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Emotions in archetypal media content

by

Huang-Ming Chang

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EMOTIONS IN ARCHETYPAL MEDIA CONTENT

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SUMMARY

Emotion is an intriguing and mysterious psychological phenomenon. While everyone seems to know what it is, researchers have not yet come to consensus on its definition, and many questions still remain unanswered. While the nature of emotion is yet to discover, the design community has noticed is importance, and poses the challenge of how emotion could inform design. We see the necessity to follow the state of the art in psychology and initiate the undertaking by exploring the emotional qualities in various types of media content. The first part of this thesis aims at constructing a theoretical framework. Recent years have seen empirical studies suggest that emotion could be unconscious. While this is to be further justified, scientists are motivated to reconsider current theories of emotion to account for this phenomenon. In light of this, we integrate these studies about unconscious emotion into our literature review. An overview from theory to practice is illustrated to provide a reference for viewing the current states in application domains, such as affective computing and emotional design. This review offers a holistic understanding about emotion from various perspectives, which allow us to look for new directions in future studies.

Based on our review, we see a promising direction by applying psychoanalysis methods to analyze the media content as affective stimuli, and these stimuli can be evaluated by using quantitative measures to investigate the connection between the content and the corresponding emotions. The analysis on the media content is based on a psychoanalysis theory—the theory of archetypes—proposed by Carl Jung. He argues that there exists a universal pattern in humans' unconscious thoughts, which can be manifested as symbolic content in various forms of narratives, such as myth and fairy tales. Today, this archetypal symbolic content can be seen in modern media, particularly in movies. By applying the Jungian approach, we analyzed the symbolic meaning in movie scenes and edit these feature scenes into a collection of archetypal media content, which serve as the experimental materials for later explorations.

In the second part of this thesis, we present three experimental studies that aim at determining if archetypal media content can be differentiated based on emotional responses. We adopted the psychoanalytical approach described earlier to collect feature scenes in movies as archetypal media content. Meanwhile, affective stimuli of explicit emotions are also included as benchmarks for comparison, such as sadness and joy. Self-reports and physiological signals are both adopted for measuring emotional responses. These three studies follow similar experimental design: presenting stimuli and measuring emotion concurrently. The results of these studies confirm that emotions induced by archetypal content are different from explicit emotions, and the statistical analysis further indicate that the predictive model obtained from physiological signals outperforms the model generated from self-reports while viewing archetypal media content. These results, however, are opposite to the results gained from affective stimuli of explicit emotions, leading us to the conclusion that archetypal media content might induce unconscious emotions, and physiological signals are more effective than self-reports for recognizing emotions induced by archetypal media content.

In the third part of this thesis, we explore how archetypal media content could inform design for media. First, we conducted two studies to answer the research question that if designers could generate richer affective content by mood boards when they are exposed to archetypal media content, comparing to non-archetypal media content. In these studies, designers were asked to create mood boards based on their emotional experience about archetypal film clips. Next, we used qualitative and quantitative questionnaires to collect subjects' opinions about these mood boards and the media content. The results show that archetypal mood boards are more attractive than non-archetypal mood boards. Furthermore, the inter-rater correlation among these mood boards is remarkably high, suggesting that mood boards can be a universal tool for representing emotional experience. Therefore, we developed a set of applications for recording and representing emotional experiences for media content by generating mood boards. The context of use is explained and a case study is presented for demonstration. Since archetypal content is mainly manifested in narratives, another promising direction is to develop emotion-driven media systems. While traditional narratives usually follow a linear storyline, emotion-driven media provides a dynamic, recursive, viewer-dependent media experience. We propose a conceptual framework and look forward to future development.

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ACRONYMS

SAM Self-Assessment Manikin

HCI Human-Computer Interaction

IAPS International Affective Picture System

IADS International Affective Digital Sound System

ARAS Archive for Research in Archetypal Symbolism

MANOVA the multivariate analysis of variance

ANS Autonomic Nervous System

EEG Electroencephalography

ECG Electrocardiogram

HR heart rate

HRV heart rate variability

SCL skin conductance level

SCR skin conductance response

ST skin temperature

LDA Linear Discriminant Analysis

LMM Linear Mixed Model

kNN k-Nearest Neighbor

SVM Support Vector Machine

AdaBoost Adaptive Boosting

Part I

THEORETICAL FRAMEWORK

1 INTRODUCTION

1.1 MOTIVATION

1.1.1 *Myth and the Human Society*

As part of our nature, human beings are always interested in exploring the world we live in. Why does the sun come up from the east? Why are there four seasons? This *world* is mysterious, not only for our ancestors but also for people in the modern society. Before human beings were capable of justifying a hypothesis with objective evidence (i.e. the scientific revolution), our ancestors formed an imaginative worldview about how this world is built as we see it is today. Therefore, we have myths. The relationship between myth and science is a subject as old as that of myth and science themselves (Segal, 2009). The modern view toward myths varies chronologically by the centuries. In the nineteenth century, myth and science were commonly considered to be opposite and incompatible. In the extreme, people at that time thought of defeating myths by scientific approaches as a sign of a modern society. It was believed that: because of the advances of science, this world is becoming less mysterious, so we have to abandon myth. On the contrary, in the twentieth century myth and science were usually taken to be compatible, and therefore myths are once again embraced by the modern society (Segal, 2009). There is no doubt that the quality of material life substantially relies on science and technology, but we shall not forget the importance of myths for enriching the mental life of modern people in many ways.

Myth is the oldest form of narrative in human history. Since there are no historical records or scientific proof, it is difficult to justify if these mythical narratives are true facts or just merely imaginary stories made up by ancient people. Nevertheless, myths are still influencing modern society and still fascinating to people nowadays. Myths, as a primeval form of living reality, have been woven into our lives in many different ways. It is usually linked with ritual. Together, they were used to regulate how ancient people were to behave toward nature and construct their basic view of how this world was made. Myths and rituals divide an individual human life into three phases: childhood, adolescence and retirement. Each of these phases is characterized by corresponding motive complexes: love, power and death (Rauterberg, 2011). In general, there are two ways of interpreting myths: literal and symbolic (Dundes, 1988). Literal interpretations look into factual or historical bases for myths while symbolic interpretation prefers to regard myths as a code requiring some deciphering. In the early nineteenth century, myths were treated as nothing different from fables, inventions and fictions (Eliade, 1998). Thus, rationalists treated myths as delusions and pure imaginations (May, 1991). From a literal perspective, myths would be merely an unrealistic and unscientific version of history. The greatest value we can gain from myths would probably be anthropology (Tylor, 1920), rituals (Eliade, 1998) and

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This chapter is (partly) based on:

Chang, H.-M., Ivonin, L., Diaz, M., Catala, A., Chen, W., & Rauterberg, M. (2013). From mythology to psychology: Identifying archetypal symbols in movies. Technoetic Arts, 11(2), 99–113.

religions (Malinowski, 1954), which mostly aim at finding a reasonable explanation or rational speculation for the reality of ancestral societies. Interestingly, it was found that ancient people tend to present symbols as an instance of association with reality, instead of looking for rational causes (Kirk, 1975). It appears that myths were not meant to give a rational explanation toward the reality but to provide a symbolic representation that shows the natural tendency of how ancient people interpret the reality that they lived in.

The nature of myth is different from fictions we read today. More than just storytelling, some scholars consider a myth as a way of making sense of the physical world (May, 1991). A myth is a sacred narrative usually explaining how the world and humankind came to be in its present form (Dundes, 1988). One of the foremost functions of myth is to establish models of behaviour (Eliade, 1998). Through its myth, a healthy society gives its people relief from guilt and anxiety, and encourages humans to discover true values in their lives (May, 1991). Rather than merely imaginary stories, myth is a narrative resurrection of a primeval reality. "It is a living reality, believed to have once happened in primeval times, and continuing ever since to influence the world and human destinies" (Malinowski, 1954, p. 100). Indeed, it is surprising that even though the content of myths seems unrealistic and irrational, myths are still manifested in modern media content, such as artwork, music and movies (Faber & Mayer, 2009). Numerous ancient myths are being re-edited as a modern version and re-made into various forms of digital media. Although the content of the myths might change over time, the skeleton of the stories still remains intact. The human society grows with myth while myth manifests the thinking and behavioral pattern of the people within the society. This circular relationship has been continuously working along with human history and, nowadays, we still can see many traces of myth in our daily lives.

1.1.2 *The Unconscious*

Some cultural rituals and customs can be traced back to historical events, but others could only count on myths, fairy tales and legends. Although these fictional narratives cannot be proved to be true, they lie at the heart of people and form the knowledge that guide us how to see things and act in our society. Fictional narratives have been an important medium for the growth of culture and society. They provide a deep and immersive simulative experience of social interactions (Mar & Oatley, 2008). Furthermore, it is believed that people's thoughts and behaviors are deeply and implicitly influenced by their social and cultural context. In recent years, psychologists start to research how people could adapt themselves into a given social situation. The results suggest that this adaption not necessarily be a conscious action but can be unconscious (Wilson, 2003; Bargh & Morsella, 2008). Indeed, many of our decisions and behaviors are irrational and driven by the unconscious (Dijksterhuis & Nordgren, 2006). While most people think irrationality is harmful for our decision-making, empirical studies have revealed the merits of utilizing the unconscious to achieve better results in a complex decision-making task (Dijksterhuis, 2004). Sometimes people make decisions based on preferences instead of rational reasoning. In fact, it is an inborn capability of humans to look for better conditions in terms of physical and mental well-being. While a cognitive task is beyond the capability of rational thinking, the intuitive, unconscious, irrational thinking might take over and solve the problem with 'gut feelings' (Gigerenzer, 2007).

The interests in human unconscious were first revealed by Freud (1922). After being quiet for a long time, research on the unconscious regains the attention of the science

community in recent years (Baumeister et al., 2011; Bornemann et al., 2012; Custers & Aarts, 2010; Dienes & Scott, 2005; Dijksterhuis & Aarts, 2010; Ekstrom, 2004; Epstein, 1994; Galdi et al., 2008; Greenwald et al., 1995; Kihlstrom, 2008; Martin & Morich, 2011). Some psychologists strictly hold a conscious-centric model of human mind, considering the unconscious as a low-level mental processing system that handles subliminal-strength stimulation from the environment, while the conscious processes still play the primary role in causing human judgment and behavior (Bargh & Morsella, 2008). This view is supported by some empirical studies, which suggest that people could perceive stimulus information presented below the threshold of perception (e.g. Bornemann et al., 2012; Codispoti et al., 2001; Greenwald et al., 1995; Winkielman et al., 2005; Zajonc, 2001). Nevertheless, other scientists uphold the priority of the unconscious, and suggest that the unconscious processing is not limited at the low-level perception but can also handle high-level mental activities, such as decision making (Dijksterhuis, 2004), goal setting (Custers & Aarts, 2010), attitude (Gattol et al., 2011), and emotion regulation (Koole & Rothermund, 2011). The distinction between conscious reasoning and unconscious thinking is significant (see Table 1.1 on page 6). According to Kahneman (2003), there are three cognitive system of the human mind: perception, intuition, and reasoning. Perception and intuition form an experiential system that processes the incoming information in real time and generates corresponding reactions automatically (Epstein, 1994). Only part of the incoming information would pass the filter of attention and enter into the rational system for logical reasoning.

In addition to the cognitive account for the unconscious, psychologists also take into account the impact from the social and cultural context (Wilson, 2003; Wilson & Bar-Anan, 2008). Barrett (2012) argues that people who live in a common social context would automatically and implicitly develop *collective intentionality* - a kind of knowledge that is formed and shared within a group of people - and this knowledge provides a basic reference for people to understand the external world and thus generate emotion, memory and other mental content. When being part of a society, people tend to adapt themselves into the given social context and this adaption might take place outside of conscious awareness (Wilson, 2003). However, it is still unclear how this collective intentionality is achieved within a large group of people, e.g. a society (Steele & King, 2011). Human communication is complicated and versatile. Besides the literal interpretation toward the languages we use, human beings tend to utilize a higher level of skill to communicate abstract notions. Some sociologists propose that all kinds of human communication are symbolic (Manis & Meltzer, 1978). Their fundamental premise is that humans do not directly react to the ontological-existing reality, but respond to their understanding of this reality. It is a natural tendency for humans to express abstract notions in an associative and symbolic manner. Symbolic meaning appears to be an important layer that lies between human mind and the physical world. The meaning-making process is automatic, spontaneous, and irreversible (Barrett, 2012). Emotion, as one of the essential psychological phenomena, allows us to respond to the meaning we perceived from the world and thus shapes our behaviors (Baumeister et al., 2007).

1.1.3 *Media and Entertainment*

While the pure science looks for precision and rationality, the application domain of entertainment aims to create emotionally-intense, rich-in-meaning media content. Entertainment is part of our daily lives. The history of entertainment can be traced back to the

EXPERIENTIAL SYSTEM (Perception & Intuition)	RATIONAL SYSTEM (Reasoning)
1. Holistic	1. Analytic
2. Affective: Pleasure-pain oriented (what feels good)	2. Logical: Reason oriented (what is sensible)
3. Associationistic connections	3. Logical connections
4. Behavior mediated by 'vibes' from past experiences	4. Behavior mediated by conscious appraisal of events
5. More rapid processing: Oriented toward immediate action	5. Slower processing: Oriented toward delayed action
6. Slower to change (slow-learning)	6. Changes more rapidly (flexible)
7. More crudely differentiated: Broad generalization gradient-stereotypical thinking	7. More highly differentiated
8. More crudely integrated: Emotional complexes; context-specific	8. More highly integrated: Cross-context
9. Experienced passively and preconsciously	9. Experienced actively and consciously
10. Self-evidently valid: 'Experiencing is believing'	10. Requires justification via logic and evidence
11. Parallel, Automatic, and Effortless	11. Serial, Controlled, and Effortful

Table 1.1: Comparison of the experiential and rational systems (adapted from Epstein, 1994; Kahneman, 2003).

ancient times. It is not only because humans need to rest from work but also due to the desire for enriching the mental and spiritual life. The essence of entertainment is versatile. Rather than a means for merely having fun, entertainment plays the role in maintaining mental sustainability (Nakatsu, 2010) and facilitating social transformation (Rauterberg, 2009). It can also be a kind of media that delivers cultural experiences at an unconscious level (van Aart et al., 2010). With the advances of media technology, the modern form of entertainment offers tremendous potential for making positive effects on human behaviors in various ways (Rauterberg, 2004). In this regard, we have to consider how entertainment gradually changes with the growth of our society, and how future entertainment technologies might in turn make impact to our lives (Rauterberg, 2009).

Since the 1980s, we have witnessed the emergence of computational technology and the advances of multimedia communication. Today, multimedia systems have widely spread and permeated to people's daily lives. Mobile technology and Internet enhances the accessibility of media content and communication becomes richer in terms of content. Entertainment, as an important category of media content, becomes one of the driving forces that thrust the development of new types of multimedia systems. Media technology has broadened the bandwidth of communication for transmitting entertaining content to people by using multimodal channels. However, the content of the entertainment is equally important and worth studying. Myths, as the media content in ancient times, were spread

through word of mouth and symbolically represented as artwork. These mythical stories were not lost along with the growth of human society, and still are being manifested in various media forms, such as video games and movies. This curious phenomenon has demonstrated the universal human capacity to classify, to codify and to communicate their experiences symbolically in different time scales (Kooijmans & Rauterberg, 2007).

There are two kinds of interpretations toward media content: rational and emotional (Nakatsu, 2010). With regard to functional purposes, communication needs to be precise and logical, so the media content has to be descriptive and concrete in order to achieve a clear understanding of the enclosed message. On the contrary, media content for entertaining purposes particularly emphasize the emotional aspect of the communication. While the rational interpretation of media content looks for simplicity, emotional interpretation of media content is abstract, dynamic, symbolic, and experiential. This categorization also resonates with the distinction between the two cognitive systems of human mind (see Table 1.1 on page 6). The emotional aspect of communication encompasses a considerable amount of information that would be handled by higher-dimension mental process: the unconscious (Rauterberg, 2010). With these two interpretations, a pure, holistic experience thus can be delivered in a more comprehensive manner (Salem et al., 2009). This ultimate form of communication is called Kansei Mediation—a rich combination of communication channels that allows conscious and unconscious information flow freely (Nakatsu et al., 2006).

1.2 EMOTIONS IN MEDIA CONTENT

In this dissertation, we intend to explore the relationship between two main subjects: emotion and media content. Media can be referred to any means of information communication. While studying media, we must not be blinded by the form of the media but need to concentrate how media content is made meaningful to people (McLuhan, 1994). If we consider media as message, it does not matter if this message is being told or written, but only the content of the message—meaning—makes sense to people. Meaning, on the other hand, is becoming an important topic in psychological research on emotion. In the early years, emotion was considered to be directly caused by stimuli in the external environment, such as natural threats (snakes or earthquakes) cause the feeling of fear Darwin (1872). Today, psychologists have developed more comprehensive explanations for the activation of emotion. Mainstream psychological theories suggest that the *meaning* of the given situation plays an important role in activating emotions (Arnold, 1960). For example, natural threats are interpreted as a cause of death and this interpretation thus activates the feeling of fear. In this regard, the symbolic meaning of media content plays a key role in bridging the gap between emotion and media content.

Narratives have been the primary media content for transmission of emotional experience since early times of the mankind. In essence, narratives are a kind of *virtual reality*, which pulls the reader into a fictional world. As we mentioned earlier, fictional narratives usually reflect the worldview of the modern time. Different from history, which is meant for documenting the true fact, the function of narratives is to render the social atmosphere in an implicit manner, and deliver rich emotional experiences along with the interaction among the characters. Most people tend to enjoy the mediated emotional experience rather than rationally analyze the logic of the content. Just as children love often-told bedtime stories, sometimes adults enjoy watching classic movies over and over again and never tire

of them. Narratives can induce profoundly emotional experience (Oatley, 1995). However, very few studies have addressed this topic within psychology probably due to the misconception that narratives are mere made-up illusions (Oatley, 1999). Recent years have seen some researchers advocating the importance of narratives in psychology. They suggest that narratives operate as a means of simulating social and emotional experience (Oatley, 1999; Mar & Oatley, 2008). The evoked emotion may even influence the viewer's daily life after viewing (Mar et al., 2011). Although most of these studies particularly focus on literacy narratives, they still shed some light on narratives in various media types, such as paintings, comics, theater plays, and movies. In the domain of marketing, narratives play an important role in branding and advertising. Woodside et al. (2008) claim that people tend to think of the brand of a company narratively and their opinions toward a brand are outcomes of unconscious processing. It is also confirmed that emotion is an important factor toward their responses to the brand while watching advertisement (Ruiz & Sicilia, 2004). If we consider media as an instrument for transmitting emotional experience, narratives can thus be defined as a design pattern of media content. In this regard, exploring the relationship between the pattern of narratives and it corresponding emotional responses appears to be a promising research direction.

Emotion is an important aspect of media experience, and it has been of great interest to the design community. Studies on emotional aspect of design usually adopt psychological theories of emotion as their theoretical basis. However, the mainstream psychological studies solely focus on utilitarian emotions (Scherer, 2005a). These types of emotions can be considered utilitarian in the sense of facilitating our adaptation to events that have important consequences for our wellbeing, such as fear triggers fleeing from danger. However, emotions in media content do not seem to have survival values for maintaining physical sustainability. This view appears to be limited and cannot explain emotional experiences in the context of media design, i.e. why people enjoy watching movies while movies do not bring any survival values? While it has been well researched that emotion has biological and social functions, other aspects of emotion remain mysterious and intriguing. Moreover, the question of whether emotions can be unconscious draws great attention in recent years (e.g. Berridge & Winkielman, 2003; Winkielman & Berridge, 2004). The answer to this question is still under debate due to the fact that psychologists hold various theoretical positions and use different measures to approach this hypothetical phenomenon. This topic is relatively new and existing theories have not yet included this into their framework. Nevertheless, this trend has reminded us the limitation of the existing theoretical framework of emotion, and encourages us to reconsider the central assumptions and think about how this hypothesis can be justified.

1.3 OBJECTIVES AND THESIS OUTLINE

This dissertation is divided into three main parts: Theoretical framework, Exploration, and Implications for design. For each part of the dissertation, we formulate the objectives we intend to achieve and research questions to be answered. In this section, the context of each objective and corresponding chapters are presented as follows.

1.3.1 *Epistemological Dilemma in Research on Emotion*

Knowledge is often defined as 'justified true belief' (Lemos, 2007). This means that all theories need to be critically assessed through justification in order to approach the unknown phenomena. This definition has founded the basis of many sciences, but some controversy still cannot be solved. In philosophy, the Gettier problem—a classic epistemic controversy—initiated the long debate that has lasted over five decades (Gettier, 1963). The problem emerges due to the fact that any single justification can never be flawless because it is always possible to find counterexamples to defeat your proposition. These debates would end up with an inevitable recursion (Moser, 2005). Many philosophers endeavor to tackle the Gettier problem but still cannot reach a perfect solution. Among all the proposed explanations can be generally classified as two perspectives: internalism and externalism (Lemos, 2007). For internalism, researchers tend to look for justifiers internal to one's perspective, that is, the knowledge is more likely acquired through self-reflection (Steup, 1998). In contrast, externalism relies on the justifiers that come from the external world and has to take into account if the justifiers are biased (Lemos, 2007).

This classic epistemic dilemma can also be seen in psychology. In the early years, many psychological theories were built upon the introspection toward one's conscious thoughts and feelings, which was considered as a 'mind' problem. Since the sixteenth century, Newtonian paradigm has becomes a dominant belief that affects all sciences. It assumes that things in the environment around humans are more like machines than like life. Some researchers tend to think of the human mind as a machine that can be decomposed into smaller functional processes (Kohler, 2010). In the extreme, behaviorists even deny free will and try to explain human behavior as a function of biology (Gendron & Barrett, 2009). Consequently, psychological research became a mere 'body' problem at that time. The body-mind problem has long puzzling psychologists just as the Gettier problem in philosophy. Regarding research on emotion, this problem is called the emotion paradox (Barrett, 2006b). If researchers count on one indicator (body or mind), the study might be limited or even biased (Podsakoff et al., 2003). While investigating unknown phenomena such as unconscious emotion, it is suggested to hold a neutral viewpoint and cross-validate the experimental results from different perspective in order to approach the nature of emotion (Moran-Ellis, 2006).

In Chapter 2, due to this epistemological problem, we start with reviewing psychological studies on emotion. In order to further justify the hypothesis of unconscious emotion is still under debate, it is necessary to have an overview toward contemporary emotion theories, emotion models and emotion measurement. This review would also help clarify the theoretical approaches that are used in application domains, such as affective computing and emotional design. Based on this review, we can see some promising directions that have not yet discovered by the mainstream psychology.

1.3.2 *Identifying Archetypal Content for Scientific Studies*

To initiate this undertaking, finding a universal pattern in narratives is necessary. Several scholars have proposed basic structures of narratives across different cultures (Propp, 1984; Field, 1984; McKee, 1997) and across various media types (Ryan, 2002; 2004; Todorov, 1977). However, these structures are mostly developed for storytellers and screenwriters, and do not take into account the psychological meaning of the narratives. In the field of psycho-

analysis, Swiss psychiatrist Carl Jung (1959) proposes one of the most influential theories of the unconscious—the *collective unconscious* and *archetypes*, which explains the connection between ancient myths and the unconscious from a psychological point of view. He argues that there exists a universal pattern in the core concepts in different cultures. These core concepts repeatedly appear in ancient artwork and their myths, fairy tales and legends despite of the separation in time and space. He considers these concepts are symbolic expressions of a kind of inborn knowledge—archetypes—that is rooted in the unconscious mind of every individual. Archetypes can be represented as myths, rituals and other forms of ancient narratives, demonstrating an intrinsic tendency of how the human mind conceptualizes the physical world. Inspired by Jung's theory, Campbell (1973) further reveals that there is a universal narrative structure in ancient myths across different cultures.

