white sort of emotional rollercoaster, and I hate the world and question everything I’ve ever done in my life because I can’t get to it.”*

Illumination stage is characterized by high arousal positive emotions such as intense happiness, excitement, enthusiasm, elation, warm fuzzy feelings as well as relief: *“It’s often quite an exhilarating feeling, combined with a sense of relief and determination, and I feel calmer.”* Or *“There’s a sense of elation about that. It’s a slightly manic experience and it’s about trying for your physical self to keep up with your mental self.”* Or *“It’s like a glow. I’ve got that warm fuzzy feeling inside me. I get a rush of I’ve applied myself in the correct way.”*

In the **verification stage** designers usually experience high arousal positive emotions together with frustration. The enthusiasm is triggered by the insight: *“I’m enthusiastic, I’m committed, I’ll go for it and I’ll just work, work, work until I arrive at that solution”*. Since this stage requires focused attention, some designers feel that frustration can be a beneficial sign of warning that the level of engagement is deep enough: *“If you didn’t get frustrated then that means it’s going too smoothly.”* However, once the design outcomes are produced they need to be presented to the clients. This can be an emotionally taxing process leading to frustration when the clients disagree with the proposed solutions: *“Sometimes, even if I feel I’ve made the right decision, my client might not necessarily agree which can be frustrating.”* Or *“When your work gets rejected, that becomes emotional.”*

Despite its benefits, designers’ deep level of engagement is also likely to make them emotionally attached to the outcomes of their work: *“Design is quite emotional, you take things to heart.”* This attachment is probably the strongest during the verification stage. However, most of our expert designers have learned to emotionally detach themselves from their work: *“You have to honestly be emotionally detached to the work, and be more objective from the client’s point of view.”* Or *“You have to be impartial in your own emotions, not undermining the merits of other routes”*.

The above findings suggest that design stages are emotionally rich including basic emotions: happiness, fear, frustration/anger, excitement, pride in achievement, relief and satisfaction. Whereas most of these are experienced as discrete states, others are experienced together and the most common ambivalent emotions are:

- excitement, and moderate fear in preparation
- frustration and fear in impasse
- frustration, fear and relaxation in incubation
- excitement and frustration in intimation
- excitement, happiness and relief in illumination
- frustration and excitement in verification.

Maintaining high level of excitement when facing the ill-defined and uncertain design problems could be quite

challenging. Besides the basic emotions described above, a particular type of social emotion has emerged from the interviews. We argue that **confidence** plays an important role in maintaining engagement throughout the design process. Confidence has been described as assured expectation and self-expression, which contrasts with anxiety and shyness which lead to uncertainty and narrow range of actions. Therefore, confidence is an emotion of assured expectation representing positive encouragement to action that facilitates self expression and creativity [7]: *“I think to be a good designer, you have to be confident, that you will however long it takes you get through any tough parts of a project.”* Or *“I still get scared on briefs that I’m not going to come up with the goods, but there’s a kind of quiet confidence that you’ll come up with something... whereas I think when you’re younger there’s a worry you won’t come up with anything at all.”*

Besides the blends of discrete emotions identified above, another significant finding relates to empathy. While not an emotion in itself, empathy is an ability to understand another’s mental state (including their emotion) and responding to this with an appropriate emotion [12]. Empathy supports designers with the social aspects of their work, for understanding and relating with clients and users through experiencing their world, responses and emotions. Empathy also allows designers to understand each other. *“The fundamental aspect about design is empathy. You have to put yourself in the position of the target.”* Empathy is required at each interaction with the clients, as well as during idea generation: *“You need to immerse yourself into your client’s way of thinking”*. Designers mentioned that empathy with the clients also helps in deciding between alternative solutions. Not at least, empathy coupled with strong positive emotions supports selling the design outcomes through a convincing pitch: *“you have to use your emotions to sell what you do”*, or *“if we went through a presentation, and we didn’t believe in what we’ve done, then we probably wouldn’t have convicted our clients of our emotions’ positivity.”*

The above qualitative analysis of emotions in design has been extended to include some quantitative aspects (Table 1). In order to investigate the predominance of emotional states within each individual stage of the design, we computed their frequency as a ratio between the number of times that any discrete emotion was mentioned and the total number of discrete emotions mentioned by all participants within that stage. Designers’ similar emotions were often described through different emotional states which for the purpose of this analysis were reduced to the Ekman’s list of discrete emotions. For instance excitement was also referred to as enthusiasm, happiness, enjoyment, passion, elation, exhilaration, and euphoria; frustration was captured by annoyance, anger, fury, agony; while fear was also described as anxiety, stress, worrying, panic, pressure, and nervousness.