The theory of archetypes lays the foundation of the analytical psychology and develops into many techniques for psychotherapy. Numbers of researchers put efforts on analyzing universal symbolic content in ancient cultural artworks based on the theory of archetypes. This research strand is called *archetypal symbolism* (Gronning et al., 2007). Some scholars apply archetypal symbolism to modern narratives, such as writing (Vogler, 2007) and movies (Hauke & Alister, 2001). Instead of being separated from the story, the viewers are seen as *participants* who unconsciously situate themselves in the context, and go through the journey with the characters Woodside et al. (2008). The archetypal symbolic content in the narratives would in turn activate unconscious thoughts and impulses in one's unconscious mind, and thus trigger corresponding emotional experiences. Just as myths reflect the worldview in ancient times, modern movies are mythical narratives that manifest the living reality of modern people, providing a fruitful resource for studying universal media content for art and design.

In Chapter 3, we start with addressing the epistemic problem of traditional experimental psychological approach, and frame a triangulation theoretical approach for research on emotion. This theoretical framework lays the basis of our research, which can be applied in psychology and media design. To further put this approach in practice, we propose to analyze the symbolic meaning of media content. Since the theory of archetypes is well documented for this purpose, it serves as the key reference for the following analysis. The media content that encompasses archetypal symbolic meaning is defined as *archetypal media content*. Thus, we form a research question:

Research question 1. *How to analyze media content for scientific studies using archetypal symbolism?*

Many researchers applied this theory to conduct a heuristic analysis on modern movies. However, these qualitative analyses cannot be directly used in quantitative experimental studies. It is necessary to build a standard procedure for editing media content as affective stimuli for psychological experiments. In order to integrate this approach into experimental design, we introduce a psychoanalytical approach for analyzing symbolic meaning of media content based on the theory of archetypes, and develop a standard procedure for editing movie clips as affective stimuli for psychological experiments. This approach is put into practice in the later chapters in Part II: Exploration.

1.3.3 *Psychophysiology of Unconscious Emotion*

Measuring emotions in media content is challenging. Traditional psychological studies on emotion usually use stimuli with discrete emotional qualities, such as pictures of happi-

ness and video clips of fear, and then use self-reports to collect subjects' emotional responses toward these stimuli. This discrete categorization is similar to emotion labeling in our daily languages, and has shown its reliability in cross-cultural studies (Osgood et al., 1975). However, this discrete categorization is suitable in which the content of the affective stimuli is relatively explicit and direct. However, narrative media content is a complex form of affective stimuli that encompasses rich emotion-filled information. It is difficult to find proper words or emotion categories to describe one's emotion toward the story. Moreover, the emotion toward media content is continuous and progressive. Using self-reports does not seem to be feasible because the emotional experience would be interrupted while the subject is asked to report their feelings (Soleymani et al., 2012a). For the above reasons, it is suggested to monitor physiological signals as a complementary measurement (Cacioppo et al., 2000). It is particularly suitable for investigating emotions in narrative media content. Physiological measures are the most used indirect measures of emotion. The main advantages of physiological measurements are that they can monitor continuous experience, are not dependent on language, do not require memory, and do not interfere while experiencing (Ravaja, 2004). Many studies have developed reliable equipment particularly for measuring the activities of the Autonomic Nervous System (ANS), which allows researchers to further identify corresponding psychological states (Cacioppo & Tassinary, 1990). Moreover, some researchers claim that physiological measures could help with recognition of unconscious emotional states that are inaccessible through introspective reports (Fairclough, 2009; Miller, 1992). Another possible solution is Electroencephalography (EEG). Although neurophysiological signals are closer to the origin of affective states than physiological signals, scientists encounter the difficulties in recording brain signals in real-world settings and interpreting them in a participant-independent manner (Mühl et al., 2014). Since our research aims to develop real-world applications that can be applied to the general population, physiological signals would be a more feasible approach rather than neurophysiological measurement.

Recent years have shown increasing evidence suggesting that humans might have unconscious emotions in some conditions (Bornemann et al., 2012; Kimura et al., 2004; Öhman et al., 2000b; Scherer, 2005b; Winkielman & Berridge, 2004; Zemack-Rugar et al., 2007). However, the existence of this phenomenon is still under debate and we need more evidence to examine this hypothesis. While numbers of new theories have been proposed, some existing influential theories have been ignored by mainstream science, such as theories in psychoanalysis. One of the most influential psychoanalytical theories - the theory of archetype - claims that the psychic content hidden in the collective unconscious would result in the complex in the personal unconscious, and then manifest as irrational thoughts and emotions (Jung, 1959). We decided to adopt the theory of archetype because it has already developed solid methodologies for clinical research on mental issues and has expanded to movie analyses and other applications, which is suitable for our context of research. Following this theory, it is necessary to take into account the possibility that archetypal media content might induce emotions at an unconscious level. The mainstream psychology considers introspection as the ground truth of one's emotional state. When a person honestly says he is happy, scientists have no reason to question this result due to the fact that emotion is subjective. However, this assumption might not be valid because unconscious emotion cannot be recognized through introspection (see review in Chapter 2). To identify unconscious emotion, it is necessary to measure the bodily changes as a complementary indicator, leading us back to the classic 'mind-body' dilemma. It is sug-

gested to have multiple perspectives rather than only one dualistic view in order to have a more comprehensive view toward the unknown phenomenon.

Therefore, we formulate two general research questions in Part II:

Research question 2. *Does archetypal media content induce unique emotional responses?*

Research question 3. *If the answer to research question 2 is positive, could archetypal media content induce unconscious emotion?*

In Chapter 4, we start our exploration from the media type of pictures and sounds. This preliminary study adopts only one class of archetypal content: the archetype of *Self*. The goal of this study is to investigate if the archetypal content of Self can induce emotion that is significantly different from utilitarian emotions such as anger and joy. Self-reports and physiological measures of ANS are both adopted in this study. The results show that the obtained physiological pattern while subjects perceive archetypal pictures and sounds is significantly different from the pattern obtained while viewing other affective stimuli. These results seem promising but not robust enough for answering the above research questions. Therefore, we proceed to the next study with more archetypal categories and a more complex media type.

In Chapter 5, we turn to use a more complex media type—movie. This is due to the fact that movie is an audio-visual, highly-immersive, rich-in-meaning media content. We target at modern commercial movies as the resource for developing archetypal media content. By using the method we developed in Chapter 3, eight five-minute movie clips of different archetypes were developed. A study was conducted to test if these eight movie clips could induce unique emotional responses. For comparison, five movie clips of basic emotions were also included in this study. Continued with the exploration in Chapter 5, in Chapter 6 our goal is to further confirm the results and build a predictive model that can be used for making predictions in practice. In order to enhance the statistical power for training models for machine learning, we developed *three* one-minute movie clips for each category of seven archetypes and five basic emotions, including 36 movie clips in total. In Part II of this thesis, these three studies progressively explored the feasibility of mapping archetypal media content with emotional responses, providing evidence for answering the second and the third research questions. The resulting physiological data are fed to machine learning algorithms to generate predictive models that can be used for developing emotion-related applications.

1.3.4 *Emotion and Design*

The meaning-making process has always been of great interest to the design community. Design is a process of meaning making (Kazmierczak, 2003). While most designers rely on their own experience for their work, symbolic meaning analyses based on psychological theories may provide a different perspective on the emotional aspect of the media content. In particular, theory of archetype has been widely used for analyzing narratives and movies. It has provided a solid explanation toward the characters as well as the structure of the stories. In the Part II of this thesis, we applied affective computing methodologies to explore the relationship between archetypal media content and the emotional responses of the audience. A more challenging task is to apply these results into the design process.

Mainstream design research usually considers emotion as a metric system. The term "emotional design" was coined by Donald Norman (2005), who considers emotion as a standard quality of design work in order to judge whether it is good or bad. The funda-

mental view of this strand is to quantify emotional qualities in certain categories of design in order to generalize design factors that can be used for breed new concepts, such as Kansei Engineering (Nagamachi, 1995) and other recent studies (Desmet et al., 2004; Desmet & Hekkert, 2007; Laurans et al., 2009; Demir et al., 2009). However, this view solely addresses on the connection between the perceptual qualities and emotional responses and ignore how meaning may emerge in between. Moreover, this approach is suitable for static design works, i.e. physical products, but seems inappropriate for dynamic design content, such as digital media. Instead of sensing and transmitting, an alternative view toward emotional design is provided: emotion, as an interaction, should be a means of understanding, interpreting, and experiencing (Boehner et al., 2005; 2007). The central idea of this approach is to reconnect emotion with the meaning emerging in the design content, and acknowledge the fact that emotions are dynamic. This approach appears to be more flexible and versatile, and it stimulates new possibilities for research on emotion in media, human-computer interaction, and digital art.

In Chapter 7, we intend to explore new paradigms in emotional design by employing emotion as a communication channel. To achieve this goal, we need to take into account how emotion measurement and emotion representation can be implemented in design practice. Thus, we formulate the following research question:

Research question 4. *How to measure and represent emotional experiences in media content in order to facilitate the design process?*

A basic and useful technique called 'mood board making' has been used for communicating design content particularly on emotional qualities (Lucero, 2012). From a psychological viewpoint, mood boards can be considered as a kind of affective stimuli that are designed to induce certain emotional qualities in both designers and clients. Hence, the making of mood boards is a kind of measure toward one's emotional experience through creating visual representation. In this regard, the usage of mood board in design practice is similar to the paradigm of experimental studies on emotion. While the traditional way of making mood boards relies on self-reports, we propose to utilize physiological measures for recognizing emotions in making mood boards. First, we conduct two studies to validate if people share a common tendency to interpret mood boards. The results suggest that the inter-rater reliability is remarkably high, meaning that mood boards can be a universal tool for representing emotional qualities. Next, by using the predictive model we obtained in Chapter 6, we develop an application called ArcheBoard, which can be used for measuring and representing continuous emotional experience in media content.

In Chapter 8, we propose a new concept of digital media system—archetypal media. For traditional media, the creator of the content holds a dominant position whereas the audience stays passive, viewing the media content presented to them. Moreover, the narrative of the media content is usually presented in a chronological manner. To enhance the interactivity and invite the audience to participate in the co-creation process, many new concepts are proposed to bridge the viewer's reaction and the media content. One of the pioneering concepts is *enactive media* (Tikka, 2010), which employs the viewer's physiological activities as part of the narrative logic in order to reshuffle the order of scenes based on the viewer's real-time emotional state. On the basis of the concept of enactive media, we propose a new conceptual framework - *archetypal media.* The vision of archetypal media is to enable the audience to explore their unconscious mind through interacting with the archetypes in the media content

Next, we present a general discussion of our findings in Chapter 9. Provided with the research questions and the studies we have conducted, we formulate our answers to the research questions and conclude our contributions to research and design emotions in archetypal media content. We further elaborate the implications of our findings for both psychology and design, and propose future work in this research direction.

1.4 CONTRIBUTION

Along with the structure of the thesis, the contribution can be divided into three parts. The first part is about theoretical framework. We started from reviewing existing theories, models and measurements of emotions in psychology and provided an epistemic framework that took into account unconscious emotions. On the basis of this framework, we proceeded to formulate a triangulation approach and thus developed a standard procedure for analyzing media content using archetypal symbolism and editing movie clips that can be used in empirical studies.

The second part of the thesis is about the exploration we went through via conducting three empirical studies. We followed the triangulation approach in order to overcome the mind-body dilemma, and used the methodology we developed for analyzing archetypal media content in these studies. The results of our studies suggested that emotions induced by archetypal media content might be unconscious. Although this phenomenon is still open to debate, a computational model of emotions on archetypal media content obtained from the physiological signals was generated and this model can be implemented in real-life applications.

Finally, the last part of the thesis focuses on possible applications specifically for emotional design and digital media. For emotional design, we conducted two studies to investigate the validity of using mood boards as a research tool for studying emotions. In order to support designers in making mood boards, we implemented the computational model into an application that generates mood boards on the basis of physiological signals collected from the target user. As for digital media, we proposed a new concept of emotion-driven media system that provides archetypal media content according to the viewer's real-time physiological reactions. This new type of media system shifted the authorship of the viewer to the first author, who fully controls the storyline at an unconscious level.

In short, the main contribution of this thesis is to investigate the emotions in archetypal media content and further explore the possibility of employing the power of human unconscious in improving design processes and stimulating the development of digital media.

2 LITERATURE REVIEW

2.1 INTRODUCTION

Emotion has been an intriguing and mysterious psychological phenomenon. While everyone seems to know what it is, researchers have not yet reached a consensus on its definition, and many questions remain unanswered, including whether emotions can be unconscious. To most people the answer seems obvious. In everyday language the terms 'emotion' and 'feeling' are usually used interchangeably; if we equate emotion with feeling, how could people be unaware of their emotion when they are actually feeling that emotion? However, researchers' opinions on unconscious emotion depend on their theoretical framework. According to some accounts emotion cannot by definition, be unconscious (Ben-Ze'ev, 2000; Clore, 1994; Gunther, 2004; Izard, 2009), while other accounts hold that emotions and other psychological phenomena can be unconscious (Bargh & Morsella, 2008; Dijksterhuis & Nordgren, 2006; Kihlstrom, 2008; LeDoux, 2012; Wilson, 2003). For further justification of unconscious emotion, scientists have sought experimental evidence to support their belief that emotion may be unconscious, at least under certain conditions (Bornemann et al., 2012; Kimura et al., 2004; Öhman et al., 2000b; Winkielman & Berridge, 2004; Zemack-Rugar et al., 2007). The results were promising, but not all scientists were satisfied with the way in which the data were interpreted (Gunther, 2004; Maia & McClelland, 2005) and some of the researchers who carried out these empirical investigations have admitted that further confirmatory evidence is needed (e.g. Winkielman & Berridge, 2004; Scherer, 2005b; Zemack-Rugar et al., 2007; Bornemann et al., 2012). Today, the issue of unconscious emotion is still open to debate; it is difficult to judge whether the phenomenon exists or is just an anecdote. Notwithstanding the uncertainty surrounding them, the early findings have encouraged researchers to reassess existing conceptual and operational definitions of emotion and look for ways to accommodate the new evidence within their theoretical framework. Rather than arguing for or against unconscious emotion, we have taken a neutral position and reviewed current theoretical and practical perspectives in emotion research in order to provide an overview of theoretical approaches to conscious and unconscious emotions.

Research on emotion has a long history and has been conducted in various fields of study, ranging from philosophy, psychology, biology, cognitive science, sociology to computing and engineering. A large number of theories and models of emotion have been proposed in order to provide a better explanation to this phenomenon. However, to exhaustively look into each of the existing theories and model of emotion would be too ambitious and go beyond the scope of this thesis. This review is intended to explain how unconscious emotion can be defined in various perspectives and stimulate more discussions not only for psychologists but also for researchers in other relevant areas, such as affective computing

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This chapter is (partly) based on:

Chang, H.-M., Ivonin, L., Diaz, M., Catala, A., Chen, W., & Rauterberg, M. (n.d.). Theory and practice: Making sense of unconscious emotions. Personality and Social Psychology Review. Under review.

(Picard, 2003). Researchers may thus relate their epistemological stance and theoretical approach to the overview when planning future research.

2.1.1 *Theories, Models, and Measurement*

If we position all emotion-related literature on a continuum between theory and practice, the main body of emotion research can be organized into three building blocks: *theories*, *models*, and *measurement*. In most cases, researchers confuse theories with models and refer to both of them as theories, but they take entirely different epistemological positions. Theories of emotion elaborate the ontology and functionality of emotions, and a good conceptual definition is an essential component of the theory (e.g. Arnold, 1960; Barrett, 2006a; Damasio, 2000; Ekman, 1992; Gunther, 2004). On the other hand, models of emotion are built to demonstrate the taxonomy of emotion by conceptualizing all kinds of emotions in a meaningful way, for example the discrete emotion model (Ekman & Cordaro, 2011) and the dimensional model (Russell, 1980). These models of emotion decompose emotions into meaningful and manipulable parameters, so that they can be used for practical purposes, such as affective computing (Picard, 2003). While models of emotion are widely known outside the psychological community, the importance of emotion theories is often overlooked. It should be remembered that conceptual and operational definitions are complementary and both have advantages and disadvantages.

In order to provide evidence relevant to hypotheses derived from specific theories and models, various measures of emotion have been developed. Operationalizing the concept of emotion in this way has allowed researchers to move beyond biology and philosophy and assert the credibility of psychology as a science. However, the measurement of emotion is challenging because it is difficult to ensure that 'the measure does index the emotion it is assumed to be related to'. The validity of measurement is often a concern in psychology (Westen & Rosenthal, 2003). Biased measurement methods significantly influence the results of experiments(Podsakoff et al., 2003) and the interpretation of data can vary depending on the theoretical approach adopted.

There have been good reviews of emotion theories from the psychological community (e.g. Cornelius, 2000; Gendron & Barrett, 2009) while different models of emotion have been compared in applied science (e.g. Eerola & Vuoskoski, 2010; Fujimura et al., 2012; Grandjean et al., 2008; Hamann, 2012; Scherer, 2000). However, an overall review which considers both theories and models seems to be missing from the literature. In fact, some theories and models belong to the same family, for example the basic emotion theory and the discrete emotion model developed by Ekman and his colleagues (Ekman et al., 1980; Ekman, 1992), or the conceptual act model of emotion and the circumplex model developed by Russell (1980) and Barrett (2011). Other theoretical approaches do not fully cover both theories and models to put forward a more complete argument. This is probably because current theorists have not reached a consensus on the conceptual definition of emotion and the debate about what constitutes an emotion is ongoing (Lindquist et al., 2013; Barrett, 2006b).

When considering a new hypothesis such as the existence of unconscious emotion, researchers need to pay attention to the epistemic tradition within which theory, model and measures are applied in order to decide whether the evidence is sufficient to support or reject the hypothesis. It is risky to solely rely on one of the three building blocks, but requires at least two of them to fulfill the construct validity of research (Moran-Ellis, 2006).

Current empirical evidence for the existence of unconscious emotion is derived from research based on different assumptions and is insufficient to answer all the objections that have been raised (Dunn et al., 2006; Maia & McClelland, 2005). In order to understand clearly how the empirical data should be interpreted in terms of the various current theoretical perspectives, it is necessary to review carefully the various theoretical arguments put forward by proponents of the concept of unconscious emotion.

2.1.2 *A Unified Structure*

To help us review the various theories of emotion, we developed a unified descriptive structure to represent the process of emotion activation (see Figure 2.1). The basic process by which an emotion emerges can be broken down into three stages: elicitation, emotional state, and reaction (Rottenberg et al., 2007). Usually the term 'emotion' refers only to the second stage, which is the emotional state of the individual at any given moment. However, the cause of the emotion (i.e. elicitation) and how this emotion influences the individual (i.e. the individual's reaction to the emotion) are equally important; if these components of emotion are neglected, the discussion becomes purely philosophical and ceases to be grounded in empirical data. The elicitation of emotion can take almost any form; any information that comes from the external world may elicit an emotion. The concept is not restricted to specific objects or events that experimental psychologists usually refer to as stimuli, but may include social or cultural contexts. Similarly, when we refer to the reaction to an emotion, the concept covers not only observable physical activities (e.g. behaviors, facial expressions, and physiological responses) but also mental activities (e.g. thoughts, preferences, attitudes, and decision making). This three-stage structuring of emotion as a process has been used to ensure the consistency and clarity of the rest of the review.

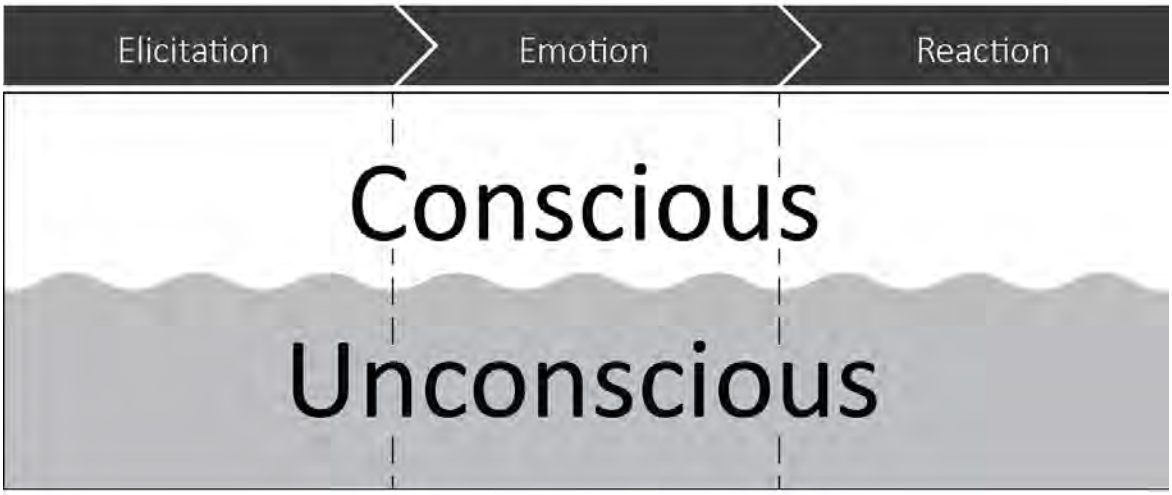

Figure 2.1: A unified structure of theory for review.

To integrate unconscious emotion into this structure, a line must be drawn at each stage to indicate the border of the conscious; the area beneath this border then represents the unconscious. How do we define the border between the conscious and the unconscious? This leads to a more complex question: what does 'unconscious' mean? Cognitive psychologists usually equate the 'unconscious' with subliminal information processing By this definition,

unconscious processing deals only with low-intensity, unsophisticated mental activities below the threshold of perception, such as subliminal perception. Social psychologists use a broader definition of the unconscious mind. They consider the unconscious to be those mental processes which the individual cannot access through introspection (Nisbett & Wilson, 1977; Wilson, 2003). This view is to some extent in line with the psychoanalytical tradition, as psychoanalysis was the field of study which pioneered the concept of a powerful unconscious. Researchers in the psychoanalytic tradition claim that the content of the unconscious cannot be directly accessed but may be represented symbolically and indirectly through associations (Ekstrom, 2004; Grossman, 1967). We will consider availability for introspection or self-observation as the defining criterion of conscious emotional process.

The way in which this criterion defines the border between the conscious and unconscious at each stage is as follows: at the first stage, emotion elicitation, the border is defined in terms of the degree to which the individual is able introspectively to recognize stimulus information. At the second stage, the momentary emotional state, differentiation between the conscious and the unconscious depends on whether the individual can recognize introspectively the emotion that is being experienced. At the third stage, emotional reaction, the border is defined by the degree to which the individual is aware introspectively of the changes in his or her own behavior, thought or bodily sensations. It should be noted that these three stages can be either conscious or unconscious respectively to constitute the whole process, i.e. a conscious activity at one stage may be related to unconscious activity at another stage and vice versa. For example, a stimulus which is not consciously recognized might elicit a conscious emotion; similarly an unconscious emotion may produce a conscious reaction. In the remaining sections of this review, the mental content at each stage will be specified in terms of this structure according to the assumptions of the theory under discussion.

2.2 THEORIES OF EMOTION

Previous review articles have usually categorized theories of emotion by theorists' names, taking into account their historical context (e.g. Cornelius, 2000; Gendron & Barrett, 2009). Rather than emphasizing historical context, we have chosen to emphasize how emotions emerge and are made available for introspection. Many theories of emotion suggest that an emotion emerges when an individual makes sense of something as being in some way related to or caused by the situation (Gendron & Barrett, 2009). Rather than thinking of emotion as a state, it has been suggested that emotion should be considered as a process of conceptualizing the world (Parkinson, 2009; Mesquita, 2010; Barrett, 2012). While the human mind has a variety of cognitive functions such perception, learning, and memory, there are higher mental mechanism operating beyond cognition, such as emotion (Kihlstrom, 2008; Rauterberg, 2010). Interest in cognitive functions is mainly driven by a curiosity about information processing in human minds, i.e. how humans understand, reason, and learn under given conditions. Most psychologists agree that the activation of emotion is effortless and automatic, not controlled (Barrett, 2012; Kihlstrom, 2008; Bargh, 1994; Zajonc, 1980); the key question is, what is the source of emotion activation? Opinions on this are different, which allows us to categorize contemporary theories of emotion into four different perspectives: evolution-based, body-based, situation-based, and mind-based.