	Excitement	Frustration	Fear	Relaxation	Happiness	Relief	Confidence	Other
Preparation	56%		14%	4%			2%	Curiosity: 18%; Empathy: 6%
Impasse		37%	36%					Clear-thinking: 9%; Determination: 9%; Self-doubt: 9%;
Incubation		19%	19%	13%			15%	Clear-thinking: 19%; Determination: 15%;
Intimation	43%	25%		13%			11%	Clear-thinking: 6%; Determination: 2%
Illumination	45%	5%	3%		20%	10%	17%	
Verification	11%	37%		11%			18%	Clear-thinking: 8%; Self-doubt: 8%; Empathy: 7%;

Table 1: Frequencies of Discrete Emotions in Design Stages

Roles of Emotions in Design

Given that emotions vary within the design process, they play different roles within each of the stages, and designers perceived them as facilitative, detrimental or irrelevant. We identified two main roles of emotions in facilitating engagement throughout the design process and idea generation, which are further described.

(i) Excitement and confidence support engagement throughout the entire process. Excitement is one of the most predominant emotions in design, responsible for supporting high levels of engagement throughout the entire process. This is not surprising given its link with intrinsic and approach motivation. We argue that excitement is an expression of intense passion or intrinsic motivation that all our designers have for their jobs: *“I think passion is probably the most important emotion really.”* Or *“This job means a hell of a lot to me. It’s a passionate job.”* It is this energy that allows designers’ deep engagement with their work: *“You can be in the office ten, eleven, twelve hours a day”* in order to face its challenges and reap the satisfaction of solving them: *“I feel creative when given a new challenge, which makes me happy.”* Or *“This job means everything to me. I couldn’t wait to just be able to do design”*. Or *“As designers we’re proud and passionate about what we do”*.

Approach motivation is oriented towards achieving success and allows designers to become absorbed [25], a state resembling flow experience [16]: *“that rush doesn’t leave until I’ve completed”*. The negative side of strong engagement in the design process is the attachment that designers may develop towards their ideas: *“you can’t put your personal emotions into a project”* because *“when your work gets rejected, that becomes emotional”*.

(ii) Excitement tempered by moderate anxiety facilitates idea generation. Our designers recognized the relationships between their emotional states and idea generation: *“I’m enthusiastic about it, which I suppose facilitates the generation of ideas.”* Or *“I’ve known but never really acknowledged it, that my mood does affect the work that is coming out.”*

Interestingly, negative emotions can also be facilitative, particularly when mild anxiety is experienced together with positive emotions and confidence: *“I think you need both of*

them at the same time”, or *“anxiety is probably helpful in a sense of driving people in design work”*. Such anxiety is often welcome and its significance clearly acknowledged: *“It’s that kind of passion and slight fear that you’re not going to succeed that makes it better.”* Mild anxiety can be self-induced by saying to oneself *“be careful because you might not come up with the solution”*. This is an emotional regulation strategy which allows for a more systematic information processing. This outcome is also consistent with previous findings suggesting that negative emotions promote a systematic and detailed information-processing style focused on concrete external information [27].

What is interesting is that designers’ strategy is consistent with findings showing that in contrast to positive emotions which support creativity on tasks viewed as fun and silly, negative emotions enhance effort on tasks viewed as serious and important [32]: *“You can’t be too complacent because I think that also stops you thinking of good stuff”*. Or *“Fear works extraordinarily well in motivating the designers to produce good work. Fear mixed up with excitement or adrenaline for the desire to produce good work.”* However, negative emotions can also limit idea generation: *“If I am feeling lousy.. my ideas don’t come in quickly.”* Or *“[during incubation] if you just allow yourself to be consumed by anger, you won’t get anywhere.”*

Whereas the above accounts suggest that designers recognize the relevance of emotions in design, we had some accounts which emphasized the rational aspects of design: *“From the brief it becomes less emotional because you are trying to solve a problem”* Or *“Although emotion comes into it, it’s mainly trying to logically solve what the problem is”*. One designer suggested that emotions should be down regulated particularly when making design decisions: *“cut out the emotions when you need to balance up the merits of different alternatives”*.

Emotion Regulation in Design

How people manage their emotions is captured by the construct of emotion regulation. According to Gross [40], emotion regulation refers to the processes by which individuals influence which emotions they have, when they have them, and how they experience and express them. Emotion regulatory processes may be automatic or controlled, conscious or unconscious, and can lead to

maintaining, increasing (up-regulating) or decreasing (down-regulating) both positive and negative emotions.

Among the conscious regulatory processes, we identified several ways in which designers manage their emotions. A significant outcome is that some expert designers are familiar with their pattern of emotional response and they know not only what to expect but also how to emotionally react to maximize their problem solving abilities. For instance, the role of positive emotions in design is clearly captured by one designer: *"My emotions during design are positive and they last for as long as I require them to."* Excitement which is paramount in the preparation stage needs to be sometimes up regulated: *"You need to approach each project in the same committed, passionate manner. Some jobs may seem slightly daunting ... but you need to be going in there with enthusiasm and commitment."* Another example is the emotional rollercoaster experienced often by a designer during intimation: *"I have now learned that is a point I have to reach. I have to go through that until I get over this bit. If I don't feel that, I won't get to that bit. It's this horrendous agony you have to go through until you come through the other side."*

The various approaches to emotion regulation within each of the design stages are further detailed. In preparation stage, enthusiasm needs to be increased in order to have a good brainstorming session, and the energy of the facilitator is particularly important: *"I think that kind of brainstorm model does energise you, but I have to feel quite energetic to do that."*

Impasse is predominantly experienced in terms of negative emotions which need to be down-regulated: *"You have to detach yourself from emotion, because frustration can lead to anger and then you're not being productive."* Or, *"If you get too annoyed or frustrated then you can't move on. You have to kind of get rid of it. You almost need to have strength of character to recognise it and move on from it".* Designers are resourceful when it comes to dealing with impasse, from revisiting the brief to engaging in unrelated activities which allow for incubation: *"When I get frustrated or hit a dead-end, I start to think logically about how best to change that emotion. Occasionally I also find cleaning (the house) to be quite a therapeutic process."* Or *"Whenever I get to a point where I don't feel I'm winning ... I just need to remove myself, take five minutes, go and read a book, go online quickly, go and make a cup of coffee. Take a step back, go for a walk, and just switch off."*

In incubation stage designers can choose to work on the problem but in ways which differ from their usual activity and facilitate openness to novel ideas: *"It always seems to help if I switch off my computer and find a more comfortable seat to doodle ideas with a pen and paper... It's about striking a balance between feeling relaxed, and feeling stimulated and inspired."* During incubation it is important to maintain confidence and motivation to keep

them persevere: *"You've got to keep your commitment. I think it's determination... Retain your focus and confidence!"* Or *"When you arrive at a point where you think this route or this approach is dead, the commitment to take a step back, to go back to the brief, to ask more questions, to do more research, to take time out, but it's that determination that you will find the right solution, that you will get there"*. At this stage, it seems that confidence is particularly to allow designers to put the problem on the side: *"Better at saying if it's really not happening today just stop. I'll walk away and do something completely different...I think that's having the confidence to know it will look better in the morning."* Interestingly, it could be the sheer anxiety which provides the needed energy: *"When problems cause you to think a lot harder, it's more of an anxiety, which you should turn into the drive to find the solution."*

In the intimation stage, there should be an effort to down-regulate the excitement because a sudden increase in the arousal may not allow the idea to emerge into the consciousness: *"When it's tantalizingly close sometimes you consciously don't let the excitement in until you know you've got everything in the bag and you're walking away."* In order to decrease the level of excitement one designer engages in physical activities: *"When I know an idea is just about there - I feel excited and sometimes physically energetic. At that point I need to get rid of some of that energy of excitement so I'll probably go for a walk or a swim so that I feel relaxed and focused again. And usually during that process I will find the solution."* Another designer engages in more relaxing activities for inducing calmness: *"The best thing to do in that situation is just relax again. Just completely relax and don't think about that fuzzy whatever it is too much."* In the verification stage it is particularly important that the emotional attachment to one's design outcomes is reduced by *"cutting out emotions in order to make clear decisions."*

The discussion above depicts various ways in which designers attempt to manage their own emotions. Another significant outcome is that designers also try to regulate others' emotions. Several designers showed efforts to create strong **creative spaces** filled with music, excitement, fun and freedom.

One designer particularly engages in up-regulating other designers' emotions: *"when it's quiet and everyone's heads down, I try to lift it. It might be case like "right, going to the shops to get some biscuits or some sweets. Add a bit of joke, just to break up any kind of negative or detrimental force."* In the illumination stage, on the moment of hitting upon the idea, he consciously intensifies the emotions of elation and excitement and imparts them to his colleagues. In the verification stage, the same designer has to impart the excitement and confidence to the client: *"If we didn't believe in what we've done, then we probably wouldn't*

have convinced our clients our emotions' positivity ... If we are really positive about our solution with our facial expression, spoken words and body language, and the energy is coming across to the client, then there is greater chance to convince the client and win the project."