2.2.1 *Evolution-Based Theories*

The functional-evolutionary perspective on emotion was first advocated by Darwin (1872). He defined emotion in a teleological fashion by stating that emotions are evolved phenomena with important survival functions that have been selected for because they have solved certain problems that humans have faced as a species (Cornelius, 2000). As results of natural selection, to some degree all humans should share a common pattern of emotional expression and the innate capability to interpret each other's emotions, especially through facial expression (Öhman, 1986). Öhman's theory was a source of inspiration for the basic emotion approach and continues to be influential. Although not all basic theorists adhere closely to Darwin's theories, they hold a biological view and assert that emotions are *natural kinds* (Barrett, 2006a). Tomkins (1962; 1963) is typically cited as the modern inspiration for the 'basic emotion' approach. The basic emotion theory relies on the assumption that emotions are universally manifested by humans, selected for over the course of evolution and biologically primitive; the fundamental elements of emotional life are thus conceived as an ancestral heritage (Ortony & Turner, 1990). The modern evolutionary perspective assumes that basic emotions are dedicated neural programs or circuits that are hardwired into the brain (Lang, 2010); this implies that all emotional reactions are survival-related, pre-programmed physiological reactions and physical behaviors.

If we fit this theoretical view to our unified structure, the sources of emotion activation appear to be utilitarian functions with survival value (see Figure 2.2). The brain circuits are responsible for making sense of the external situation and generate emotions accordingly to drive survival mechanisms. For example, external threats trigger the relevant brain circuits and thus generate the emotions of fear or anger, which in turn produces an impulse to flee or fight. The direct causation of behavior is the primary function of emotion. Since emotions are defined as natural kinds and the brain circuits are hardwired, emotion activation itself is more like an 'instinct' as the old model of basic emotion proposed (McDougall, 1923). Such instincts could be accurately defined as fixed action tendencies corresponding to utilitarian functions, meaning that most emotional reactions are observable as spontaneous, homologous facial expressions and bodily reactions. Although the contemporary evolutionary perspective considers emotions to be related to social context, facial expressions were considered as a natural adaptation to the social environment (Allport, 1924) and social events were conceived as survival challenges from an evolutionary perspective (Öhman, 1986). In evolutionary emotion research, a common approach to emotion elicitation is the presentation of affective pictures, specifically images of facial expressions (Ekman et al., 1980; Ekman & Friesen, 1976), natural threats like snakes (Öhman, 1986; 2009), or others (Lang et al., 1993). As for measuring emotional reactions, the evolutionary perspective holds that all emotions can be manifested through facial expression and behaviors as it assumes that emotions are preprogrammed and universally recognized.

There have been some studies of unconscious emotion from an evolutionary theoretical perspective (Kihlstrom et al., 2000; Öhman et al., 2000b; Öhman & Soares, 1994; Scherer, 2005b; Winkielman & Berridge, 2004). From this perspective the activation of basic emotional systems is to some extent independent of conscious awareness of the current situation (LeDoux, 2012; Öhman et al., 2000b). In terms of our structure, since emotion activation is considered biologically coded and hardwired in the brain circuits, the border between conscious emotion and unconscious emotions can only be the threshold of perception: conscious emotions are emotions triggered by stimuli that are perceived con-

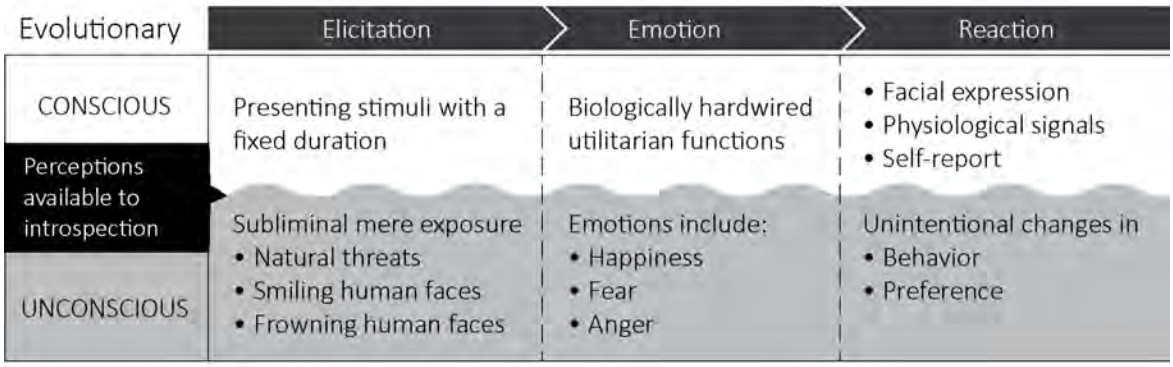

Figure 2.2: Evolution-based perspective.

sciously while unconscious emotions are emotions induced by stimuli that are exposed below *the threshold of perception*. This has led to considerable research into subliminal processing of affective stimuli. Researchers who take an evolutionary perspective argue that some mental activities can occur without being available for introspection, such as implicit perception and implicit cognition (Kihlstrom et al., 1992; Kihlstrom, 2009). This claim was substantially supported and implicit processing characterized by empirical studies on the *mere exposure effect* or *subliminally priming effect* (Bornemann et al., 2012; Codispoti et al., 2001; Greenwald et al., 1995; Monahan et al., 2000; Winkielman et al., 2005; Zajonc, 2001; Zemack-Rugar et al., 2007). Emotional reactions related to subliminal priming are not measured directly from facial expression or physical behaviors as in studies on conscious emotions; rather they are assessed from indirect measures such as changes in preferences and changes in behavior when performing a specific task which is held to be significantly related to affect (Winkielman et al., 2005; 1997; Zajonc, 1980).

2.2.2 *Body-Based Theories*

The body-based perspective was first put forward by William James, who argued that "the bodily changes follow directly the perception of the exciting fact, and that our feeling of the same changes as they occur is the emotion" (James, 1884, pp. 189-190). Contrary to earlier psychologists who believed that emotions were mental events that caused physical changes in the body, James asserted that emotion emerges immediately after one perceives an internal physical sensation that is triggered automatically and adaptively by the external environment. This counterintuitive proposition led to a new approach to research on emotion but also generated considerable theoretical debate. James's arguments overlap to some extent with Darwin's theories about the automaticity of emotion, and broadly speaking it inspired the investigation of emotion-specific autonomic nervous system activity (Cornelius, 2000). This is probably why James has often mistakenly been considered as a basic emotion theorist and why the other part of his theory has been largely ignored (Gendron & Barrett, 2009, p. 324). The key distinction between James's theory and the evolution-based perspective is that for James, the human mind formed sensual experiences from internal body sensations rather than mind-free information processing in the brain circuits. His theory has been criticized specifically for the temporal ordering of emotion and bodily sensations. While James insisted that emotions emerged *after* the physical sensations, some physiological studies have provided contradictory evidence (e.g. Cannon,

1927; Schachter & Singer, 1962). Nevertheless, James's theory addressed the importance of bodily sensation to the formation of emotional experience. Despite the debate about the temporal relationship between the physical sensation and the emotional experience, it is still valid to assume that emotion emerges through making the internal physical sensation meaningful, and this is an important aspect of both conscious and unconscious emotion.

The theories of psychological constructionists can be considered as a body-based perspective. They consider emotion to be an act of sense-making directed by the internal sensory or affective state (Gendron & Barrett, 2009, p. 318). In contrast to the basic emotion theorists, psychological constructionists claim that emotions are not biologically given, but are constructed through the process of making sense of physical changes arise in the body (Barrett, 2006b). The basis of the sense-making process is also not a hard-wired instinct; rather it is socially shared conceptual knowledge (Barrett, 2012; Barsalou et al., 2003; Niedenthal et al., 2005). The psychological constructionist view considers that emotions are socially related but cannot be reduced to mere social situations, as it holds that the presence of an individual mind is necessary to the sense-making process. Sense-making is the core concept of psychological constructionist approach to emotion, as Barrett states: "Human brains categorize continuously, effortlessly, and relentlessly... Via the process of categorization, the brain transforms only *some sensory stimulation* into information... To categorize something is to render it meaningful" (Barrett, 2009).

Damasio (1994; 1996) proposed a similar hypothesis, namely that conscious emotions are actually feelings – emotions can be consciously *felt* through perception of the bodily sensation. Similarly to the basic emotion theory, he defined emotions as biological life-regulation phenomena that are reflections of cognitive actions in our bodies toward a given situation. According to Damasio, what we perceive as emotional *feelings* are composite perceptions of these biological phenomena; in other words, feelings are images of emotions, rather than emotions themselves. Feelings and emotions are therefore not always identical, and not all emotions can be perceived as feelings. This hypothesis has been supported by some empirical evidence on the significant changes in physiological data which occur when an individual is performing certain decision-making tasks. Changes in an individual's physiological signals – *somatic markers* is Damasio's term – indicate when a risky choice is being made although the individual is unaware of them (Bechara et al., 1994; 1997; 2005; Damasio, 1996). Although these experimental results are still the subject of debate (Maia & McClelland, 2005; Dunn et al., 2006), we suggest that Damasio has put forward a promising theoretical perspective that is complementary to the psychological constructionist view of emotion in that the bodily sensation is the target of the sense-making process. If it is assumed that the emergence of emotion is an automatic process rather than a controlled one (Barrett et al., 2007b), it follows that it is difficult for one individual to manipulate his or her own emotions toward the same thing because the interpretation toward this thing has automatically generated and preoccupied the individual Barrett (2012).

Based on the above theories, being able to make sense of physical sensations in introspection appears to be the primary difference between conscious and unconscious emotions. As the psychological constructionists suggest, the sense-making process relies on a connection to the situation in which the emotion emerges. In other words, when a mismatch or loss of connection occurs during the sense-making process, the emotion is unavailable for introspection and thus becomes unconscious. Studies of emotion elicitation from the body-based perspective usually use stimuli with rich contextual information or simulated scenarios, such as contextual images (Barrett & Kensinger, 2010), contextual emotion words

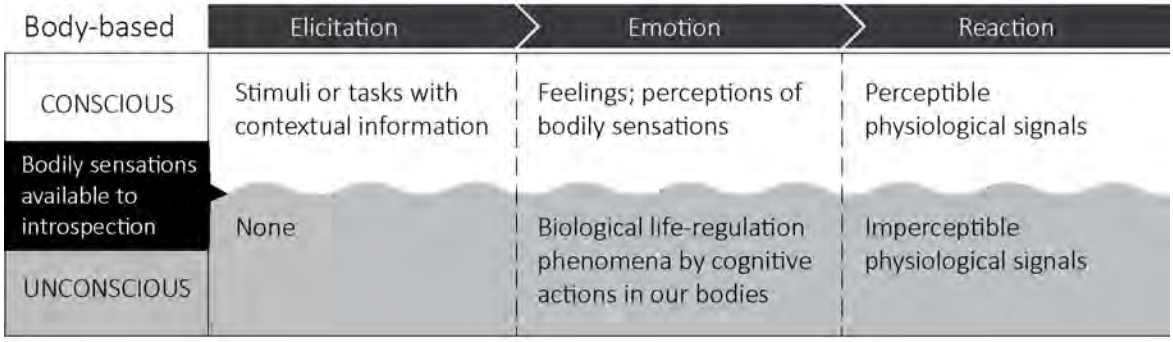

Figure 2.3: Body-based perspective.

(Gendron et al., 2012; Lieberman et al., 2007), and simulated games (Bechara et al., 1997; 2005), but there have been no investigations using stimuli that are unavailable for introspection (see Figure 2.3). To track the emotional reaction, measures of physiological signals and brain states are frequently used, because physiological responses are at the heart of the body-based perspective. Some of the physiological changes in the autonomic nervous system (ANS) are available for attentive introspection, such as heart rate and respiration rate, but other changes such as changes in brain states cannot be detected without biometric equipment.

2.2.3 *Situation-Based Theories*

The situation-based perspective was developed by Irons (1897a;b). He argued that meaning analysis is an essential psychological process that intervenes between the external environment and the resulting emotion. Irons further emphasized that emotion is *intentional* – the emergent emotion is always directed at, and references an object in the world. Because this sense-making process is subjective, the same object can induce different emotions in different individuals. Irons's theory seems to have been an important inspiration for the cognitive theories of emotion which emerged a few decades later. The contemporary situation-based perspective is embodied in the *appraisal theory* proposed by Arnold (1960). Arnold used the term 'appraisal' to describe an essential cognitive mechanism: a given situation is evaluated, and the results of this evaluation then cause emotion. Frijda (1988) described appraisals as assessments of situational meaning: "Input some event with its particular meaning; out comes an emotion of a particular kind" (p. 349). Appraisal theory has often been criticized for over-intellectualizing emotions and some researchers have argued that emotion does not necessarily require deliberative thoughts (e.g. Zajonc, 1980). In fact, this concern has been addressed by appraisal theorists but often been ignored. Although appraisals are necessarily intentional, their meaning analyses are automatic cognitive mechanisms specifically dedicated to emotion and they need not be available to awareness (Arnold, 1960; Frijda, 1987; Lazarus, 1994). Furthermore, Arnold (1960) defined appraisals as 'sense judgments'; in the context of this thesis, appraisals are automatic sense-making processes directed at the given situation.

Social constructionists also take a situation-based perspective but one that differs from that of the cognitive theories of emotion. Rather than looking inwards, towards the human body or human mind, social constructionists treat emotions as cultural products whose

meaning is based on learned social rules (Averill, 1980). Social constructionists emphasize the social functions of emotion and how social contexts cause one's emotional state. For them, cultures provide the content of the appraisals that form the basis of emotions, which are constructed within a culture to serve specific social purposes (Scherer, 1997). Unlike the psychological constructionists who hold that emotions are socially related but not socially specific, social constructionists hold that culture plays a central role in the organization of emotions; they consider that emotions can be reduced to the social situation in which they occur (Gendron & Barrett, 2009). Rather than considering emotion as an entity, social constructionists believe that emotion is a dynamic process that emerges while an individual is interacting with others within a given social context (Mesquita, 2010). They believe that emotions have a social function and that to understand emotions, one has to consider what a specific emotion accomplishes socially (Averill, 1980). This is the fundamental distinction between the two constructionist views: for social constructionists the target of the sense-making process is the external social situation; whereas psychological constructionists regard bodily sensations as the target of the sense-making process.

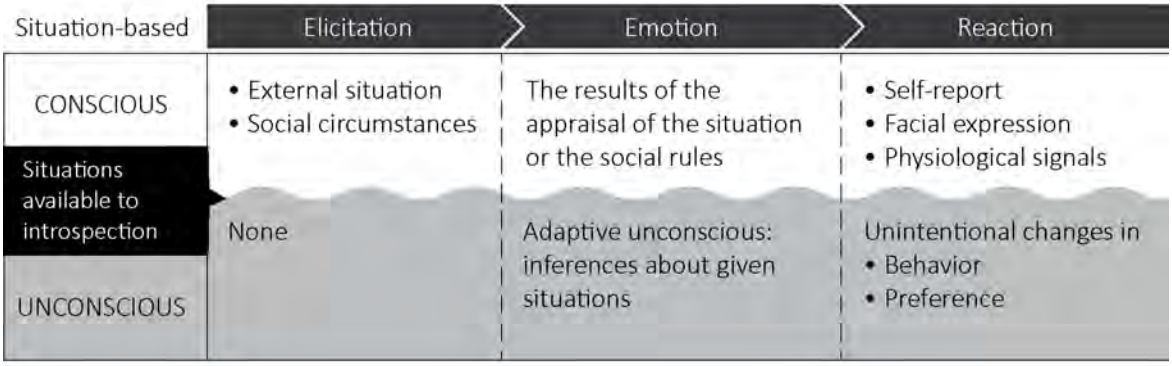

Figure 2.4: Situation-based perspective.

Taking a similar approach to appraisal theory, some social psychologists argued that emotion may also be inaccessible to the conscious. The concept of the *adaptive unconscious* (Wilson & Bar-Anan, 2008; Wilson, 2003; Wilson & Dunn, 2004) was put forward. These authors regarded the sense-making process as an inferential or self-attribution process by which an individual makes sense of a given situation in terms of his or her bodily sensations. Making inferences about the world is not always rational and intellectual; it may be intuitive, effortless, and adaptive (Gigerenzer, 2007). This inferential process can take place either consciously or unconsciously and cause conscious or unconscious emotion accordingly. Surprisingly, some empirical results have revealed that there can be differences between conscious and unconscious emotions related to a given situation (Schachter & Singer, 1962; Schachter & Wheeler, 1962). "The conscious system is quite sensitive to personal and cultural prescriptions about how one is supposed to feel... People might assume that their feelings conform to these prescriptions and fail to notice instances in which they do not" (Wilson & Dunn, 2004, p. 129). Although physical sensations are an important reference for the sense-making process, the target of it appears to be the situation which the individual finds him- or herself.

According to the situation-based theories discussed above, the distinction between conscious and unconscious emotions is based on whether an individual is able consciously to identify the connection between his or her emotion and the given situation (see Figure 2.4).

In terms of the unified structure in this review, the emotion elicitation process relies on the external situation, more specifically a social circumstance. As for the emotional reaction, like the evolutionary-based research on emotions, research in the situation-based tradition usually utilizes self-reports of preferences or decision-making tasks to capture conscious emotional responses, while physical behaviors are used as an index of unconscious emotion. This is probably because researchers with a situation-based perspective tend to use connections with the external world as the criterion for distinguishing conscious and unconscious emotion.

2.2.4 *Mind-Based Theories*

Social psychologists place focus on groups and tend to look externally, to the situation for explanation, whereas the psychoanalytic tradition focuses on individuals and uses internal data to explain inward subjective experience The psychoanalytic tradition stands in opposition to mainstream psychological research; rather than trying to deconstruct emotions, it tends to approach human mind as a whole. In psychoanalytic theories, the unconscious mind is the primary source of psychological content, which is deeper than the conscious mind. Rather than looking for connections to the body or the environment, psychoanalytic theories seek for psychological meanings within the deeper levels of the human mind. The importance of the unconscious was first advocated by Freud (1922); in Freud's original model the metaphor of the dark cave was applied to the human mind. He argued that the unconscious was a complex dynamic that suppressed primal desires and these desires can only be represented as anxiety. Since mental content (memories, thoughts, and emotions) in the unconscious was assumed to be inaccessible to conscious introspection, Freud likened psychoanalysis to an archeological dig in which the psychological content of the unconscious would be uncovered (Wilson & Dunn, 2004). Freud assumed that emotions were the outlets for instinctual drives, and that emotions emerged when the expression of these instinctual drives was blocked (Freud, 1922). Emotions can be felt at the surface of the conscious, however the cause of these emotions remains buried deep in the unconscious and unreachable for introspection.

The Freudian concept of the unconscious, although it is well-known outside psychological science, has not been supported by empirical studies; but it continues to provide inspiration for research in the psychoanalytic tradition. In addition to Freud's concept of the individual unconscious, Jung (1959) proposed an unconscious specifically focused on the psychological content that was common to all human minds. Jung's interpretation of observational data from his patients was that there is a universal pattern to the psychological content of the mind that can only be expressed through symbolic content. Jung argued further that the universal pattern in the unconscious mind contained some contents and modes of behavior that are identical in all human beings, and thus constituted the common psychological substrate of a universal nature which is present in every individual. All human beings, sharing essentially the same biological equipment (e.g. the brain and the central nervous system), would show a tendency to perceive common meanings embodied in symbolic content at an unconscious level (Bradshaw & Storm, 2013). Although psychoanalysis has often been criticized for the unfalsifiability of its hypotheses because it relies largely on the interpretation of the symbolic meaning of individual data (Jones, 2003; Walters, 1994), there has recently been new interest in psychoanalytic theories in

neuroscience; surprisingly, new evidence has been found in neuroscience to support some psychoanalytic hypotheses (Carhart-Harris & Friston, 2010; Shevrin et al., 2013).

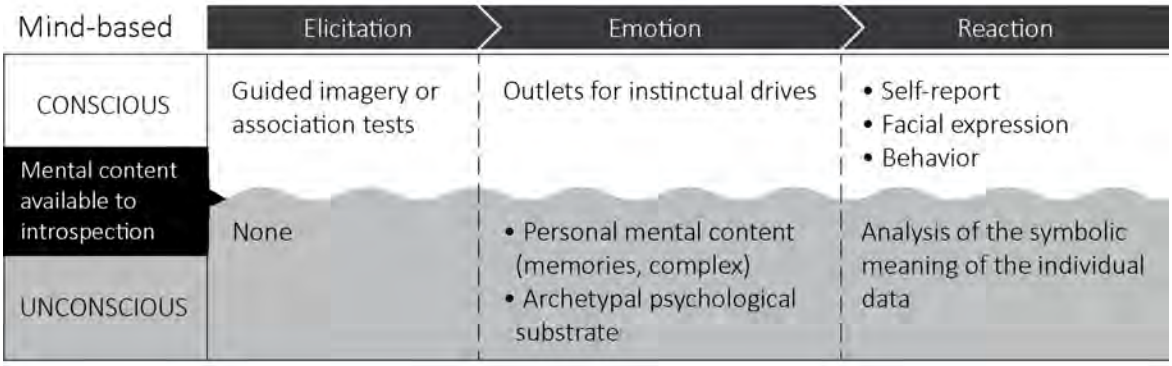

Figure 2.5: Mind-based perspective.

Since the psychological content of the unconscious mind cannot be directly accessed or described, the psychoanalytic tradition usually utilizes meaning analysis of its symbolic content expressed in different ways by individuals (e.g. association tests and guided imagery). Nevertheless, it is clear that the source of emotion activation is psychological content within the mind (see Figure 2.5). The key distinction between conscious and unconscious emotion is whether the individual can make sense of his or her psychological content (e.g. thoughts and memories) at a conscious level. Conscious emotions are directly available for introspection because their psychological content can be recognized by the individual, whereas unconscious emotion can only be expressed indirectly through symbolic content that seems irrelevant or irrational but is implicitly associated with previous life events.

Instead of eliciting specific emotions by providing specific situations or pre-selected stimuli, the psychoanalytic tradition applies a different approach, using techniques that allow subjects to relax and respond freely to the guiding cues or symbolic content in a task. This is probably because many psychoanalytic theories are developed in clinical and therapeutic practice. The psychoanalytic tradition uses the analysis of the symbolic meanings of the data provided by the subject to infer emotional reactions. These data usually are not directly informative about emotions but are a rich source of information that is interpreted by the facilitator on the basis of his or her experience. Measuring emotion in psychoanalytic research is challenging by its nature because the cause of certain emotions is related to personal life events and difficult to justify.

2.3 MODELS OF EMOTION

The above four perspectives represent four general metaphysical hypotheses about the nature of emotion. In this section we review models of emotion that are widely accepted and often used in other fields of study. Models of emotion are generalized from emotion theories to allow all kinds of emotional qualities to be classified and conceptualized in a more concrete way. We therefore consider models of emotion as direct representations, in that they have been developed as a kind of operational definition that can be applied directly for practical uses, for example emotion recognition for video game play.

2.3.1 *Discrete and Dimensional Model of Emotion*

Psychological models of emotion are mainly based on two views of emotion. The first view holds that emotions are discrete and fundamentally distinct constructs while the alternative view is that emotions can be represented dimensionally (Russell, 2009). Some researchers have combined these two perspectives to provide an integrated view (Hamann, 2012; Tellegen et al., 1999). It appears that these two models both have advantages and disadvantages in terms of context of use in research (Barrett, 1998; Eerola & Vuoskoski, 2010; Mauss & Robinson, 2009).

The discrete model of emotion proposes that there are a limited number of distinct types of emotion, each with characteristic properties (Barrett et al., 2007a). This model was originally inspired by one of the evolution-based perspective theories – the basic emotion theory (Ekman, 1992). In accordance with the assumption of this theory, the discrete representation of emotion encompasses a limited number of basic emotions (i.e. happiness, sadness, anger, fear and disgust) that are universal, biologically inherited, and unique, so that each class of discrete emotion has a distinctive physiological and neural profile. Other emotions are either conceptualized as blends of the basic emotions (e.g. contempt is a blend of anger and disgust) or given a different status (e.g. shame is a complex social emotion). The discrete emotion model is mainly characterized by its reliance on linguistic forms. Emotional words such as 'anger' are universally understandable references to the corresponding emotional qualities. This aspect of the model has drawn criticism from other researchers for the way in which it confuses the nature of emotion and global terms for labeling emotions (Barrett, 2006b). Other drawbacks of the basic emotion model are discussed in some review articles (Grandjean et al., 2008). They argue that this model does not make clear predictions on the eliciting conditions for discrete emotions (e.g. the behaviors associated with fear can range from freezing to vigilance to flight, instead of a one-on-one relationship), which has implications for its predictive validity; the defining criteria for basic and non-basic emotions are also unclear (e.g. Sabini & Silver, 2005).

Unlike the taxonomic approach of the discrete emotion model, the dimensional model of emotion is based on the idea that emotions can be described by several independent and meaningful dimensions (Osgood et al., 1975; Russell, 1979). The current version of dimensional model, known as the circumplex model (see Figure 2.6), makes two primary dimensions: 'unpleasant-pleasant' (valence) and 'activation-deactivation' (arousal) as the *core affect* (Russell, 2003). The exact nature of the dimensions and the existence of a circumplex distribution of central emotional states has been debated (Lang, 1984; Tellegen et al., 1999). Core affect is defined as "the most elementary consciously accessible affective feelings (and their neurophysiological counterparts) that need not be directed at anything" (Russell & Barrett, 1999, p. 806); different prototypical emotional episodes or distinct emotions induced by specific objects can therefore be represented by a combination of the two dimensions. Some researchers have proposed the inclusion of a third, less prominent dimension 'in control – dominated' (dominance) (Bradley & Lang, 2007b; Mehrabia, 1980) to distinguish emotions that are in almost the same position in two-dimensional affective space, e.g. anger and fear. There are a number of drawbacks to dimensional theories Grandjean et al. (2008), such as the absence of attempts to predict theoretically the determinants of differences between emotions and the lack of an explanatory mechanism which predicts response patterning. Moreover, not all researchers agree on the number and nature of dimensions needed in a framework for classifying emotion Fontaine et al. (e.g. 2007).

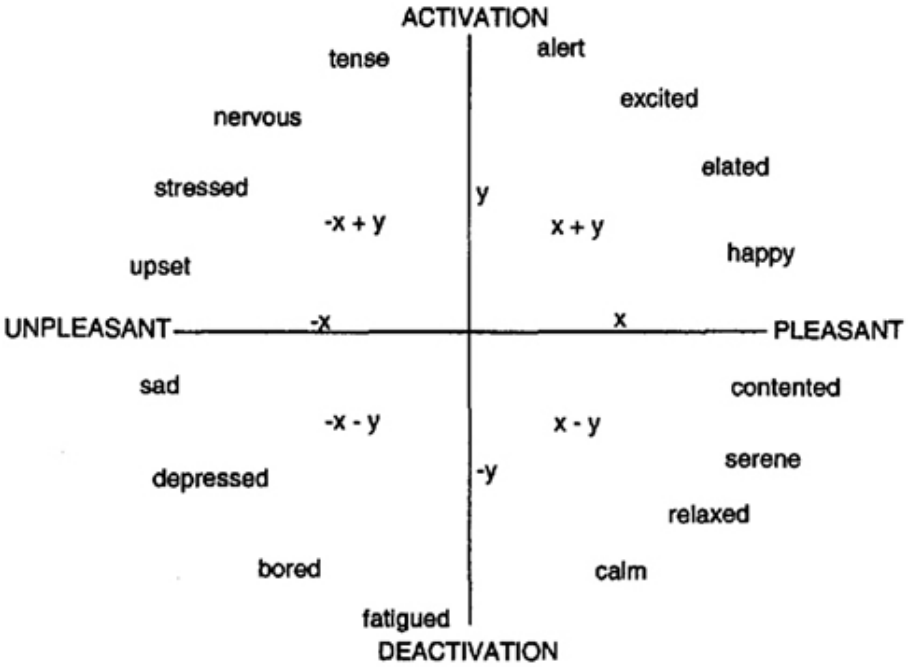

Figure 2.6: The dimensional modell of emotion. Taken from (Barrett & Russell, 1998, p. 970). Copyright 1998 by the American Psychological Association. 1984.

2.3.2 *Building Models with Physiological Signals*

Physiological signals are important indirect representations of emotion because they are tightly bound to emotional reactions (Chamberlain & Broderick, 2007). Observations of physiological activations in the autonomous nervous system enable researchers to identify and label corresponding psychological states (Cacioppo & Tassinary, 1990). Psychophysiological instruments have the advantage of being language-independent and can be used with individuals from different cultural backgrounds (Peter & Herbon, 2006) and individuals do not need to be interrupted with questions during measurement (Soleymani et al., 2012a). It has also been suggested that physiological observations could be used to identify unconscious emotional states that are inaccessible through introspective reports (Fairclough, 2009; Miller, 1992). Recent years have seen growing trends towards the application of machine learning techniques for training predictive models of classification based on data obtained from physiological signals. These predictive models can also be considered as a kind of representational model of the emotional responses induced by given classes of affective stimuli, i.e. emotion profiles (Mower et al., 2011). However, unlike the discrete model and the dimensional model, which both have meaningful classification rules, a predictive model is a 'black box' with parameters that it is difficult to relate to psychological concepts (Fairclough, 2009; Novak et al., 2012). The classification rate of the predictive model only reflects the homogeneity of the stimuli in each category and the physiological heterogeneity of the groups of responses. Although a considerable body of research has attempted to relate physiological signals to meaningful classification rules such as those used by the discrete and dimensional models, the results obtained of empirical studies still lack consistency and the variation in results is difficult to explain (Kreibig, 2010). What researchers may find more psychologically meaningful is the classification of the affective

stimuli that serve to elicit emotion in our structure. Many researchers training predictive models strive to achieve a higher recognition rate; developing a well-classified collection of affective stimuli is equally important but has often been overlooked.

The discrete and the dimensional models have probably gained widespread acceptance because they come close to the folk psychological understanding of emotion, the way in which individuals consciously recognize their own emotional states. However, these two models do not take into account the possibility that emotion may be unconscious. Even if we assume that unconscious emotions exist, it is unclear that one could simply add one more dimension termed 'conscious - unconscious' to the existing dimensional models as it has not yet been confirmed that unconscious emotions and conscious emotions are homologous (e.g. do unconscious joy and conscious joy have the same quality of joy?). Researchers can use physiological signals as the basis for an alternative model of emotion because the modeling algorithms do not have psychological meanings. The model derived from physiological signals can only be interpreted on the basis of the psychological meaning of the classification of the affective stimuli used for emotion elicitation.

2.4 MEASURES OF EMOTION

The most common method of measuring emotion in empirical studies is self-report techniques: subjects report their emotional states using introspection. In the case of conscious emotion, most researchers have considered introspective judgments about emotional feelings to be fundamentally valid or correct (e.g. Bradley & Lang, 2007b)because it is assumed that human beings are capable of conceptualizing their own emotions in a universally recognized way. Although it is recognized that there are some cultural differences, the expression and interpretation of emotions is considered to be universal at a certain level (Elfenbein & Ambady, 2003). Empirical studies have also indicated that self-reports of emotion are likely to be more reliable than other measures although they are limited in some conditions. For example, some people may be unaware of or incapable of reporting their emotional feelings (Mauss & Robinson, 2009). The Self-Assessment Manikin (Self-Assessment Manikin (SAM)) was based on the dimensional model; it was developed by mapping three meaningful dimensions – valence, arousal, and dominance – to Likert scales (Bradley & Lang, 1994). Although some researchers have raised concerns about the validity of self-reports of emotions (Haybron, 2007; Nisbett & Wilson, 1977; Schwarz, 1999), the SAM scale has been proved effective and is widely used in several research domains (Bradley & Lang, 2007a; Lang et al., 2008; Höök et al., 2011; Lottridge et al., 2011). PrEmo is another self-report instrument. It is a questionnaire based on the discrete emotion model and illustrates different emotional states with cartoon figures (Desmet et al., 2004). However, self-report techniques are less effective for capturing unconscious emotions because unconscious emotions are unavailable for introspection. To address this, cognitive science has seen an increase in the use of indirect indicators to assess a larger range of human emotions.

As we discussed the section of models of emotion, physiological measures are the most commonly used indirect measures of emotion due to the fact that certain physiological changes coincide with the appearance of specific emotions. Biosensors have proved a powerful tool and have allowed researchers to monitor almost exhaustively the physiological activities of human body in a convenient way. Physiological measurement offers several advantages: emotional experiences can be monitored continuously, physiological

signs are not language-dependent or memory-dependent, and the measurement process does not interfere with the emotional experience (Ravaja, 2004). Using physiological signals also allows researchers to utilize computational algorithms to build models of psychological events (Fairclough, 2009; Novak et al., 2012). A computational model obtained using this approach can be used directly for emotion recognition in practical applications (i.e. make predictions about emotion recognition). Advances in computational algorithms have enabled researchers to keep improving the quality of models based on the same data (Peng, 2011). Although psychophysiological measurements seem to offer several advantages, some limitations should be noted. Firstly, physiological measurements relate to a broad range of cognitive and affective activities as well as emotional reactions. The extraction of useful information from physiological data is not as intuitive as direct representational methods. Most psychophysiological approaches use supervised classification methods based on introspective judgments about emotional states. In dealing with unconscious emotions, i.e. emotions which are unavailable for introspection, researchers have to consider the risk of falling into epistemological traps when interpreting physiological data (i.e. does the measure index the emotion it is assumed to be related to?). The same data can be interpreted in different ways. For example, the debate relating to interpretation of data from the Iowa Gambling Task and their implications for the somatic marker hypothesis is ongoing; further empirical evidence is needed (see Bechara et al., 1997; Maia & McClelland, 2004; 2005). Secondly, previous studies have demonstrated recognition accuracy for various sets of emotions ranging from 30 to 90 percent across different experimental settings (Novak et al., 2012). It appears that physiological responses are influenced not only by psychological and affective stimuli, but by diverse factors such as physical activity, ambient temperature and individual physiological differences.

Social psychologists are more interested in changes in behavior, attitude, preference, and decision-making (Berridge & Winkielman, 2003; Gigerenzer, 2007; Wilson, 2003; Winkielman & Berridge, 2004; Zajonc, 1980) than physiological measurements. The social psychological approach has a long history and is widely used in several research domains, it is particularly important in behavioral science. The advantage of this approach is that changes in social psychological measure are intrinsically meaningful, unlike physiological changes. Results are usually self-explanatory and can be interpreted intuitively. The key to this approach is experimental design and inference. Because the social psychological approach focuses specifically on changes, the experimental design must consider the baseline from which changes are to be measured. It is difficult to define a baseline because this leads to a debate on the nature of emotion (e.g. discrete vs. dimensional). Furthermore, because there is not a simple one-to-one causal mapping between behavior and emotion, it is hard to infer the exact emotional cause of a specific behavioral change (e.g. fear and anger both may cause the behavior of fighting). The context and the motivation for the experimental task are also critical factors as they may affect how subjects understand and perform the tasks. This means that data obtained using this approach is usually only valid in the given context and interpretations cannot be generalized (e.g. the 'misattribution of arousal' experiment in Dutton & Aron, 1974).

To obtain data on emotional experiences, the psychoanalytic tradition focuses on the symbolic meaning of the content generated by clients in imagery tasks. Jung (1959) claimed that there is inborn psychological substrate embedded in every human's unconscious mind which cannot be directly accessed or described by the conscious. However, this substrate – which he called *archetypes* – can be manifested through symbolic content in various forms.

The concept of archetypes, although it is not accepted by all psychoanalysts, was the basis of the symbolic tradition in psychoanalysis. Within the symbolic tradition, many therapeutic techniques were developed to help clients express their emotional feelings indirectly by guided construction of imagery or association tasks using specific stimulus words, graphics or objects. For example, the *guided affective imagery* (GAI) technique uses a narrative script to guide the client, and a set of imagery targets such as meadows, trees, and houses as cues to enable clients to indirectly express their emotions (Leuner, 1969). The psychoanalytic approach differs from mainstream psychological approaches in that it takes a bottom-up approach. Rather than inducing and recognizing pre-defined emotions such as joy and sadness, psychoanalysts tend to pose a neutral scenario, and observe how people generate symbolic content related to it to express their emotions implicitly. This approach requires that the subject be deeply relaxed (e.g. hypnotized) to facilitate the emergence of unconscious emotions. While the subjective nature of this approach is often criticized by scientific positivists, there is some empirical evidence for the therapeutic efficacy of the psychoanalytical approach (Shedler, 2010).

2.5 AN INTEGRATED OVERVIEW OF UNCONSCIOUS EMOTION

Integrating the above four theoretical perspectives and various representations of emotion, we have provided a theoretical overview of emotion research (see Figure 2.7). In general, emotion research encompasses three complementary building blocks: theories, models and measures of emotion. This classification is similar to some views in cognitive science (Kosslyn & Koenig, 1995; Roesch et al., 2011). Although these three building blocks share some common ground, they reflect differences in scientific aims and diverse research questions. These three building blocks form a 'triangulation' of emotion research (for more discussions about triangulation, see Moran-Ellis, 2006). They are mutually constraining yet also support each other. When a theoretical perspective is proposed to explain the underlying mechanisms of emotion, researchers can conduct empirical studies to assess the validity of the theory using various measures. On the other hand, data collected from different measures may also be useful for developing new models and theories. While theoretical perspectives concentrate on the ontology and functionality of emotion, models of emotion are intended exhaustively to describe and classify all possible emotions. When it comes to unconscious emotion, it is important to reconsider which theoretical perspective, model and measures can be used to confirm or refute the existence of this phenomenon and interpret experimental results without falling into epistemological traps. Drawing on our overview, we point out below the potential challenges and outline some promising approaches that could be used in future studies of unconscious emotion.

2.5.1 *Potential Challenges and Promising Approaches*

The first challenge that researchers encounter is the choice of guiding theory or model for future empirical research. As we have illustrated, the existing theories represent four complementary perspectives about emotion (i.e. brain, body, situation, and mind). There are considerable overlaps between them and none can be excluded from a discussion of emotion. Rather than seeing these four theoretical perspectives as conflicting conceptualizations, it is better to consider them as different epistemological approaches to the same

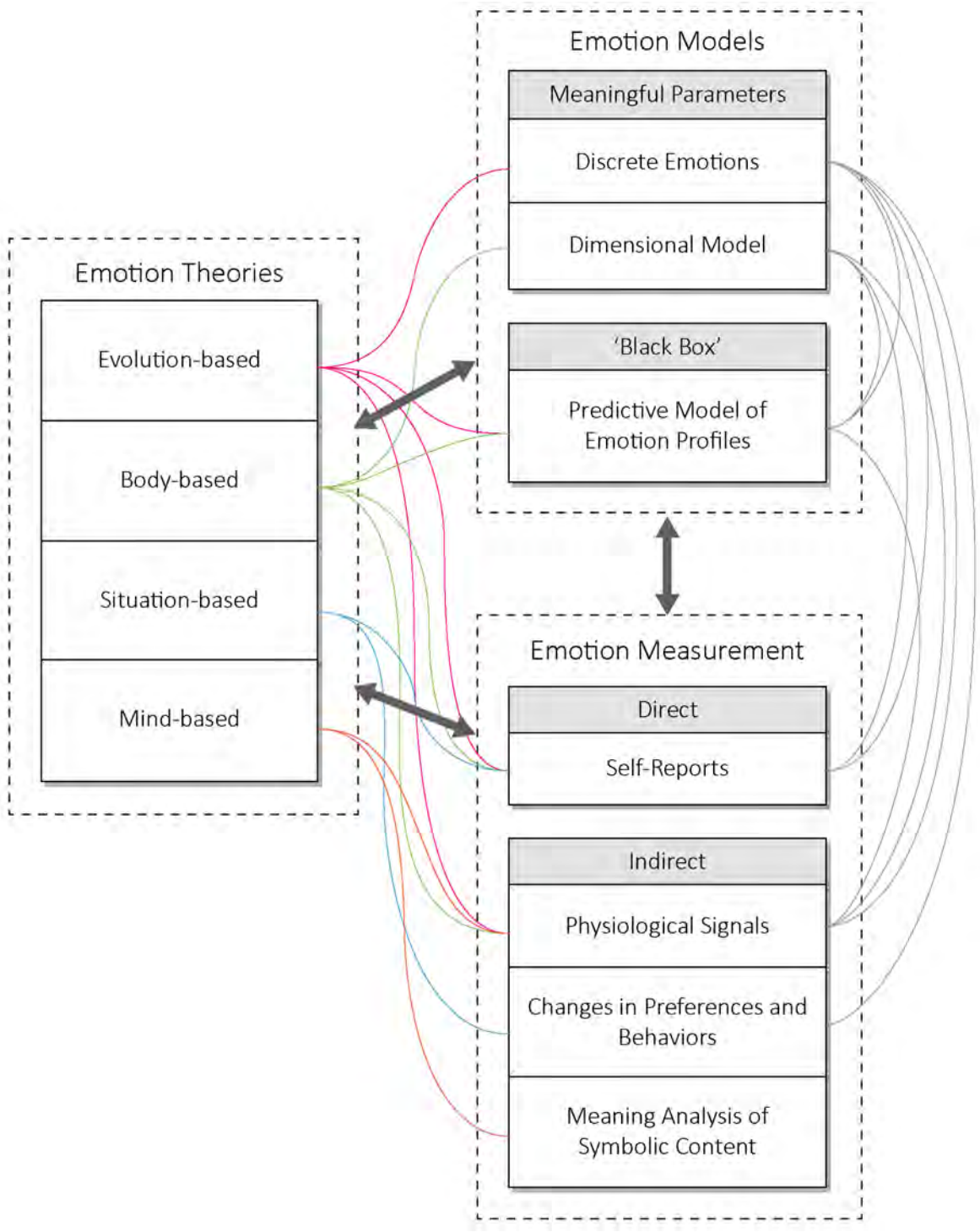

Figure 2.7: An overview of emotion research. Thick arrows represent strong tie among the three building blocks; thin lines represent the approaches that are often used by the mainstream research on emotion.

phenomena. By taking this approach we were able to take a neutral position and attempt to explore new ways of looking at the evidence to explain phenomena related to emotional experience. As some researchers have pointed out, there are limits to behaviorist explanations of psychological phenomena and it is time to look for new paradigms in psychology (Kohler, 2010; Kono, 2010). Given that the existing theories of emotion have been well researched, it might be useful to explore human emotions using an integrated approach. This idea is not new. In cognitive science a theoretical approach which took a 'groundless' stance, resisted mind-body dualism and argued that mind, body and world were interrelated and interdependent – the 'enactive mind' – was proposed (Varela et al., 1992). Another integrated approach based on the 'extended mind' considered the environment as an extension of the mind (Clark & Chalmers, 1998), thus as individuals change the environment, they are also changing how they experience the world (Kono, 2010). These two theoretical approaches are relatively new and more like philosophical propositions than predictive, explanatory theories. There is a long way to go before they can form the basis of empirical, scientific studies. However, these theoretical approaches have provided fruitful inspirations for psychological research. When it comes to the concept of unconscious emotion, the real challenge is not proving it exists, but providing a good explanatory account of the experimental data to improve current theory in this area.

The other critical challenge is a reevaluation of the basis of measurements of emotion. Because self-reports have been considered the most valid measure of conscious emotion, many studies have regarded the results of introspection as a fundamentally true account of experienced emotions (Mauss & Robinson, 2009). The accuracy of self-reports relies on their direct relationship with individual emotional experience; all the other measures are indirect and inferential. Unfortunately, these effective measures are unsuitable for assessing unconscious emotion because by definition unconscious emotions only take place below the threshold of introspection. It is epistemologically impossible to assess unconscious emotions through direct measures, which means that there is no easy foundation for models and theories. Since unconscious emotion cannot be accessed directly, it is necessary to use indirect measures. It should also be noted that conscious and unconscious emotions are inter-related and may co-exist in most cases (Reingold & Merikle, 1990). To extract information about unconscious emotion from the overall emotional experience appears to be the most difficult task of all. Recent years have growth in the use of mixed-methods approaches to complex phenomena (Johnson et al., 2007; Moran-Ellis, 2006). It is suggested to consider integrating both direct and indirect measures in order to contrast the phenomena that cannot be directly captured (Reingold & Merikle, 1988). This would help distinguish conscious and unconscious emotions and interpret the results in a relatively unbiased manner.

2.5.2 *What Has Been Missing?*

In this overview, we have seen that many potential theoretical approaches have not yet been used. In particular, mind-based theories have long been marginalized by mainstream scientific studies because the unconscious was, and sometimes still is, treated as a taboo in science. Researchers tend to prefer externally rather than internally oriented explanatory accounts of a given phenomenon, partly because contemporary science is deeply influenced by Newtonian notion of 'objectivity'(Chancer, 2013). The legacy of the behaviorist tradition has been the emphasis on using observations of human behavior to understand

human psychology and a negligence of the concept of mind. Nevertheless, it has recently been asserted that researchers should consider humans outside the machine paradigm (Kohler, 2010). The fast, subjective and irrational aspect of human mind has been noted by some leading scientists (e.g. Kahneman, 2003; Bargh & Ferguson, 2000; van Gaal & Lamme, 2012; Custers & Aarts, 2010; De Neys et al., 2010; Evans, 2010; Zeelenberg & Nelissen, 2008; Baumeister et al., 2007; Norman, 2010; Kihlstrom, 2008). While the best method of investigating unconscious phenomena in empirical studies remains unclear, psychoanalysis might provide a useful starting point for those seeking new paradigms.

The procedures associated with the experimental psychological approach usually encompass both qualitative and quantitative research methods. While emotion recognition has largely relied on quantitative measures such as physiological signals and questionnaires like SAM, inferences and attributions relating to emotion activation can only be understood using qualitative methods. Social psychology looks for explanations in the external world (i.e. situation-based accounts) whereas psychoanalysis searches for answers from the subjective world (i.e. mind-based accounts). Social psychologists often combine quantitative data and qualitative analysis to investigate how social circumstances influence emotional experience, however, little attention has been paid to psychoanalytic studies combining qualitative and quantitative methods (e.g. Rosen et al., 1991; Bradshaw & Storm, 2013; Whorwell et al., 1992). This approach has been missing from contemporary research on emotion and it seems a promising direction, in particular for researchers who are interested in subjectivity and the unconscious aspects of the human mind.

2.5.3 *Current State in Application Domains*

In the engineer field, emotion is a relatively new topic and recently starts to draw attention to many researchers. Affective Computing was first proposed by Picard (2000), who advocates the importance of emotion while the mainstream engineering studies focus more on machines rather than humans. One of the primary motives of Affective Computing is that computers (or machines) should be capable of sensing human emotions and acting accordingly, and, in an ideal scenario, computers should even be able to deliver emotional expressions to enhance their communication with human users Picard (2003). As stated, Affective Computing stresses more on emotion recognition and emotion modelling in order to ground the basis for future applications. Instead of jumping into the debate about the true nature of emotion, seeking a more objective, unobtrusive and reliable approach for emotion recognition appears to be the current goal of Affective Computing. Researchers in this domain strive to use physiological measures due to the fact that these bodily activities controlled by ANS are believed to be objective and language-independent. By using these physiological measures, researchers broaden their focus on different media type of stimulus content, ranging from pictures (Tkalčič et al., 2010) to music (Etzel et al., 2006; Yang et al., 2008), and films (Soleymani et al., 2012b; **?**) and games (van Reekum et al., 2004). Since Affective Computing studies mainly address on issues of emotion recognition and modelling, emotion theories are not in its scope. Most studies adopt the dimensional model for the convenience that both physiological signals and dimensions are numerical scales, which is better for mapping and interpreting. By using this approach, the ground truth of emotion relies on the results of self-reports so that the analysis on physiological signals aims at determining how well the obtained models could explain the self-report data.