CONCLUSION

Within this exploratory study we investigated the emotional aspects within the design process by interviewing 9 expert designers. A content analysis revealed that excitement, frustration and anxiety are the predominant discrete emotions, while different blends of emotions characterize each stage of the design process. Confidence and empathy are additional emotional aspects infusing expert design. The social emotion of confidence is particularly relevant in impasse and incubation while empathy is closely related to the social aspect of design in understanding others such as clients, users or colleagues.

With regard to emotional dimensions, the design process seems to be dominated by high arousal emotions, with the exception of incubation stage where emotional states of low level arousal appear beneficial. In terms of valence, the design process is experienced ambivalently, both as stimulating and challenging, and with a peak of negative valence in impasse and incubation. With regard to approach-avoidance, expert designers experience the design process as predominantly appetitive or rewarding, with accents of avoidance during impasse and incubation stage. The anxiety of not finding a solution either now or in the foreseeable future makes the process particularly challenging. In order to deal with this, in the incubation stage, expert designers up-regulate their positive emotions to overcome the negative impact of anxiety. Although a negative emotion, frustration is in fact approaching, motivating one towards action so that the stages following incubation are perceived as appetitive.

Our findings also suggest that emotions play two broad roles of facilitating high level of engagement throughout the entire design process, and of facilitating idea generation. Whereas positive emotions support engagement and sustained motivation, idea generation is fostered by a mix of positive and negative emotions. An interesting finding is that fear can be up-regulated in the preparation stage when excitement is particularly high. This is in line with previous findings suggesting that fear can in fact promote a more systematic and detailed information-processing [27].

Another interesting outcome is that expert designers are good at dealing with their emotions and the emotions of others. They have a rich emotional experience within each stage of the design process and they know what to expect and how to manage their emotions. They increase their excitement during the entire process, increase fear in preparation, reduce anger and increase calmness and confidence during incubation, decrease excitement and increase calmness in intimation, and reduce emotional attachment in verification.

Our study has one limitation relating to the interview questions targeting the various stages of Wallas' model. Although our questions aimed to capture emotions within each stages and the majority of participants well understood our questions as reflected in their answers, in some cases participants referred to the emotional states in other stage(s) while describing emotions in one particular stage. In particular, the questions targeting incubation and its temporally closely related stages appeared to lead to some confusions.

This has been addressed during the content analysis when the emotions within each stage were analyzed not only in terms of the questions they were related to, but more importantly with respect to the activities that the participants reported to engage in and the outcomes that they produced. Indeed, participants' answers provided the context needed to disambiguate this issue. For example impasse was usually described as one moment and the starting point of incubation, whereas incubation was described as a lengthy stage where additional activities pertaining to preparation and verification iteratively occurred.

Despite its exploratory nature, our study makes several contributions which could open up new avenues into understanding and supporting creative design. Important theoretical contributions relate to creative problem solving, design thinking, and design expertise and are further summarized.

- Wallas' model of creative problem solving has been therefore revised to include emotional aspects within each of its stages.
- The prevalence of emotions in the design process and the significance of their roles suggest that future work in design reasoning and design rationale could strongly benefit from considering not just the impact of cognition but both of cognition and affect in decision making.
- The identified emotion regulation strategies successfully employed by expert designers can contribute to the design expertise research area.

Future work in this direction can also have important practical contributions in the area of design methods and tools.

- Design methods can benefit from targeting the emotions related to the design stage where they are employed. For example, brainstorming could be more productive with an enthusiastic leader within a creative space, personae could have stronger emotional details to support empathy, and mood boards may emphasize different emotions at different stages to facilitate the most productive ones.
- Developing novel methods and tools for training novice designers to recognize and regulate their emotions. For instance by increasing their awareness

of what is to be emotionally expected at each stage and the awareness of the most successful ways of managing emotions.

- Developing novel design tools to support reflective practice. For instance affective interfaces could capture and visualize designers' emotions in a way which invites reflection, supporting thus the reflective practice of design for both novice and expert users.

To conclude our findings suggest that emotions do matter in design and moreover, it is possible that emotionally competent designers are probably more able to reap the benefits of their emotions during the design process. Therefore it is important that future work will focus on this exciting research direction.

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