In the same way as Affective Computing, Kansei Engineering aims at quantifying emotional qualities particularly in products and generalizing design factors that allow designers to refine the current design and even explore new possibilities at the early stage of design process (Nagamachi, 1995). The connection between emotion and design has drawn more attention since the term 'emotional design' was coined and popularized by Norman (2005). The design community is more interested in gaining insights about emotions from psychological studies. However, many psychological theories address more on the functional views of emotions that facilitate the survival of human beings as a species, but non-utilitarian emotions are rarely researched, e.g. aesthetic emotion (Scherer, 2005a). This missing link between psychology and design has led to the challenge for design researchers to explore this subject on their own and import psychological theories into the context of design. Pioneering design researchers have extended existing psychological theories to develop theories and models particularly for product emotions and user experience (Desmet & Hekkert, 2002; Desmet, 2003; Hassenzahl, 2008; Diefenbach & Hassenzahl, 2011). Based on our review, design studies hold a Situation-Based Theories perspective, concentrating on the emotional qualities that can be elicited by the objects in the environment (i.e. the product) (Desmet & Hekkert, 2007; Demir et al., 2009). For modeling emotion, they use discrete categorization for framing product emotions (Desmet, 2012; Desmet et al., 2004). As for emotion measurement, design studies largely rely on self-reports as the main instrument for investigating emotions toward products (Laurans et al., 2009; Desmet et al., 2004). Based on our overview diagram (see Figure 2.7), we can clearly see the theoretical approach adopted by emotional design in the triangulation of psychology: situation-based, discrete emotion, and self-reports.

Since most of the application domains follow contemporary psychological findings, research is conducted based on the assumption that self-reports serve as the ground truth of emotion. Although many psychological theories and empirical studies suggests the existence of unconscious emotion and its impact on behavior and decision-making, more evidence is needed to justify these hypotheses. As we outlined as potential challenges, we have to carefully consider the validity of this assumption and keep the discussion open for the unconscious part of human mind. Moreover, we should look forward to how the given theories and evidence about unconscious emotion can inform application domains. Since Affective Computing more stress on emotion recognition, the concept of unconscious emotion poses the challenge for researchers to review theoretical arguments in psychology to think about better approaches to improve the state of the art. On the other hand, emotional design concentrates on how and what emotional qualities can be communicated through products, media and interactions, the hypothesis of unconscious emotion stimulates many interesting directions for design researchers. For example, how could products and media deliver emotional qualities unconsciously? Will this topic stimulate new forms of media that elicit richer emotional experience?

2.6 OUTLOOK

As demonstrated in the overview, many new theoretical approaches have yet to be applied to empirical research. As mainstream science starts to take account of the importance of unconscious aspects of emotion, psychoanalytic methodologies may become a valuable resource and be integrated into cognitive science. Although we remain neutral in the debate about the existence of unconscious emotion, we look forward to more insightful discus-

sions of empirical results. In application domains, the debate on the existence of unconscious emotion not only raises the challenge about how emotions can be delivered and measured at an unconscious level, but also triggers new inspirations for developing new types of emotion-driven media and products. In the next chapter, we will present our first effort on analyzing affective stimuli based on psychoanalytical theories and speculate how these stimuli can inform psychological studies and the design of media content.

3 ANALYZING ARCHETYPAL MEDIA CONTENT

3.1 INTRODUCTION

Every day you turn on the TV or open the web browser to see what is happening in the world. Pictures, texts, and videos, all kinds of media content pervasively pour through your eyes and ears, and then enter your brain. Maybe you are not aware of it, but your brain has been processing all the information and reacted accordingly in many ways. In another scenario, you walk into a cinema, holding popcorns and drinks, sitting comfortably, and then go through a mysterious journey with the characters in the movie. After the movie, you might discuss the movie with your friends, asking each other: what do you feel about the movie? Then you recall those scenes that you love (or hate) and try to figure out what you were feeling at the exact moment.

It seems just a common scenario that happens to everyone, but it is not so different from what psychologists have been doing in research on emotion. This everyday scenario formulates the paradigm in experimental psychology: presenting stimulus content to subjects and then asking them what emotion they felt about the stimuli. By using this straightforward approach, psychologists are able to generalize various explanations for emotion and even further propose models for representing emotions in a meaningful way. Although this approach has been considered reliable to some degree, recent years have seen discussions on the limit of self-report on emotional experience (Haybron, 2007; Nisbett & Wilson, 1977; Schwarz, 1999). Furthermore, the mismatch between what people *think* they are feeling and what they are *actually* feeling initiate the debate on the question: can emotions be unconscious? This question can be answered in many different ways depending on which theories and measures are applied. In the previous chapter, we review the state of the art in emotion research particularly including recent studies about unconscious emotion. It appears that this hypothesis holds particular promise for further understandings about emotion, but more empirical evidence is needed for justification. Since the existence of unconscious emotion has not yet been confirmed, in the previous chapter, we come to the conclusion that it is needed to hold a neutral view toward these theoretical arguments and look forward to new methodologies by utilizing existent measures for further exploration.

Emotion is an essential part of media experience (Ravaja, 2004) and, in turn, media content serves an important kind of affective stimuli in research on emotion (Gross & Levenson, 1995). The relationship between media content and its corresponding emotional experience has always been curious to not only psychologists but also to researchers in application domains, such as entertainment (El-Nasr et al., 2010), media design (Tikka, 2010),

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This chapter is (partly) based on:

Chang, H.-M., Ivonin, L., Diaz, M., Catala, A., Chen, W., & Rauterberg, M. (2013). Experience the world with archetypal symbols: A new form of aesthetics. In N. Streitz & C. Stephanidis (Eds.), Distributed, Ambient, and Pervasive Interactions (Lecture Notes in Computer Science Vol. 8028) (pp. 205–214). Berlin, Germany: Springer. doi:10.1007/978-3-642-39351-8_23

Chang, H.-M., Ivonin, L., Diaz, M., Catala, A., Chen, W., & Rauterberg, M. (2013). From mythology to psychology: Identifying archetypal symbols in movies. Technoetic Arts, 11(2), 99–113. doi:10.1386/tear.11.2.99_1

and many others (Freeman, 2003; Boehner et al., 2007; Gilroy et al., 2008). For designers and media artists, "how stories can be made meaningful to people" and "how storytelling can be emotionally-richer" lies at the heart of research in this domain. While some studies focus on the impact of perceptual qualities on emotional experiences (e.g. Lakens et al., 2013), a higher-level aspect of story—symbolic meaning—has not yet been included in research on emotion. In the field of psychoanalysis, *archetypal symbolism* grounds the basis for analyzing symbolic meaning of media content in different cultures (Jung, 1964), and has been used for elaborating a universal pattern in various forms of narratives (Campbell, 1973). This universal pattern not only fits the structure of stories in ancient times, such as myths and fairy tales, but also can be mapped to modern forms of narratives such as movies (Hauke & Alister, 2001). Since the theory of archetype is a reliable source for analyzing media content, it seems a promising direction to integrate this theory into research on emotion.

In this chapter, we look into the existing research on emotion, identify their problems, and propose an improved theoretical framework—the triangulation approach. In order to initiate this approach, a new categorization method has to be established. Thus, we introduce a method for analyzing media content on the basis of archetypal symbolism and develop a standard procedure for editing archetypal media content into affective stimuli that can be used in empirical studies. Next, we use this analysis in real practice for analyzing modern movies for demonstration. Finally, we discuss how this theoretical framework and the categorization method can inform research and design.

3.2 A TRIANGULATION APPROACH

3.2.1 *Affective Stimuli in Practical Use*

Since emotion is a psychological phenomenon that cannot be directly captured, research on emotion in the laboratory is usually done by means of emotion elicitation and emotion recognition. (Rottenberg et al., 2007). For emotion elicitation, a number of techniques have been developed, e.g. hypnosis, affective guided imagery, and affective stimuli presentation (Gross & Levenson, 1995). Hypnosis and imagery are broadly used in long-term therapy or diagnosis on patients who suffer from mental or physical pains (Utay & Miller, 2006; Whorwell et al., 1992). However, these two techniques need experienced experts to participate and the procedure of these techniques is time consuming. In contrast, the technique of presenting affective stimuli appears to be relatively fast and simple. Although presenting stimuli is essentially a scenario simulation so that the emotional responses might be moderated, the data of these responses are still robust enough for recognition (Bradley & Lang, 2007b). More importantly, this technique is easy to reproduce on a large number of subjects in a laboratory. Therefore, affective stimuli presentation has been broadly used in research on emotion elicitation under laboratory settings. Although the experimental design with this technique is relatively simple, the selection and the validation processes of affective stimuli appear to be critical and challenge. Incorrect selections of stimuli and validation processes would lead to invalid results and misleading interpretations.

It has been debated for decades whether emotions are universal or culture-dependent. Based on the comparison among numbers of studies on emotion in different countries, a metaphorical concept 'emotion dialects' was proposed (Elfenbein & Ambady, 2002). It was argued that human emotions are universal on a general level while people from the same

cultural background could interpret and express their emotions with each other better than cross-cultural pairs. To investigate emotion for the general publics, it is essential to define a shared ground for standardization, i.e. internationally-valid affective stimuli that enable comparison and generalization of emotional responses across different cultural backgrounds. Due to limitations in time and budget, most researchers utilize affective stimuli that are solidly verified with experiments on cross-cultural subjects, e.g. IAPS (Lang et al., 2008), IADS (Bradley & Lang, 2007a), ANEW (Bradley & Lang, 1999), GAPED (**?**), DEAP (Koelstra et al., 2012), MAHNOB-HCI (Soleymani et al., 2012a), and many others (for an overview, see (for an overview, see Cowie et al., 2005). These databases contain affective stimuli of diverse emotional qualities that are attentively validated, and they also provide their experimental results for reference. Researchers could just adopt these valid stimuli to study specific emotional qualities under laboratory settings. However, these approach lies in the assumption that people can recognize emotions through introspection and precisely report their emotional feelings. This assumption has been challenged, and the most recent one would be the *emotion paradox*.

3.2.2 *Emotion Paradox*

It seems natural that people can describe emotions when they feel them, such as anger, sadness, and joy. As a consequence, these words might form an impression that these emotions are *natural kinds* (Barrett, 2006a). By saying natural kinds means that these emotions are believed to be unique emotional qualities that exists biologically in nature, so that these emotions are pure, cannot be broken down into parts, and can be measured objectively to some degree of accuracy. It is assumed that some situations or body activities can be directly mapped to corresponding emotional states, and these states can be expressed and categorized by their names, such as threats cause fear, being insulted triggers anger. The dominant scientific paradigm in the study of emotion is grounded in this assumption. However, scientists have yet to find clear evidence on these simple mappings, so that it is still unclear if these commonly-known emotions are natural kinds. This is what Barrett (2006b) called as the *emotion paradox*: people think they know what these emotions are, and recognize them when they feel these emotions, but the nature of these emotions still cannot be scientifically explained. What we know as natural-kind emotions might probably be a result of *collective agreement* toward the mapping between situations and emotional experience (Barrett, 2012). However, these mappings only appear when some extreme conditions are fulfilled (e.g. threats cause fear). In other words, there might be more delicate, complex emotions that cannot be labelled or verbally reported, but can be indirectly recognized by other measures such as physiological signals (see review in Section 2.4). The concept of the emotion paradox has raised a critical challenge to the traditional approach in emotion research. While presenting affective stimuli has been widely used in emotion research, researchers have to consider how this paradox would impact the validity of this experimental method.

To apply this method, researchers have to start with selecting proper affective stimuli for their experiment. In most cases, the stimuli selection process is subject to the emotion model that is chosen by the researcher as the fundamental premise. Researchers could therefore select proper stimuli according to this pre-defined model. However, as we have reviewed in Section 2.3, there is still no definitive classification or model for emotion. Researchers usually choose a model that better fits their purposes, such as Affective Com-

puting tend to use the dimensional model whereas emotional design researchers usually apply the discrete emotion model. Next, researchers recruit subjects to report their emotion toward these stimuli by using self-reports such as SAM (Bradley & Lang, 1994). Finally, the emotional qualities of the stimuli can be generalized by means of statistical analyses. Thus, these validated stimuli can be used in other studies to elicit target emotions. The best examples are International Affective Picture System (IAPS) (Lang et al., 1995)and International Affective Digital Sound System (IADS) (Bradley & Lang, 2007a). This procedure has set up a paradigm in emotion research. Numerous researchers adopt the affective stimuli in IAPS and IADS in their experiments. Some other researchers follow the same paradigm to develop their own databases of affective stimuli (e.g. Dan-Glauser & Scherer, 2011). Although the whole procedure seems to be methodologically reasonable, it does not help solve the emotion paradox and might lead to validity problems.

The first problem we need to consider is about the reference for selecting affective stimuli. The selection process in the existent affective stimuli databases is rarely discussed. It can be reasonably assumed that contributors only choose those pictures and sounds that they *think* are emotionally stimulating. To be more specific, the standard for the selection process relies on contributors' conscious introspection and subjective judgment toward the experienced emotion when they are surveying potential stimuli. In other words, if the aim of the selection process is to select stimuli with pre-defined emotional qualities, stimuli that induce emotions outside of the given scope might never be selected by using this approach. For example, while searching for stimuli for basic emotions (joy, sadness, anger, disgust, and fear), stimuli of jealousy would probably be missed or excluded by subjective judgment. Even though researchers strive to survey potential stimuli as comprehensively as possible, the selection process still appears to be inefficient.

Secondly, since most of the existent emotion models are built under the premise that emotions can be consciously recognized and reported, emotions beneath the threshold of awareness (if any) would lack the chance to be discovered. If we consider the possibility that emotions could be unconscious, the corresponding stimuli might never be discovered by surveying through self-introspection. Moreover, if some conscious emotions are too trivial to be included in the pre-defined model, the corresponding stimuli would likely be treated as less-effective stimuli. In the previous example of jealousy, stimuli of jealousy might be categorized into anger or fear, but would not be seen as a unique kind because this emotion is not included in the basic emotion theory (Sabini & Silver, 2005). If researchers are limited with the pre-defined model for their experiment, the stimuli of jealousy would probably be excluded since these stimuli do not induce pure anger or fear. For a more practical reason, since one experiment could only accommodate a limited number of stimuli, choosing stimuli that support the pre-defined model would be easier for data analyses and later interpretations. However, this approach does not help solve the emotion paradox, and the development of emotion research seems to be limited by the existent emotion models.

3.2.3 *The Third Angle of the Triangulation*

Validity of research method has long been discussed in behavioral science (Loevinger, 1957). Some common biases might lead to misleading results (Podsakoff et al., 2003). In the domain of research, *face validity* has been used to describe the extent to which *one* indicator represents all facets of a phenomenon (Dey, 1993; Kumar, 2010). As a case of *face validity*,

researchers solely rely on the pre-defined model to select stimuli and use these stimuli to examine if the model is valid (see Figure 3.1 on page 42). This would be easier for forming logical arguments but might lead to an epistemological trap, i.e. using the same ruler to measure how precise it is. Furthermore, this approach also cannot solve the emotion paradox. Since the whole procedure assumes that self-introspection is the ground truth of emotion, the interpretation on the results is built upon the *collective agreement* toward the pre-defined emotional qualities (Barrett, 2012). Nevertheless, this does not account for the nature of the emotion and might be regressively misunderstood as if this emotion does exist like a natural kind. For example, a researcher selects a picture of joy because he introspectively felt joy in this picture. Then he put this picture into evaluation to see if other people also feel joy in it. If the result is statistically significant, a conclusion can be drawn: this is a picture of joy. But, it needs to be noted that this does not explain what joy is, and it is unclear if joy really exists as a natural kind.

It seems that the traditional approach is prone to use a biased selection and might limit the development of emotion research. In order to solve the validity problem, construct validity focuses on not only 'how to measure' but also 'the degree to which a test measures what it claims, or purports, to be measuring'. It requires more than one set of indicators to examine the given phenomena (Dey, 1993; Kumar, 2010). Kahneman & Miller (1986) suggest that two kinds of indicators are needed to build an unbiased *norm* in research. For selecting stimuli, we need a first kind of indicator for categorizing stimuli and the other kind for measuring emotional responses. Indicators should be independent and heterogeneous to ensure the validity of research. Therefore, the categorization among stimuli should be emotion-independent. Furthermore, while introspection (self-report) serves as a subjective and direct indicator, another emotion measure is well developed as a neutral and indirect indicator: physiological signal measurement (see review in Section 2.4). The categorization on stimuli, introspection, and physiological measures formulate a valid triangulation of research on emotion, (Moran-Ellis, 2006), allowing us to overcome the face validity problem (see Figure 3.1).

After the selection process is done, researchers have to proceed to the experiment phase. Traditional ways of developing affective stimuli consider experiments as an evaluation process to see if subjects feel the same emotion as expected. That is, when a picture of joy is collected, it was expected to induce joy among subjects. Otherwise this picture is considered as a *selection failure*. On the contrary, if we utilize symbolic meaning as an independent indicator for selection, the experiment serves as a process of *exploration*—exploring the emotion corresponding to the given symbolic meaning. Since there is no pre-defined model in the selection process, researchers are free to utilize any existent model and measures for exploring the emotional qualities of the given stimuli. Since the two indicators of emotion measures are well developed, the last angle of this triangulation—the categorization for selection— appears to be critical. There are many ways of categorizing stimulus information, such as perceptual qualities (e.g. color and brightness), physical content (e.g. bird and book), and social situations. The categorization rules depend on which theoretical perspective is adopted (see Section 2.2). Psychoanalysis is a discipline that is specialized in analyzing the symbolic meaning of the content subject to individuals. However, its methods are rarely applied in psychological studies. In this thesis, we consider psychoanalysis as a fruitful resource for categorizing the content of affective stimuli. Since symbolic meaning is emotionally neutral, it fulfills the requirement for serving as an independent indicator in the triangulation. Therefore, the theoretical framework of this thesis is formu-

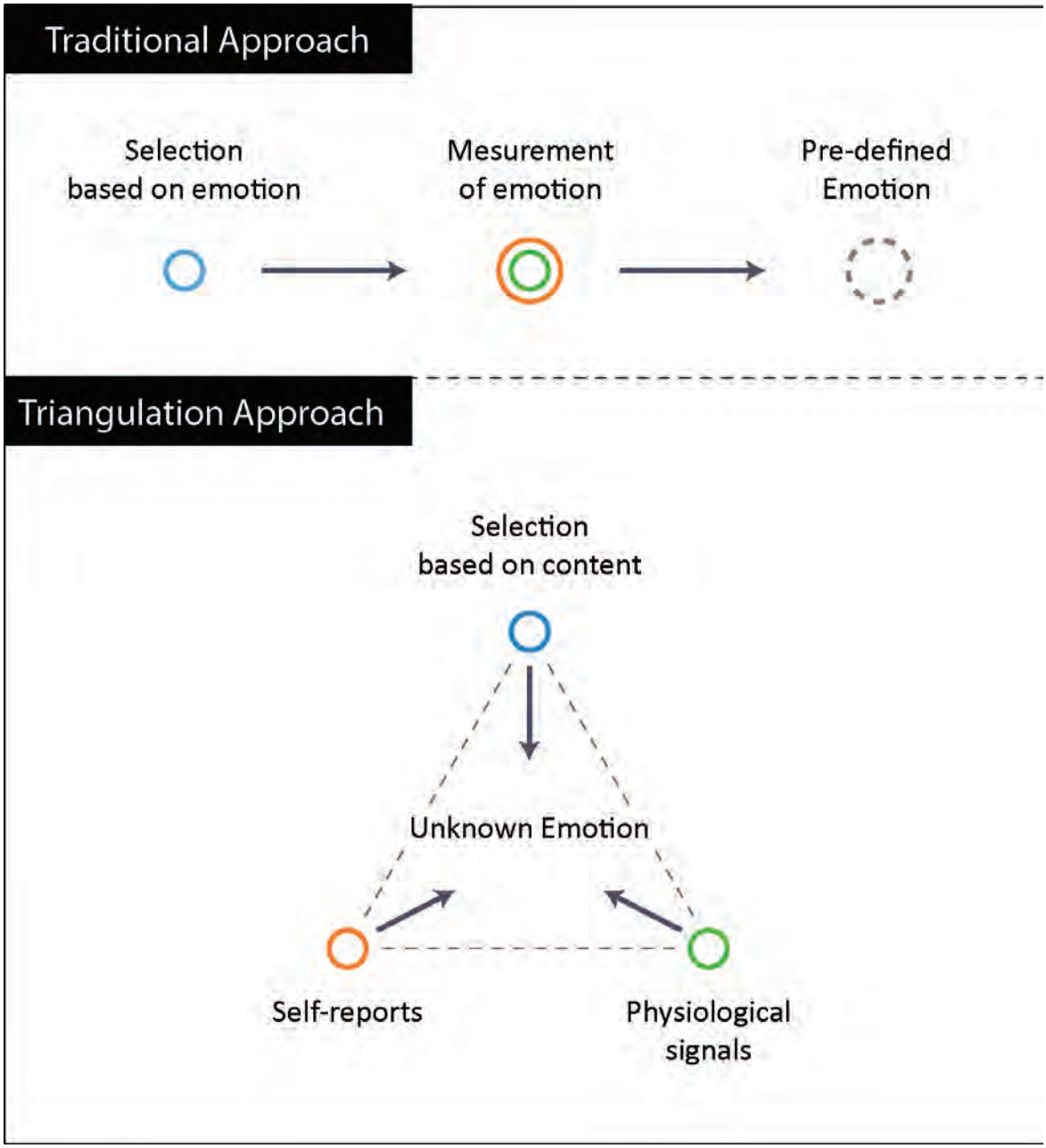

Figure 3.1: The traditional approach and a tringulation approach in research on emotion.

lated: selecting and categorizing stimuli based on the symbolic meaning of the content, and evaluate these stimuli with the other two indicators to measure emotional responses (see Figure 3.1).

3.3 ARCHETYPAL SYMBOLISM

3.3.1 *A Symbolic View of Human Mind*

What are symbols? Do symbols equal to signs? A sign is a representation of one concrete concept that implies a direct connection between itself and the concept it refers to. What it means 'direct connection' is that this connection to the extreme leads to a causal relationship. For example, thunders are usually known as the sign of a storm due to the fact that thunders always come with storms. In contrast, symbols are used to signify things without rational correlations, such as a flag is a symbol of a country. It is further argued that sign can only be used to refer to the known things, whereas symbols indicate something that is still unknown, or ideas that cannot be precisely depicted (Jung, 1964), e.g. peace, love, and culture. In essence, symbols itself are ontologically objective, and bear no psychological meaning. Their meanings emerge only when one's life-world is being lived. By saying this means that the meaning of symbols is ontologically subjective among people. Therefore, symbols can be in any kind of forms or values of anything in the physical world depending on how we approach the physical world to reveal our subjective world (White, 1940). In other words, the meaning of symbols would vary based on which layers of knowledge are adopted to support the experiencing procedure. Opposite to explicit knowledge that needs to be acquired by conscious learning and repetitive remembering, Sperber (1975) argues that symbolism is a kind of tacit knowledge, an autonomous cognitive mechanism that, alongside the perceptual and conceptual mechanisms, participates in the construction of knowledge and in the functioning of memory. However, different from semiology, symbolic interpretation is not a matter of decoding, but an improvisation that rests on an implicit knowledge and obeys unconscious rules. He further propose a hypothesis that the basic principles of the symbolic mechanism are not induced from experience but are, on the contrary, part of the innate mental equipment that makes experience possible.

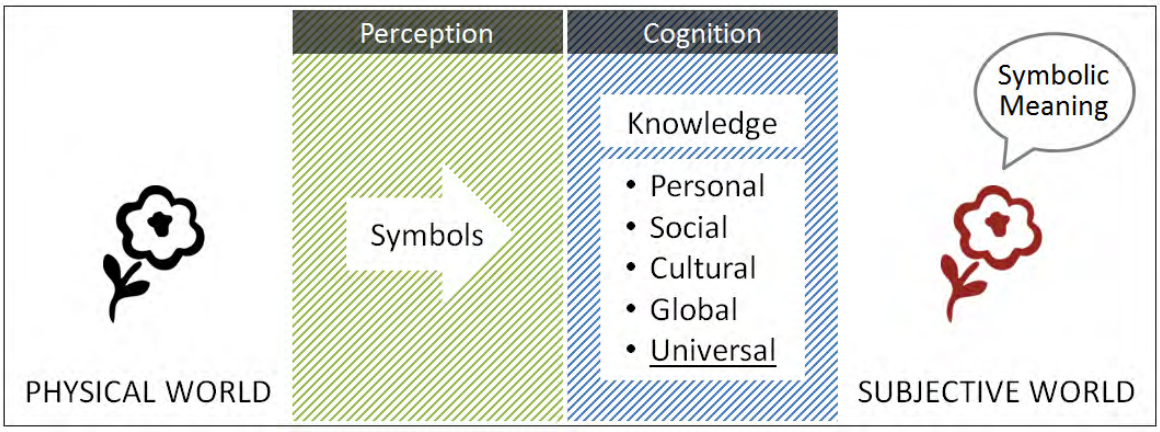

Figure 3.2: A conceptual procedure of sense-making with symbols. The universal layer is the focus of our research.

In the traditional psychological concept, especially behaviorism, humans are usually understood with a stimulus-response, machine-like paradigm (Kohler, 2010). Meanwhile, other researchers hold a more flexible account for how psychological phenomena emerge. Sabini & Silver (2005) argue that the automated mechanisms in our brains can link abstract classes of stimuli to abstract classes of responses. These mechanisms are not direct links among concrete elements, and need some *tokens* for initiation (Royzman & Sabini, 2001). Cognitive scientists also proposed a hypothesis that there is a symbolic level between the physical level (i.e. how human brain and body work) and the representational level (i.e. how the humans perceive, feel, and understand the world) (Varela et al., 1992, p. 41). Barrett (2012) claims that humans share a kind of 'category knowledge' in their sense-making process to interpret the ontologically-subjective meaning of ontologically-objective events. This knowledge enables the psychological phenomena to link the body to the world to create meanings. This has informed us a basic premise for the technique of presenting affective stimuli: it is not the ontologically-objective physical attributes of stimuli that induce emotions, but the ontologically-subjective meaning of the stimuli that construct emotion (Barrett, 2012). She further argues that the society can be the source of the knowledge. The society, by the definition of symbolic interactionism (Manis & Meltzer, 1978), is a reality that is embodied through interaction among the people within it. On the other hand, the society in turn provides the symbolic meaning of everything within its social context. Symbolic meaning is seen as a dynamic phenomenon, being constructed while interaction occurs, and in turn, grounding the basic understanding among people within it. It could also be understood as a pre-understanding of the physical world. Extended from this pre-understanding by living within it, humans create their new understanding, which in turn becomes the pre-understanding of the society. This loop is so-called hermeneutic circle (Gadamer, 1975). People living in the same society or in the same culture to some extent share the same languages, value system, and even ways of thinking. Sometimes we also see some global trends occurring along with time. The meaning of symbols would vary based on which layers of knowledge are adopted to support the experiencing procedure. This knowledge is not always explicitly given through education, but more often is gained implicitly through living within it.

We argue that there are many levels of knowledge that supports the cognitive process that constructs our subjective worldview (see Figure 3.2). These five levels of knowledge are personal, social, cultural, global, and universal. The first four levels of knowledge are neither static nor independent, but in a dynamic circulation. Information flows through different levels, influencing their next level of knowledge simultaneously. According to the theory of the unconsciousness, the top level–personal knowledge–is related to the concept of one's ego, which makes a person consciously think herself as a unique individual. The next three levels of knowledge are concealed in one's personal unconscious mind. Thus, a person would be unconsciously influenced by the given society, culture, or even global trends. Top four levels of knowledge change differently with time while the deepest level of knowledge remains consistent across time and space as we call it the universal knowledge of symbols (Kooijmans & Rauterberg, 2007).

3.3.2 *The Theory of Archetype*

Jung (1964) reveals insights about unconsciousness in a wider sense throughout analyzing myths and fairytales from numerous cultures. He proposed the concept of *the collective*

unconscious. His theory suggests that all human beings share a universal layer of unconscious mind, which is hidden beneath the personal psyche (including both conscious and unconscious minds). This hidden layer contains some contents and modes of behavior that are identical in all human beings, and thus constitutes a common psychic substrate of a universal nature which is present in every individual (see Figure 3.3). Egos of people are like separated islands above the water, as people see each other as independent individuals in the physical world. Our conscious thinking makes us believe that we are separate entities who are floating freely above the water. However, people can hardly notice the unconscious part of their mind under the surface of water. Furthermore, people are unaware that they are connected to each other by means of the ocean floor beneath the water. This is what Jung claimed that our personal unconsciousness rests upon a deeper layer, the collective unconsciousness, which is not a personal acquisition but is inborn as the foundation of the psyche (Jung, 1959). As a result, all human beings, sharing essentially the same biological equipment (e.g. the brain and central nervous system), would show a tendency to perceive common meanings embodied in a symbol, even at an unconscious level (Bradshaw & Storm, 2013).

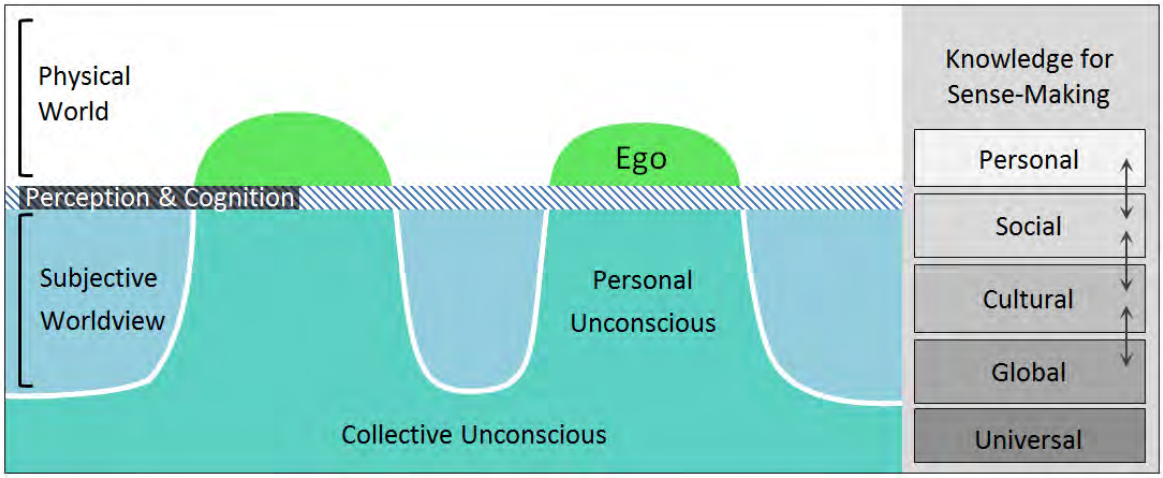

Figure 3.3: A metaphorical mapping of the levels of knowledge and Jung's view of human mind (adapted from Carminati et al., 2013).

Jung further developed the concept of archetypes. Archetypes are defined as the components of the collective unconsciousness, which is an inborn tendency that cannot be consciously acquired to experience things in a certain way. They exist universally in the psyche, and prepare individuals psychologically to deal with life experiences that are universally common (Walters, 1994). Archetypes are unconscious psychic impulses that are impersonal, inherited traits that present and motivate thoughts, emotions, and behaviors long before any consciousness develops. An extreme analogy would be describing archetypes as the structure of the psyche, which is similar to organs of the physical body (Jacobi, 1973). In this way, archetypes are similar to other sensory and cognitive models, e.g., receptive fields of the retina are not consciously perceived, but determine the structure of visual perception (Perlovsky, 2007). People interpret the world through archetypes, however without being aware of the existence of them.

Therefore, the deepest level of knowledge is inborn with the collective unconsciousness, appearing ever before any consciousness is built. The essential components of the collective

unconsciousness, archetypes, represent the universal tendency of how humans think and act toward the physical world. This universal level of knowledge constructs a fundamental structure of worldview, which provides a convincing explanation for the phenomenon that many symbolic contents in ancient myths still manifest in modern society. In this sense, archetypal symbolism can be defined as a universal knowledge of symbols that describes how these universal symbolic meanings of the physical world are revealed to humans and represented in myth, culture, and religion across time. Archetypal images or archetypal content are ancient motifs and predispositions to patterns of behavior that manifest symbolically as archetypal images in dreams, art, or other cultural forms (Jung, 1964). According to Jung's personal confrontation with the unconscious, he tried to translate the emotions into images, or rather to find the images that were concealed in the emotions (Jung, 1959). Furthermore, based on the record of Jung's patients, archetypal symbols are essential for representation of one's emotions at an unconscious level (Jung, 1963; Bush, 1988; Henderson et al., 2007).

3.4 MEDIA CONTENT ANALYSIS

Jung's theory provides an explanation that goes beyond society and culture by connecting mythology and psychology (Krippendorff, 1989), and grounds the theoretical basis of analytical psychology and Jungian psychotherapy (Knox, 2001; Roesler, 2012). The theory of archetype also influences research in marketing and personality, and recently has been applied for analyzing media content (e.g. Vogler, 2007; Hauke & Alister, 2001; Terrill, 1993; 2000; Zehnder & Calvert, 2004), particularly for movies. Movies are a complex form of symbolic content that communicates delicate and rich visual-audio information to the audiences by means of storytelling. Cinema offers not only the content of movie, but also both a means and a space highly similar to psychotherapeutic sessions that enable the viewer to witness their psyche in projection (Hauke & Alister, 2001), meaning that viewers are in a process of projecting themselves in the movies and not just being a pure 'viewer'. Moreover, it is also claimed that the cinema deliver a contemporary experience for the viewers to set apart from their daily life and engage their unconscious in a manner similar to hypnosis and dreaming. Some researchers have put efforts toward elaborating symbolic meanings on modern movies according to Jung's theory (Broda, 1994; Hauke & Alister, 2001; Falsafi et al., 2011). These efforts have provided good references for our analysis on movies.

Jung first discovered several essential archetypes: hero, shadow, anima, animus, mentor (or wise old man) and mother (Jung, 1969; Neumann, 1970). Furthermore, mythologist Joseph Campbell (1973) extended Jung's concept of the hero archetype to a more complete scope—monomyth (or hero's journey), a common structure in all mythical hero stories in different cultures and religions. This metaphorical structure depicts seventeen stages that the hero has to go through to complete his adventure. These stages can be generally divided into three larger stages: departure, initiation, and return. A similar pattern can also be seen in modern screenwriting (Field, 1984) and the narrative theory (Todorov, 1977). It has to be noticed that the hero in monomyth should not be equated as the concept of "superhero" in popular culture although most of the successful stories of superhero usually comply with the path of hero's journey (e.g. Spiderman and Batman). In general, the hero image in monomyth can be referred to any characters that go through a self-evolved process to become better or bring greatness to others. The structure of monomyth represents

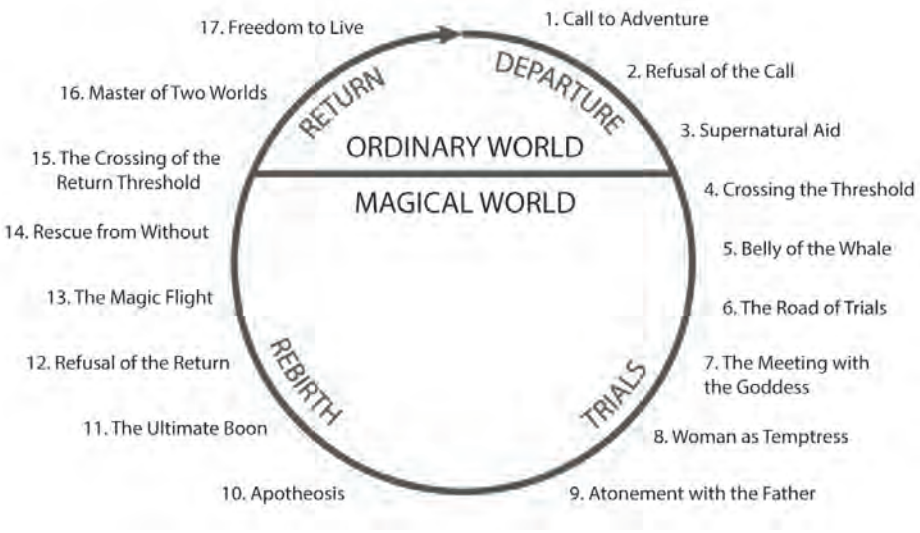

Figure 3.4: Hero's journey and other archetypes (adapted from Campbell, 1973).

a universal pattern of narrative that is clearly manifest in various forms of art and media (Faber & Mayer, 2009). The archetype of hero, as a symbolic form of the self, represents a metaphorical instance of who lives his life as going through the hero's journey repeatedly. Other archetypes like mentor, mother, etc. represent the essential figures that a person would meet on his life-long journey (see Figure 3.4). These abovementioned archetypes are considered to be essential among all the archetypes (Jung, 1969; Neumann, 1970). Therefore, we included all of these eight archetypes in our research as the first attempt in this undertaking: anima, animus, mentor, mother, shadow, hero's departure, hero's initiation, hero's return.

3.4.1 *Method*

In our study, we follow the psychoanalysis method to analyze movie clips. Different from scientific studies that tend to use systematic approaches, psychoanalysis tends to use heuristic approach, which allows researchers improvise, forming their own method based on general guidelines. Symbolic interpretation is not a reasoning task like decoding, but an improvisation that rests on an implicit knowledge Sperber (1975). From a mythologist viewpoint, Lévi-Strauss (1955) argues that the meaning of a story cannot reside in the isolated elements which enter into the composition of this story, but only in the way those elements are combined. Looking for an 'ultimately correct' symbolic meaning as qualities like color or brightness does not seem to feasible due to the fact that symbolic meaning is associative and abstract in nature. However, it is still possible to categorize meaningful content to some degree of accuracy. The only method can be suggested is to "proceed tentatively, by trial and error, using as a check the principles which serve as a basis for any kind of structural analysis: economy of explanation; unity of solution; and ability to reconstruct the whole from a fragment" (Lévi-Strauss, 1955, p. 431).

In the context of analyzing media content, several guidelines could help researchers prepare themselves for executing this task. First, it is encouraged to be fully immersed in the story, and to put one's vantage point in the center of the projection of the story. This is

related to the so-called *diegetic effect*, that the viewer looks into a fictional world through a magic window (Tan, 2011). Unlike traditional scientific studies try to keep a distance away from the given phenomena for the sake of objectivity, symbolic interpretation requires a deep subjective view to authentically observe what the character has been experiencing. This guideline can also be found in contemporary narrative analysis in psychology, which considers narratives as: autonomous intentional agents and their interactions (Mar & Oatley, 2008). To authentically elucidate how the fictional world is made meaningful to the character, it is necessary to mimic the mindset the character as a living person instead of an inanimate puppet. Second, it is suggested to stay with the story and ignore the unrealistic details. Researchers are trained to be critical. However, *association* plays the essential role in the quest of analyzing symbolic meaning. Being critical on the minor details in logic would lead to distraction and confusion that impede the construction of association (Lin et al., 2011; Liang & Chang, 2013). Similarly, it is advised to embrace the character instead of being preoccupied by personal judgment. Characters and the story are in a complementary relationship: while stories make characters meaningful, the interplay of the characters constructs the whole story. Rejecting any of the characters might lead to biased interpretation not only toward the character but also the whole story.

3.4.2 *Editing Procedure*

After analyzing the content, we develop a standard procedure for editing affective movie clips that can be used for later experiments (see Figure 3.5). First, we surveyed many commercial movies in the market to find suitable movies that might contain narratives relevant to these target archetypes. It is suggested to start from movies with high ratings by browsing reliable online resource such as Internet Movie Database [1] (IMDB) and Rotten Tomatoes [2]. Second, we view the whole movie from a holistic viewpoint to observe the characters and the storylines, and decide if it demonstrates strong archetypal symbolic meaning in general. Next, we choose the characters that fit our categories of archetypes, and have a general idea how this character influences the whole storyline. By selecting important scenes of this character, we take a closer look into the symbolic meaning of these scenes by taking a first-person viewpoint of the target character. While seeing through the eyes of the character, it is important to concentrate on how objects and people are made meaningful to the target character.

In order to edit movie clips that can be used in experiments, the format of the clips needs to be defined first, including the file format, the length of the movie clips, the resolution of the play screen, and the transition style between scenes. All the selected scenes should be edited into the same format and build up a dataset of movie clips that is ready for later experiments. This is a challenging task. In most cases, one session of experiment needs to finish within two hours, or the subject would become fatigued. Considering the experimental design, researchers have to make a good trade-off between the length of the clip and the number of the clips. The length of the movie clip in related studies varies from one minute up to five minute, which suggests a safe range for set the unified length for movie clips. Nevertheless, compressing complete symbolic meaning into a clip with such a short period of time is extremely difficult. In particular, a movie is intertwined with

1 IMDB website can be found at: http://www.imdb.com/
2 Rotten Tomato website can be found at: http://www.rottentomatoes.com/

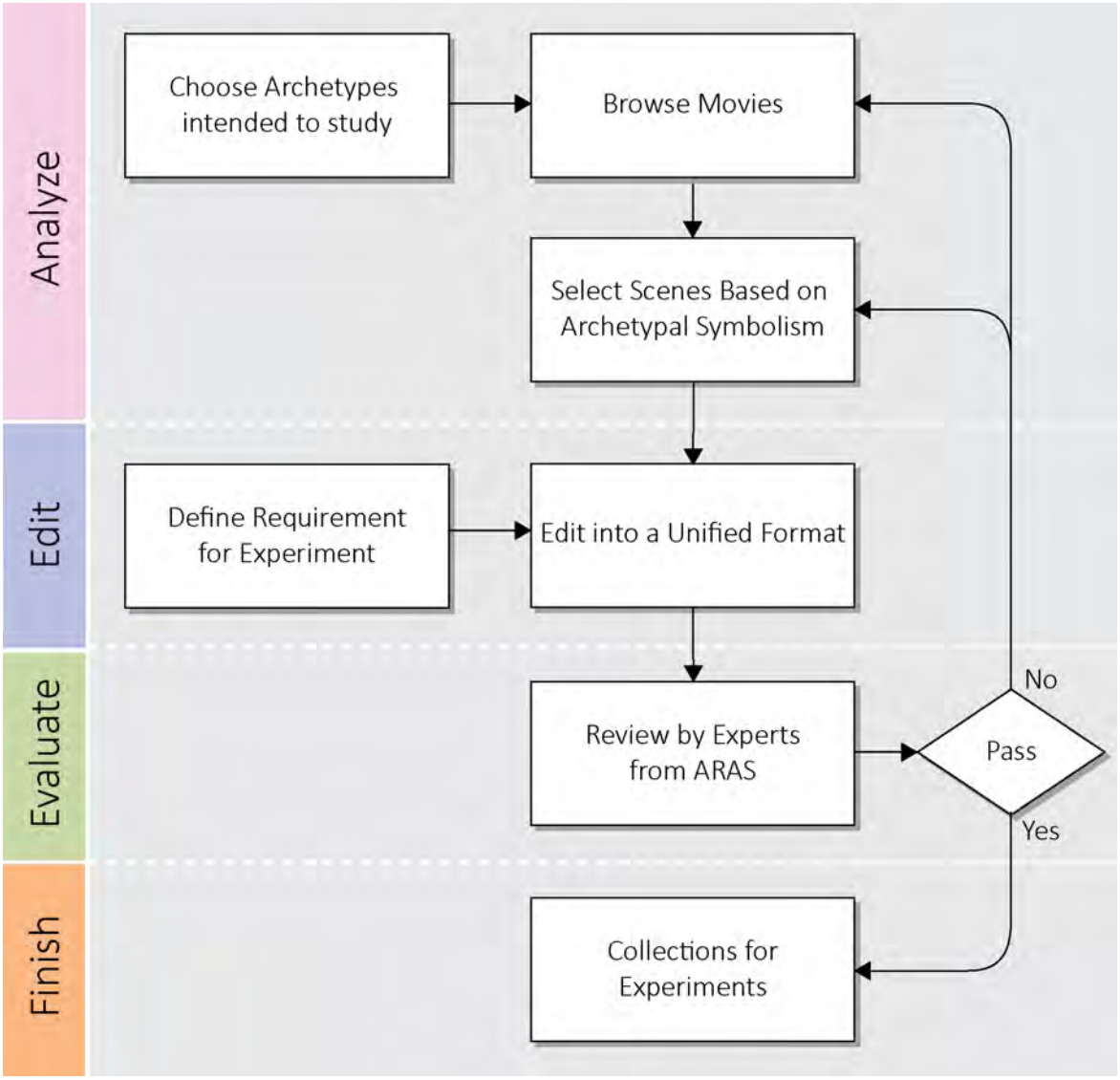

Figure 3.5: The developing process for archetypal movie clips. ARAS means The Archive for Research in Archetypal Symbolism.

multiple storylines and numerous characters. Although some movies are well-structured archetypal content, the length limit is still critical. If we simply cut feature scenes and merge them regardless the continuity of the storyline, the clip would likely fail to convey the symbolic meaning we intend to study. To tackle this issue, it is suggested to first extract the core storyline that is directly related to the archetype, and then remove the unnecessary scenes in between. Another suggestion is that each scene should only accommodate less than two characters. This would help the subject quickly focus on the interaction of the two characters and the symbolic meaning would be more easily to be contrasted (such as mother and son, hero and shadow). Moreover, in order to make the subject more immersed, it is suggested to choose more recent movies due to the fact that some movie effects are outdated, which might be a distraction to the subject. For example, in the movie Superman (Donner, 1978), the outdated special effects might make the subjects feel funny and lose their focus on the story.

For further confirmation on the validity of the edited clips in our study, we worked in cooperation with researchers from The Archive for Research in Archetypal Symbolism (Archive for Research in Archetypal Symbolism (ARAS))[3] to help verify our movie clips. Since the early 1930s, ARAS has been collecting and annotating mythological, ritualistic, and symbolic images from all over the world and from all epochs of human history (Gronning et al., 2007). This step might require additional effort. Each of ARAS researchers offered her individual review for all the clips (see Appendix A for the review form). Only those clips that they all confirmed to be archetypal clips were kept in our collections. After several iterations of filtering sessions, we built a set of movie clips that are verified as archetypal media content.

3.4.3 *New Categorization for Affective Stimuli*

In this section, we will explain the symbolic meaning of each archetype and the corresponding movies that have been chosen. A list of reviewed movies is presented in Table 3.1 on page 51.

3.4.3.1 *Anima*

In the unconscious of the male, the archetype anima finds expression as a feminine inner personality whereas animus is expressed as the masculine inner personality in the female's unconscious. The anima is the utmost important factor in the psychology of a man in terms of emotions and affects (Jung, 1959). Anima intensifies, exaggerates, falsifies, and mythologizes all emotional relations with his work, generating fantasies and entanglements. "When the anima is strongly constellated, she softens the man's character and makes him touchy, irritable, moody, jealous, vain, and unadjusted. He is then in a state of 'discontent' and spreads discontent all around him" (Jung, 1959, pp. 70-71).

Alternative movies for this category include American Beauty (Mendes, 1999), Malèna (Tornatore, 2000) and The Wrestler (Aronofsky, 2008). In the movie American Beauty, the image of the young cheerleader girl becomes the projection of the middle-age man's anima, generating all the illusions of highly sexual temptations, which are beyond the control of his consciousness. The man is entirely obsessed, and considers himself awakening from a coma, which is actually the illusion that put him into an extremely discontent condition.

3 ARAS website can be found at: http://aras.org/index.aspx

Archetype	Movie	Viewpoint	Representing Figure
Anima	American Beauty (Mendes, 1999)	Lester Burnham	Angela Hayes
	Malèna(Tornatore, 2000)	Renato Amoroso	Malèna Scordia
	Perfume: The Story of a Murderer (Tykwer, 2006)	Grenouille	The girls to be killed
Animus	Black Swan (Aronofsky, 2010)	Nina Sayers	Thomas Leroy
	The Silence of the Lambs (Demme, 1991)	Clarice Starling	Dr. Hannibal Lecter
	Million Dollar Baby (Eastwood, 2004)	Maggie Fitzgerald	Frankie Dunn
Mentor	The King's Speech (Hooper, 2010)	King George VI	Lionel Logue
	The Lord of the Rings I (Jackson, 2001)	Other heroes	Gandalf
	The Lion King (Allers & Minkoff, 1994)	Simba	Mufasa
Mother	All about My Mother (Almodóvar, 1999)	Son	Manuela
	The Lord of The Rings (Jackson, 2001; 2002; 2003)	Others	Galadriel
	The Matrix (Wachowski & Wachowski, 1999; 2003a;b)	Neo	Oracle
Shadow	Fight Club (Fincher, 1999)	Protagonist	Tyler Durden
	The Lord of The Rings (Jackson, 2001; 2002; 2003)	Gollum (good)	Gollum (evil)
	The Dark Knight (Christopher Nolan, 2008)	Batman	Joker
Hero's Journey	Braveheart (Gibson, 1995)	Self-Projection (the Viewer)	William Wallace
	V for Vendetta (McTeigue, 2005)		Evey
	The Lord of The Rings (Jackson, 2001; 2002; 2003)		Aragorn
	The Matrix (Wachowski & Wachowski, 1999; 2003a;b)		Neo

Table 3.1: A list of movies that were reviewed in our studies

Just like the spindle in the fairytale "sleeping beauty" (Ronnberg & Martin, 2010), the man is pricked by the thorn of the rose (the girl), and falls into a deep dream constructed and controlled by his dark anima.

3.4.3.2 *Animus*

As mentioned above, the female is compensated by a masculine element, and therefore her unconscious has a masculine imprint, which is the animus (Jung, 1969, pp. 11-12). As the counterpart of anima in one's psyche, the animus influences a woman's interactions with men and her attitude toward them. The image of animus represents authority, power, and aggressiveness while being seductive and inspiring, driving the transformation of the feminine part of the psyche.

Alternative movies for this category are Black Swan (Aronofsky, 2010), Million Dollar Baby (Eastwood, 2004), and The Silence of the Lambs (Demme, 1991). In the movie Black Swan, Thomas, the male tutor as the projection of the anima, tries to lead the female dancer Nina into her own unconsciousness reservoir of passion and feeling. He represents the deepest fear of her for being cast aside. On the other hand, he is also seductive in a way that pre-empts her initiative. This is a kind of projective identification that is a characteristic strategy of the animus archetype, which in the end successfully induced the shadow of Nina in her unconsciousness to take over the control of her psyche. The final decision goes to Black Swan due to the reason that the character of the tutor represents a typical animus: powerful, fearful, and at the same time sexually seductive (to lead Nina to be more creative).

3.4.3.3 *Mentor*

The manifestations of the archetypal figure of the mentor (or the wise old man) are demonstrated in various myths and fairytales. His role is precisely that of the one whose words assist the hero through the trials and terrors of the weird adventure (Campbell, 1973, p. 34). The mentor archetype typically appears and represents the knowledge that is needed to cross the thresholds when the hero is in a hopeless or desperate situation from which he cannot extricate himself alone. "This figure is described as representing knowledge, reflection, insight, wisdom, cleverness, and intuition, as well as moral qualities such as goodwill and readiness to help, which make his spiritual character clear" (Jung, 1959, pp. 217-230).

Alternative movies for this category are The King's Speech (Hooper, 2010), the trilogy of The Lord of the Rings (Jackson, 2001; 2002; 2003), and The Lion King. In the movie The King's Speech , the British king, as the hero in a myth, acknowledges his weakness in speaking, as a metaphor that he lives in a mundane world, but still refuses to accept it. Dr. Lionel, as the mentor archetype, gives the earphones to him as a very distinctive sign of the call to the adventure. The recording without hearing his own voice, which the king considers as a trick, represents the supernatural aid that guides the hero to start his journey. It also suggests the need of the person being mentored to accept what the mentor wants them to hear and to stop listening to his own destructive mental processes, which might induce severe doubt that he can overcome his obstacle. The character Gandalf in the Lord of the Rings trilogy and Mufasa in The Lion King are also selected as the figures of the mentor archetype.

3.4.3.4 *Mother*

The demands of the child upon the mother are at first connected with the role of the mother as protector, caretaker and supplier of nutritive needs (Jung, 1916). With the germinating eroticism later, the child's love becomes admixed with the developing sexual quality and is exhibited as jealousy. In this way, the typical conflict is developed which in the son is directed towards the father and in the daughter towards the mother, which are known as the Oedipus complex for the son and Electra complex for the daughter (Bettelheim, 1984). The mother archetype has two ambivalent aspects: she is both loving and terrible (Jung, 1959). Positively, the mother archetype has been associated with solicitude, wisdom, sympathy, spiritual exaltation, helpful instincts, growth and fertility; the negative or evil side of the mother archetype is associated with secrets, darkness, the world of the dead, seduction and poison.

Alternative movies for this category are All about My Mother (Almodóvar, 1999), The Lord of The Rings: The Fellowship of the Ring (Jackson, 2001), Matrix (Wachowski & Wachowski, 1999; 2003a;b), and Black Swan (Aronofsky, 2010). In the movie All about My Mother (Almodóvar, 1999), the positive mother archetype is well presented by seeing through from the son's eye when he interacts with his mother. He is eager to assure the mother's love toward him, and meanwhile he also intends to know more about his mother's past, especially his father, who seems to have abandoned him. Her willingness to share the memories about his father, even if it may be unpleasant, a difference from a smothering mother who cannot let the boy find his father, a discovery that might separate her son psychologically from her. Different from the modern image of mother in All about My Mother, the character Oracle in Matrix and Lady Galadriel in The Lord of the Rings are manifested as the image of 'great mother' in mythology. Contrary to these positive mother images, the mother in Black Swan is a typical negative mother archetype. The mother love is being over-protective and suffocating, which becomes a devastating suppression to the growing spirit of her daughter.

3.4.3.5 *Shadow*

"Shadow, the inferior part of the personality, sum of all personal and collective psychic elements, because of their incompatibility with the chosen conscious attitude, are denied expression in life and therefore coalesce into a relatively autonomous 'splinter personality' with contrary tendencies in the unconscious" (Jung, 1959, p. 284). The shadow personifies everything that a person refuses to know about himself. Although it usually hides in one's unconsciousness, the shadow is always imposing itself on the person's mind directly or indirectly. The encounter with the shadow plays a central part in the process of individuation. Although the shadow usually appears negative, sometimes traits and associations arising from the shadow can also suggest a positive resolution to conflict.

Alternative movies for this category are Fight Club (Fincher, 1999), the trilogy of The Lord of the Rings (Jackson, 2001; 2002; 2003), and The Dark Knight (Christopher Nolan, 2008). In the movie Fight Club, the unnamed protagonist (played by the actor Edward Norton) is discontented with his current life until he meets the man Tyler, who lives in freedom. After a series of conflicts and struggles, the protagonist realizes that Tyler is actually the counterpart in his unconsciousness, his shadow. One of the typical scenes is when Tyler forces the protagonist to feel the pain of being burned by chemical acid. The consciousness was trying to escape by meditation and refuse to obey Tyler's order. However,

in the end, the consciousness gives up resisting, and becomes more obsessed with the dark shadow. The shadow archetype usually can be found in movies about Dissociative Identity Disorders (DID) although this mental disorder does not equal to the presence of shadow archetype. Gollum in the trilogy of The Lord of The Rings is also a similar example. Nevertheless, the figure Joker in The Dark Knight is an individual character that represents the dark side of the protagonist Batman. They are lifelong rivals, like light and shadow, contrasting the existence of each other.

3.4.3.6 *Hero's Departure*

Based on Campbell (1973), hero's departure is the first stage of hero's journey. The hero was born and grows up in the mundane world until he receives the call to the adventure. The call to the adventure usually comes with a supernatural aid, which invites, encourages, or pushes the hero to accept the call. The hero refuses to answer the call until some miserable tragedies take place, which forces him to be separated from his family, leave the mundane world, and start his journey in a magical world. As at the early stage of the journey, the hero is too immature to fight against the evil, the mentor, or the wise old man, will appear unexpectedly, guide him to cross the first threshold, and help him develop wisdom and skills to face the rest of his own journey.

3.4.3.7 *Hero's Initiation*

Hero's initiation is the second stage of hero's journey (Campbell, 1973). This is also the main content of the story—the confrontation in modern screenwriting (Field, 1984). The hero fights against monsters and villains on his journey to the treasure, the ultimate boon or the magical elixir. This part of journey is called *the road of trials* (hero's trials). The further he goes the more dangerous situations he faces. The most difficult challenges would usually be encountering his deepest fear or darkest evil, and also fighting against his dearest brother or friend. Although eventually he will win, the hero will get seriously injured and almost died. The wounded hero resurrects from the fire and water and gains the great power as a process of transcendence. This procedure is called *hero's rebirth*. With the help of his surprising ally or amazing miracle, the hero is able to escape and bring the ultimate boon or magical elixir back to the people who are still suffering in the mundane world.

3.4.3.8 *Hero's Return*

Hero's return is the last stage of hero's journey. The ultimate goal of a hero is to bring the boon or the elixir to save the people. However, on the way he goes back to mundane world, there is the final test waiting for him. Only if he goes across the final threshold, he could eventually return home and accomplish his task. A huge price to achieve this goal must be taken, so the hero would give everything, even sacrifice himself for the life of others. After fierce physical and mental fights, the hero eventually fulfills his goal and becomes the master of the two worlds: the magical world and the mundane world. And all the people in the mundane world broadly benefit from the ultimate boon or magical elixir brought back by the hero.

Alternative movies for this category are Braveheart (Gibson, 1995), V for Vendetta (McTeigue, 2005), the trilogy of The Matrix (Wachowski & Wachowski, 1999; 2003a;b), and others (see Table 3.1 on page 51). Taking Braveheart for example, the three general stages of the hero's

journey are clearly manifested in this story of the Scottish hero—William Wallace. The symbols are visually embodied: the huge sword he uses represents as a token for his extraordinary fate and power; he was physically and mentally devastated and almost died in the battlefield; he rises from the death by passing through burning fire; the magic escape by jumping off from the top of the castle into the water, and the final word "freedom" as the ultimate boon that is brought to people. V for Vendetta and the trilogy of The Matrix also demonstrate a complete path of the hero's journey. Different from these 'bright' heroes, the movie The Wrestler represents a tragedy of a 'dark' hero. A reversed hero's journey for an old wrestler, who cannot sustain the frustration in the mundane world and decides to go back to his throne in the magical world.

3.4.4 *Summary*

In this thesis, we consider the triangulation approach as the main theoretical framework. As we pointed out in LITERATURE REVIEW, psychoanalysis methodologies are fruitful resources for emotion research, but are often ignored by the mainstream psychology. In this section we demonstrated a complete procedure for analyzing media content based on archetypal symbolism. Taking into account using this media content as affective stimuli in psychological experiments, this new categorization process functions as the first step in the triangulation approach. In the following chapters, we use this analysis method to build new collections of affective stimuli, and apply the other two indicators of the triangulation for exploring the emotions in archetypal media content. Since archetypes are often manifested in narratives, this analysis method has shown potential values for not only psychological research but also for designing media content.

3.5 IMPLICATIONS FOR RESEARCH AND DESIGN

As we outlined in Section 1.3.2, the first research question has been answered: *How to analyze media content based on archetypal symbolism?* We have constructed a theoretical framework of research, and demonstrate a new categorization process for affective stimuli by analyzing the symbolic meaning of the media content. Next step is to investigate the emotions in these archetypal media content. As we illustrated in Figure 3.1, our research relies on a triangulation approach. In this framework, two different sets of emotion measures are adopted: self-reports and physiological signals. Physiological signals are considered as a neutral measure that is not bounded with any pre-defined emotion models. However, self-report methods are often developed complying with emotion models, such as the discrete model and the dimensional model.

Some previous studies demonstrate how to label or tag the emotional qualities in affective stimuli (e.g. Malandrakis et al., 2011; Soleymani et al., 2012a). While selecting an appropriate model for self-reports, we have to notice that the emotion paradox has not been solved, and the state of the art in psychology has still yet to confirm if emotions are natural kinds. The dimensional model would probably be a more feasible choice due to the fact that it gives more statistical power than discrete emotion model. Nevertheless, since it is still unclear if the emotions in archetypal media content can be retrieved through self-reports, physiological signals serve as an indirect indicator that provides neutral evidence for justifying theoretical hypotheses. By comparing the results from both measures,

it might create a new path for solving the emotion paradox. A more curious hypothesis worth verifying is that: do archetypal media content induce emotions at an unconscious level? Since we adopt Jung's theory to analyze media content, it is reasonable to assume that these movie clips to some extent could induce emotional reactions in people's unconscious. Since our triangulation research method does not solely relies on self-reports, it creates more space for discussion on this unknown phenomenon.

In the field of design, how design content makes meaning has always been an intriguing topic. The impact of social and cultural phenomena toward symbolic meaning of design content has been profoundly discussed (Krippendorff, 1989; Krippendorff & Butter, 1984). As Jung proposed, archetypal symbolism is a discipline that intends to explore a universal pattern of meaning-making that goes beyond society and culture. Since archetypes are manifested in a narrative form, applying archetypal symbolism to analyzing media content seems to be a promising fit. In the context of media design, archetypal symbolism provides a universal structure for constructing narratives and also a reference for forming characters in stories (Campbell, 1973; Voytilla & Vogler, 1999; Vogler, 2007). Relevant applications are considerably broad, such as consumer studies (Caldwell et al., 2010). Connecting archetypal content and emotional responses is a new direction that aims at exploring the emotional feeling toward individual elements in this universal pattern of narratives. We have demonstrated a complete meaning analysis and the editing process for affective stimuli. This would benefit research on emotional experiences toward the content in different forms of media, and also expand our knowledge about how to design emotionally-rich media content.

Part II

EXPLORATIONS

4 EMOTIONS IN ARCHETYPAL PICTURES AND SOUNDS

4.1 INTRODUCTION

Emotion has been intensively discussed in the field of psychology. However, the mainstream of psychological studies mostly focuses on explicit emotions, e.g. anger, fear, joy, disgust, and sadness. These types of emotions are consciously recognizable and can be considered utilitarian in the sense of facilitating our adaptation to events that have important consequences for our wellbeing (Scherer, 2005a). As we pointed out in Chapter 2, contemporary theories of emotion mostly take a functional viewpoint (including biological and social functions), but other aspects of emotions remain unresearched. Some emotions are relatively implicit, ambiguous, and not specifically for utilitarian purposes. These non-utilitarian emotions seem to be ignored in the mainstream psychology, but still play important roles in our daily lives, e.g. emotions in media content. It appears that such emotions are more delicate and difficult to describe. To enrich the diversity of affective content, we attempt to explore new affective content of emotions that emerge without utilitarian reasons.

As pointed out in Chapter 3, archetypal media content is a new category of affective content that is not yet studied by the contemporary psychology. It draws the question that whether archetypal content could elicit emotions that are different from explicit emotions. To initiate this undertaking, we began our exploration with the *Self* archetype. Based on the theory of archetypes, the Self archetypes is the central part of one's mind in the collective unconscious, signifying the unification of consciousness and unconsciousness in a person, and representing the psyche as a whole (Jung, 1964). In ancient cultures, the archetype of the Self was often manifested in visual images and verbal sounds. As the first exploration in this direction, we utilized the archetypal pictures and sounds of the Self as a new class of affective stimuli, and applied an experimental approach to investigate its corresponding emotional responses. At the meantime, we also intend to explore if it is feasible to include physiological measures into this research direction. Since the central idea of Jung's theory address largely on the unconscious, we have to take into account the possibility that archetypal media content might elicit unconscious emotion.

Therefore, an experiment was set up in a laboratory setting. We took the Triangulation approach (see Section 3.2)

The self-report questionnaires and the heart rate measurement were applied in this study for measuring emotional responses from 'the mind' and 'the body' (see Chapter 2 for reviewing measurements of emotion). In addition to the archetypal pictures and sounds,

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This chapter is (partly) based on:

Chang, H.-M., Ivonin, L., Chen, W., & Rauterberg, M. (2013). Feeling something without knowing why: Measuring emotions toward archetypal content. In M. Mancas, N. d' Alessandro, X. Siebert, B. Gosselin, C. Valderrama, & T. Dutoit (Eds.), Intelligent Technologies for Interactive Entertainment–INTETAIN 2013 (LNICST Vol. 124) (pp. 22–31). Cham, Switzerland: Springer.

Ivonin, L., Chang, H.-M., Chen, W., & Rauterberg, M. (2013). Unconscious emotions: Quantifying and logging something we are not aware of. Personal and Ubiquitous Computing, 17(4), 663–673.

existing stimuli of explicit emotions were included as a benchmark for comparison. This experiment should help clarify (1) if the emotion induced by archetypal content is different from explicit emotions, and test (2) if this difference can also be observed in the data of heart rate.

4.2 VISUAL AND AUDITORY AFFECTIVE STIMULI

There are many ways to elicit specific emotions under laboratory settings, e.g. hypnosis, imagery, and presenting affective stimuli (Gross & Levenson, 1995). Among these approaches, presenting affective stimuli is often used for its simplicity and reliability. Unlike the approaches involving confederate interaction procedures, this method may not provide psychological responses of high intensity but it ensures high degree of standardization (Rottenberg et al., 2007). As a benchmark for exploring new content, we look for reliable resources that provide affective stimuli with well documented results.

4.2.1 *Affective Pictures and Sounds*

Bradley and Lang developed the International Affective Picture System (IAPS) (Lang et al., 2008), and the International Affective Digital Sound System (IADS) (Bradley & Lang, 2007a), which are two of the broadly-used databases to investigate the correlation between subjects' self-reported emotions and the presented affective stimuli. IAPS and IADS are being developed to provide dimensional ratings of emotions for a large set of emotionally-evocative, internationally-accessible stimuli that include content across a wide range of semantic categories. Some other studies contribute to find the mapping of stimuli and induced emotions as well (Schmidt & Stock, 2009; Dan-Glauser & Scherer, 2011; van der Zwaag et al., 2011). In this study, we apply IAPS and IADS for the following reasons. First, the databases broadly cover the affective space and have relatively complete contents including pictures and sound clips than other databases. Second, detailed results of the initiators' experiment are provided, which are references for comparison. Finally, several studies utilizing these databases have shown their validity in different regions, including North America, Spain, and Brazil (Lang et al., 2005; Redondo et al., 2008; Ribeiro et al., 2005; 2007).

Auditory contents are another kind of stimuli to evoke emotions. There are considerable numbers of research that discuss how auditory contents influence human's psychological status and induce emotions (Kim & André, 2008; Kreutz et al., 2008; Thompson, 2008; Tan, 2010; Juslin & Sloboda, 2011). Using the same dimensional model as in IAPS, IADS can serve as the basic standard for mapping of sounds and emotions. All the items from the databases can be generally categorized into four groups, which are: Positive-Arousing (PA), Positive-Relaxing (PR), Neutral (NT), and Negative (NG) (Ribeiro et al., 2007). In general, each group of pictures and sounds consists of specific contents (Bradley & Lang, 2007a; Lang et al., 2005). PA pictures include erotic couples, adventure, sports, and food. PR pictures include babies and nature. Neutral pictures include neutral objects and mushrooms. Negative pictures include human threats, animal threats, accident, disgust, illness, and grief. PA sounds include erotic, gamble, adventure, cheering crowds, and baby laughing. PR sounds include nature, rain, water, and classical music. Neutral sounds include neutral

objects and daily behaviors. Negative sounds include screams, crying, accidents, disgust, animal threats, and human threats.

4.2.2 *Archetypal Pictures and Sounds*

Researchers have done numbers of studies on explicit emotions using pictures and sounds. Most of the pictures and sounds of explicit emotions contain extreme content that can be directly linked to high-intensity emotions. For example, the picture of a burned victim reminds participants about pain, hurt, or death; a baby's laughter induces happy feelings; weather forecasts induce boredom. These emotions are connected with survival values and therefore it is natural for human beings to reason the relationship between the stimuli and the induced emotions. In addition to these explicit emotions, some trivial, complex emotions that are not related to survival values have not yet been well studied in empirical studies, e.g. aesthetic emotion (Scherer, 2005a). According to Jung's theory, archetypal content are pictures, sounds and other media content that contains primordial symbols of nature, human and mythical beings (Ronnberg & Martin, 2010). These pictures and sounds of ancient cultures do not directly link to the knowledge that is known in modern people's daily lives, but contain archetypal meanings in human unconscious minds (Rosen et al., 1991; Huston et al., 1999). For example, modern people consider white birds (e.g. doves) as a symbol of 'peace', but its archetypal meaning is actually 'spirit' (see Chapter 3 for more descriptions about the theory of archetypes and archetypal symbolism).

Archetypes have been found to be represented as ancient motifs and predispositions to patterns of behavior that manifest symbolically as archetypal images in dreams, art, or other cultural forms (Jung, 1964). Jung identified various archetypes from his diagnoses of mental disorder in his patients by asking them to verbalize or visualize their dreams (Jung, 1959). He also tried to translate his own emotions into images while he was 'diving' into his unconsciousness, or rather to find the images that were concealed in his emotions (Jung, 1963). The Sanskrit word Mandala means 'circle', which is the Indian term for the circles drawn in religious rituals (Jung, 1959). Mandala represents a structural model of the organization of the universe in the form of the cosmic mountain, where as its strongly marked center stands for a cosmic post determining a center of the mythical world (Kazmierczak, 1990). Jung (1964) considered mandala as a representation of the archetype of the *Self*. The essential form of mandala is composed of a circle with a square or a cross in the middle (see Figure 4.1), as a round canvas with a center point that allows painters to fill any symbols and colors in symmetry (Kazmierczak, 1990). Traditional Tibetan mandala usually contains several layers of concentric circles. The square between the inner circle and the outer circle represents a courtyard with four gates, signifying sacred seclusion and concentration (Jung, 1959). Each layer represents different levels of achievement of the maker's mind, whereas the center of these circles is the final stage, the Great Bliss, becoming an empty, immutable form, or pure essence (Crossman & Barou, 2004).

Mandala is a typical example of the universal symbolic content that exists across culture and time, manifesting in various cultural forms such as the Celtic cross, the halo, the aureole, and rose windows. Moreover, mandala is also considered as a telematics design of the cosmos and consciousness, and represents high-level spirituality of humans (Huh, 2010). Jung (1964) claimed that mandala drawings, whether spontaneous or not, can help enable psychological research to make a closer investigation into its function and meaning. Therefore, some contemporary psychotherapists use mandala drawing as a basic tool

(a) (b) (c)

Figure 4.1: Examples of mandala in different cultures: (a) the basic form of mandala (Kazmierczak, 1990); (b) Tibetan Buddhist thangka painting in 19th century (Wikipedia, 2012c); (c) rose windows in churches of the gothic architectural style (Wikipedia, 2012d).

for self-awareness, self-expression, conflict resolution, and healing (Slegelis, 1987; Curry & Kasser, 2005; Kim et al., 2009). Recent studies have discovered that mandala could be a promising tool for non-verbal emotional communication (DeLue, 1999; Cox & Cohen, 2000; Henderson et al., 2007; Elkis-Abuhoff et al., 2009; Schrade et al., 2011). For patients with post-traumatic stress disorder (PTSD), therapists can diagnose patients' emotional statuses through the mandalas drawn by them while these patients are not willing or not able to discuss sensitive information regarding childhood abuse (Cox & Cohen, 2000). Furthermore, in another study of breast cancer patients, mandala drawings, as a non-invasive assessment tool, allowed the physician to extract valuable information that may have been otherwise blocked by conscious processes (Elkis-Abuhoff et al., 2009). Inheriting the ideas of Jung, the Archive for Research in Archetypal Symbolism (ARAS)[1] was established (Gronning et al., 2007). ARAS is a pictorial and written archive of mythological, ritualistic, and symbolic pictures from all over the world and from all epochs of human history. As the first exploratory study, we selected archetypal pictures that resembled mandala from ARAS.

The work of Bush (1988) applied Mandala and Music Imagery into psychotherapy, which inspired us thinking of applying audio forms of universal symbolic contents into our entertainment systems, such as natural sound and aboriginal music. However, very few resources can be found. However, based on Jung's theory, Solfeggio Frequencies (Wikipedia, 2012a) and 'Om' (Wikipedia, 2012b) would be the closest to what we considered as archetypal sounds. Solfeggio frequencies are a set of six tones that were used centuries ago in Gregorian chants and Indian Sanskrit chants (i.e. 'Om'.) These chants contained special tones that were believed to impart spiritual blessings during religious ceremonies. Solfeggio frequencies introduce the common fundamental sound that can be found in Western Christianity, Eastern Indian religions, and aboriginal music in different countries. Because of its universality, we therefore considered Solfeggio frequencies as archetypal sounds. As mentioned, 'Om' is a typical kind of Solfeggio frequencies. 'Om' or 'Aum' is a sacred syllable in Indian religions (Wikipedia, 2012b). "Here the sound A represents waking consciousness, U dream consciousness, M deep sleep" (Campbell, 1973, p. 247). Putting altogether, this syllable represents an endless cycle, reflecting the absolute reality without beginning or the end and embracing all that exists (Maheshwarananda, 2004).

1 ARAS website can be found at: http://aras.org/index.aspx

4.3 EXPERIMENT

4.3.1 *Materials*

IAPS and IADS contain huge amounts of visual and audio stimuli, including 1194 pictures and 167 sound clips. To reduce the amount of materials for our experiment and also keep the validity of the content of the two databases, we select six stimuli for each category carefully regarding three following principles. First, four featured categories in the affective space of IAPS and IADS had to remain, they are Positive and Arousal (PA), Positive and Relax (PR), Neutral (NT), and Negative (NG) (see Table 4.1 on page 64). Second, the selected stimuli of each category should refer to the feature of the database contents. For example, the PA picture category mainly consisted of pictures about erotic couple, adventure, sports, and food. Thus, the selected stimuli in PA picture category for our experiment should contain all these contents as well. Last, stimuli that can better represent the category should be selected first. For example, for PA category, the most positive and arousing content should be included first.

The same criteria were used to select the materials for the fifth category archetypal content (AR), with the main difference that the distribution of archetypal content in the affective space is not defined yet. To sum up, there were two kinds of media, which were pictures and sound clips; each media contained five categories, which were mentioned above as PA, PR, NT, NG, and AR; each category comprised of 6 stimuli. In total, 30 pictures and 30 sound clips were selected and included as experimental materials in our experiment.

4.3.2 *Participants*

Thirty-six healthy subjects, including 17 males and 19 females, participated in our experiment. Most of the participants were students and researchers associated with Eindhoven University of Technology. The participants had diverse nationalities: 17 from Asia (China, India, Indonesia, and Taiwan), eight from Europe (Belgium, the Netherlands, Russia, Spain, and Ukraine), eight from the Middle East (Turkey and United Arab Emirates), and three from South America (Colombia and Mexico). The mean age is 26.8 years (Std. Deviation=6.06). The participants provided informed consent prior to the start of the experiment and were financially compensated for their time.

4.3.3 *Procedure*

The experiment followed a within-subjects design. The participants executed our experiment separately, and all of them follow the same procedure to watch and listen to all the affective stimuli that are prepared for this experiment. The experiment started with a short introduction to the participant. Next, the participant was seated in front of a monitor for displaying visual stimuli and two speakers for playing audio stimuli. The electrodes for the electrocardiogram (ECG) recording were placed. The ECG was taken with four Ag/AgCl electrodes with gel placed on left and right arms (close to shoulders), and left and right sides of a belly. The electrode placed on the right side of the belly served as a reference. The

Media	Category	Content	Stimuli (Code Name/Source)	Source
Picture	Positive–Arousing	Erotic couples, Adventure, Sports, Food	EroticCouple (4652, 4668), Sailing (8080), Bungee (8179), RollerCoaster (8490), Cupcakes (7405)	IAPS
	Positive–Relaxing	Infants, Nature	Butterfly (1605), Rabit (1610), Baby (2060), NeutBaby (2260), Nature (5760), Clouds (5891)	IAPS
	Neutral	Neutral objects, Mushrooms	Mushroom (5530), RollinPin (7000), HairDrier (7050), Book (7090), Lamp (7175), Cabinet (7705)	IAPS
	Negative	Animal threats, Accident, Disgust, Illness, Grief	BurnVictim (3053), BabyTumor (3170), AimedGun (6230), Attack (6350), Vomit (9321), DeadMan (9412)	IAPS
	Archetypal	Mandala	Mandala(3Hc.041, 3Pa.208, 5Ef.007, 7Ao.014), Mandala (Jung, 1964), the Wheel of Life (Wikipedia, 2011)	ARAS
Sound	Positive–Arousing	Erotic, Gamble, Adventure, Cheering Crowds, Baby laughing	Baby (110),EroticFem1 (201), EroticCouple2 (215), SportsCrowd (352), RollerCoaster (360), Casino2 (367)	IADS
	Positive–Relaxing	Nature, Rain, Classical Music	Seagull (150), Robin (151), Brook (172), Giggling (230), CorkPour (726), Beethoven (810)	IADS
	Neutral	Neutral objects or behaviors	CountryNight (171), Yawn (262), Lawnmower (376), Rain1 (377), Clock (708), BrushTeeth (720)	IADS
	Negative	Screams, Accidents, Disgust, Animal Threats,	Bees (115),Vomit (255), BabiesCry (260), Femscream3 (277), Victim (286), CarWreck (424)	IADS
	Archetypal	Om and Soffegio frequencies	SF396Hz, SF417Hz, SF528Hz, SF639 Hz, SF741 Hz (Welch, 2011), Om (ONEMIND4U, 2006)	Others

Table 4.1: An overview of the affective pictures and sounds used in our experiment.

signal was recorded at 1024 Hz using an amplifier included in ASA-Lab and Advanced Source Analysis.

The participant was then asked to fill in demographic questionnaires while the host was checking the connection of the sensors. The experiment was built with a web-based system and all the experimental data were stored online in the database for further analysis. Before the real experiment started, each participant went through a tutorial to get familiar with the controls and the interface. After introductions and making sure that the participant was calm and ready for the experiment, two sessions were performed: a picture session and a sound session. Once a session began, the screen or the speakers started to display pictures or play sound clips one at a time in a random order. Each picture or sound clip was exposed to the participant for six seconds. Then the stimulus was replaced with a black screen and the interface paused for five seconds. The rating scales to self-report emotional feelings were shown after the pause. Participants had unlimited time to report their emotional feelings. Another five-second pause and a black screen appeared after the self-report, which was meant to let participants calm down and recover from the previously induced emotion. Then the next picture or sound clip was shown or played. All of the 34 participants went through the whole procedure individually.

4.3.4 *Self-Reports*

Introspection toward psychological states is usually done through self-report instrument, such as questionnaires and interviews. When using stimuli presentation techniques in laboratories, researchers often apply Self-Assessment Manikin (SAM) as an instrument for measuring introspection toward emotional feelings (Bradley & Lang, 1994). SAM applies an emotional model called the circumplex model, proposed by Russell (1980) and Barrett (2011). This model is founded based on the assumption that emotion is continuous, not discrete entities (see more in Models of Emotion). The idea is to decompose emotion to a simpler representation with a small number of meaningful dimensions. The most common variation of the dimensional model involves 'unpleasant-pleasant' (valence) and 'activation-deactivation' (arousal) (Lang, 1984). Mehrabia (1980) further proposes to include a third, less strongly-related dimension 'in control – dominated' (dominance) to distinguish different emotions that are plotted almost in the same position in the two-dimension affective space, e.g. anger and fear. Consequently, SAM adopts the above three dimensions and further utilize pictorial figures to replace semantic scales in order to avoid language dependence (see Figure 4.2). By giving a score from one to nine for each of the three dimensions—valence, arousal, and dominance, emotions can be plotted into a three-dimension affective space.

It is claimed that these three dimensions are capable of representing most of human emotions that are commonly known. Since this model is more flexible and easy to understand, it is widely used in many application domains (e.g. Mandryk & Atkins, 2007; Tkalcic et al., 2011; Villon & Lisetti, 2007). For calculation, the scale of all the three ratings is ranging from -4 to 4. We presented all of the selective stimuli to each participant and collect their affective ratings for each stimulus.

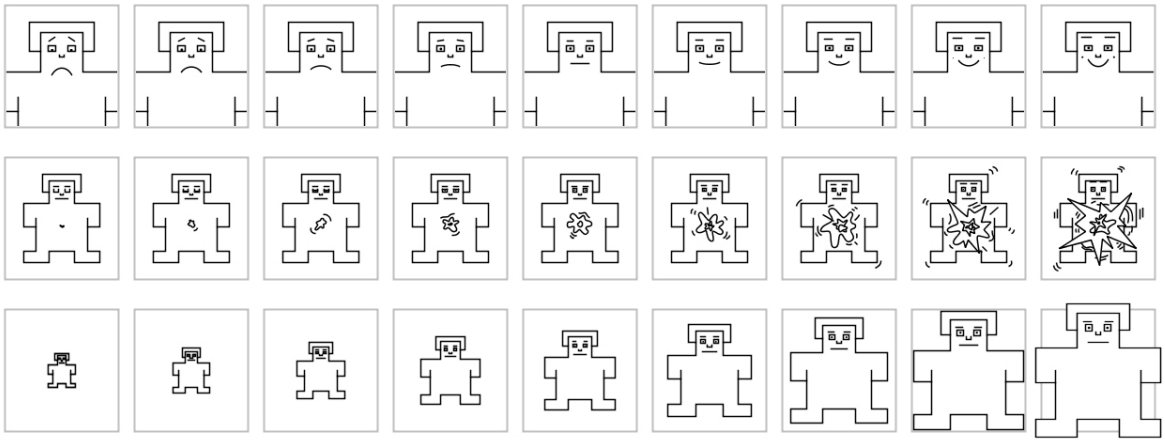

Figure 4.2: Self-Assessment Manikin (SAM) encompasses three dimensions listing from top to bottom: Valence, Arousal, and Dominance (adapted from Bradley & Lang, 1994).

4.3.5 *Physiological Measures*

At the end of the experiment, two data files for every participant were obtained. The first file was retrieved from the presentation system and contained information about the time intervals of stimuli presentations. For every stimulus, the system stored the time when it appeared and disappeared, as well as the time when the rating scales were presented to a subject and the time when the subject submitted the ratings. The second file contained signals from the three ECG electrodes together with the timestamps of beginning and ending of the recording. Normally the ECG signal was taken from electrodes that represent the lead II of Einthoven's triangle, but for some of the participants we had to use the lead I because the signal from the electrode placed on the left side of the belly contained a strong noise. Next, QRS complexes were identified in the ECG signals following the method described in (Chesnokov et al., 2006).

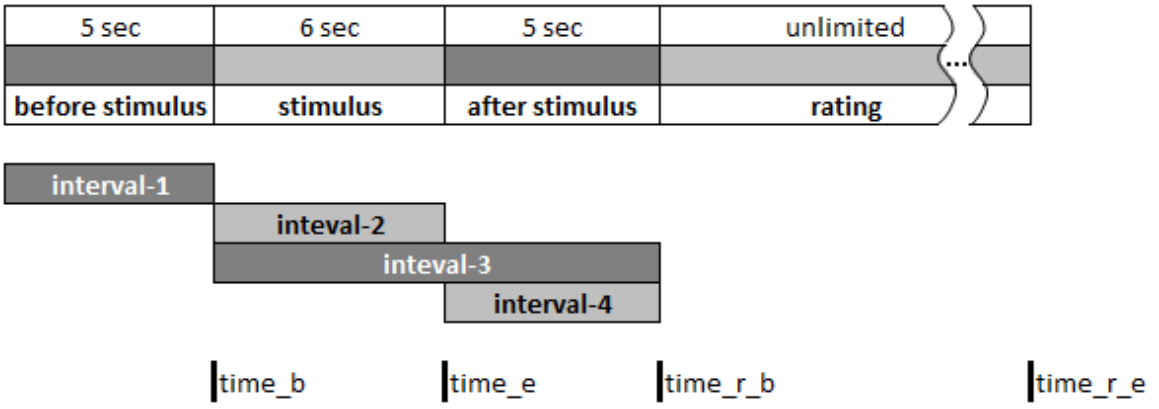

Figure 4.3: The timeline of a stimulus presentation. A stimulus is presented at time_b, and then it is removed at time_e. At time_r_b a participant is presented with the rating scales and at time_r_e the participant submits the ratings.

The specifics of the stimuli presentation procedure is demonstrated in Figure 4.3. The interval-1 is used to calculate average heart rate just before a stimulus is displayed; this

heart rate, therefore, serves as a reference. During the interval-2, a stimulus is presented and for this reason we expect changes in heart rate relative to the interval-1. The interval-3 includes both a stimulus demonstration and a pause with black screen. We expected that, due to the latency of physiological signals, the changes in heart rate might not be visible during the stimulus presentation. Thus, the interval-3 gives extra time to observe changes in heart rate. Additionally we took into account the interval-4 to investigate if there is a difference in heart rate during and after the presentation of a stimulus. The number of heartbeats, time between the beats, and average heart rate per second were calculated with our computer program for every interval mention above. In the statistical analysis the type of media (i.e., picture or sound) and the category of stimuli (i.e., Archetypal, Positive and Relaxing, Positive and Arousing, Neutral, and Negative) were treated as independent within-subject variables, and the average heart rates for the interval-2, the interval-3, and the interval-4 were treated as dependent variables.

4.4 RESULTS

After the experiment three types of heart rate analysis were performed. The first type of analysis studied the values of heart rate that correspond to each category of the stimuli. The second type of analysis examined the changes in heart rate during the stimuli demonstrations with regard to the heart rate calculated for the reference intervals. The third type of analysis aimed to investigate the classification of the emotional categories based on heart rate.

4.4.1 *SAM Ratings*

The multivariate analysis of variance (the multivariate analysis of variance (MANOVA)) for repeated measures is applied for the statistical analysis on self-reports data (i.e. SAM ratings over valence, arousal, and dominance). It shows significant main effects on the variable of media type ($F(3, 33) = 3.466$, $p = 0.027$, Wilks' Lambda) and category ($F(12, 365.405) = 65.049$, $p < 0.001$, Wilks' Lambda). There also exists significance on the interaction between media type and category ($F(12, 365.405) = 4.259$, $p < 0.001$, Wilks' Lambda). Next, we proceeded to look into the test of (univariate) repeated measures **ANOVA!** (ANOVA!) (Huynh-Feldt) on the variable category, the three affective ratings all show significance: valence ($F(3.177, 111.185) = 244.$, $p < 0.001$), arousal ($F(3.332, 116.607) = 78.291$, $p < 0.001$), dominance ($F(2.418, 84.633) = 26.770$, $p < 0.001$).

We performed the tests of within-subject contrasts on affective ratings to see if the emotions induced by archetypal category are different from other four categories of explicit emotions (see Table 4.2 on page 68). Archetypal content was set as the reference category to be compared. The tests on valence dimension between archetypal content (including both pictures and sounds) and other four categories all show significance. Then we look into the descriptive statistics. For both media (pictures and sounds), the rating of archetypal content on valence was lower than positive-relaxing and positive-arousing categories, higher than neutral and negative categories. The explained variance of positive-relaxing ($\eta^2=0.780$) and negative ($\eta^2=0.912$) are remarkably high, whereas positive-arousing ($\eta^2=0.275$) and neutral ($\eta^2=0.103$) are relatively low. Same tests are performed on arousal and dominance. Along these two dimensions, the results only show significance among positive-arousing and

DIMENSION	CATEGORY	PICTURE		SOUND		SPECIFICS OF EFFECT		
		Mean	Std. Dev	Mean	Std. Dev	F Value	P	η^2
Valence	Archetypal	0.94	1.30	0.45	1.55	-	-	-
	Positive-Arousing	216	1.51	1.31	1.76	F(1,35) = 12.708	0.001 ***	0.266
	Positive-Relaxing	2.29	1.48	1.75	1.39	F(1,35) = 120.056	<0.001 ***	0.774
	Neutral	0.62	1.34	0.26	1.29	F(1,35) = 4.546	0.040 *	0.115
	Negative	-2.74	1.53	-2.26	1.63	F(1,35) = 356.606	<0.001***	0.911
Arousal	Archetypal	-0.53	1.60	-0.57	1.81	-	-	-
	Positive-Arousing	1.28	1.73	1.19	1.42	F(1,35) = 124.637	<0.001***	0.781
	Positive-Relaxing	-1.08	2.09	-0.62	1.83	F(1,35) = 1.963	0.170	0.053
	Neutral	-0.82	1.72	-0.22	1.58	F(1,35) = 0.056	0.815	0.002
	Negative	1.66	1.84	1.72	1.43	F(1,35) = 181.015	<0.001***	0.838
Dominance	Archetypal	0.33	1.37	0.44	1.55	-	-	-
	Positive-Arousing	0.91	1.82	0.75	1.64	F(1,35) = 5.935	0.020 *	0.145
	Positive-Relaxing	0.62	1.79	0.62	1.27	F(1,35) = 2.120	0.154	0.057
	Neutral	0.44	1.30	0.02	1.32	F(1,35) = 2.767	0.105	0.073
	Negative	-1.23	2.20	-1.06	1.75	F(1,35) = 35.358	<0.001 ***	0.503

Table 4.2: Statistical results of the affective ratings (valence, arousal, and dominance) on each category of pictures and sounds. Specification of effect column shows the results of the tests of within-subject contrasts on affective ratings, comparing Archetypal category with each of the four categories (Positive-Arousing, Positive-Relaxing, Neutral, and Negative). (* means p value < 0.05, which shows significance; ** means p value < 0.01, which shows high significance; *** means p value <= 0.001, which shows very high significance.)

negative categories. Then we looked into the descriptive statistics (see Table 4.2 on page 68). For both media (pictures and sounds), the arousal rating of archetypal category is lower than positive-arousing and negative categories; the dominance rating of archetypal category is lower than positive-arousing category, but higher than the negative category.

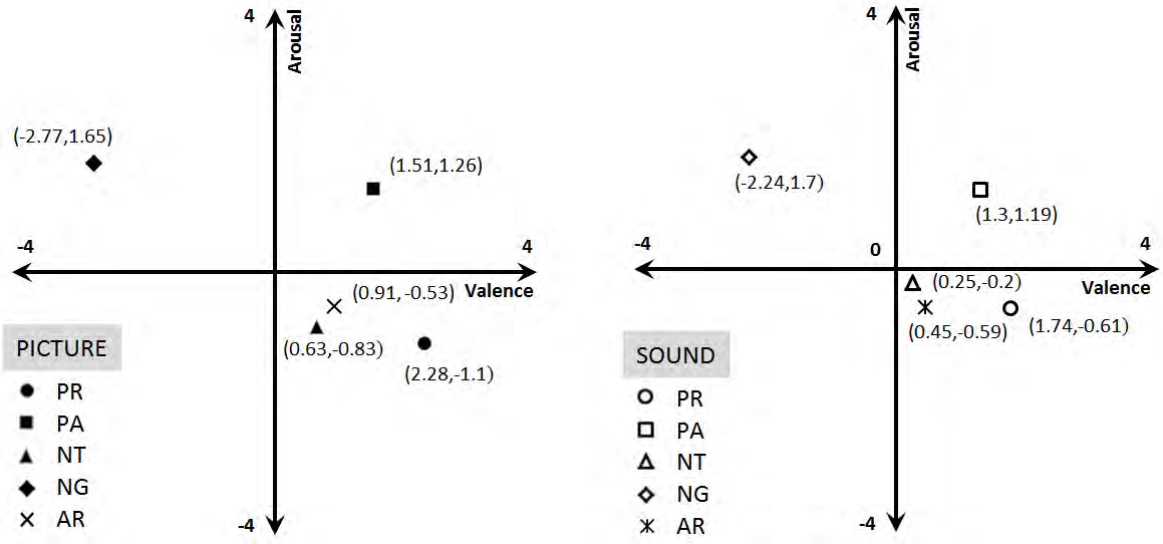

Figure 4.4: Plots for SAM ratings on affective pictures (the left panel) and sounds (the right panel).

Scatterplots of the ratings on valence and arousal (see Figure 4.4) provides a general overview of archetypal content and plot the other four categories in affective space. It needs to be noticed that the distribution of the archetypal category (both pictures and sounds) in the affective space is very close to the neutral category. Moreover, the significance appears to be very weak (p = 0.049) and the explained variance is relatively low (η^2=0.103). Therefore, we performed an in-depth analysis specifically on the comparison between the archetypal category and the neutral category. It still showed significant main effects on the variable of media type (F (3, 34)=4.218, p = 0.012, Wilks' Lambda) and the interaction between media type and category (F(3, 34)=6.162, p=0.002, Wilks' Lambda). However, the significance on the variable category disappeared (F (3, 34)=1.946, p=0.141, Wilks' Lambda). In order to have a clear view of the difference between the archetypal content and the neutral content, we proceeded to conduct the same test on different media type (pictures and sounds) separately. The results can be found in Table 4.3.

Media	Valence	Arousal	Dominance
Picture	F(1,36) = 5.151 p = 0.029 *	F(1,36) = 5.820 p = 0.021 *	F(1,36) = 0.911 p = 0.346
Sounds	F(1,36) = 1.321 p = 0.258	F(1,36) = 2.764 p = 1.05	F(1,36) = 7.040 p = 0.012 *

Table 4.3: Further comparison between Archetypal and Neutral categories.

For the media type of picture, it demonstrated significant effects on the valence dimension (F(1,36) = 5.151, p = 0.029) and the arousal dimension (F(1,36) = 5.820, p = 0.021). For the other media type—sound, only the dominance value shows significance (F(1,36)

= 7.040, p = 0.012). Bringing all the above analysis together, it can be argued that the emotions induced by archetypal content are distinctive from most of the explicit emotions. Although the differences between archetypal content and the neutral content are relatively minor, they can still be differentiated if we compare them only with the same media type.

4.4.2 *Heart Rate Measures*

As the experiment followed a within-subject design and the stimuli for every participant were presented in a random order, the effect of ECG baseline drift is leveraged. Therefore, it is reasonable to make a comparison of average heart rates during the presentations of different stimuli. Descriptive statistics for average heart rate and the changes in heart rate during emotion elicitation for different intervals of time is presented in Table 4.4 on page 71.

The multivariate analysis of variance (MANOVA) for repeated measures is applied for the statistical analysis on average heart rate. It shows significant main effects on the variable of media type (F (3, 33) =3.567, p = 0.024, Wilks' Lambda) and category (F (12, 24) = 2.947, p=0.012, Wilks' Lambda). There is no interaction between media type and category (F (12, 24) =1.084, p=0.415, Wilks' Lambda). Next, we proceeded to look into the test of (univariate) repeated measures **ANOVA!** (Huynh-Feldt) on the variable category, the averaged heart rates in the three time periods all show significance: interval-2 (F(3.704, 129.653) =4.595., p=0.002), interval-3 (F (3.551, 124.275) =5.092, p=0.001), interval-4 (F(3.704, 129.626) = 4.349, p=0.003).

At the next step of our analysis, the changes of heart rate during the presentation of stimuli relative to the reference intervals were examined. For every stimulus, first, an average heart rate for the reference interval (interval-1) was calculated, and then the differences between the calculated value and the average heart rates at interval-2, interval-3, and interval-4 were determined.

In the statistical analysis the type of stimuli (i.e., picture or sound) and the category of stimuli (i.e., Archetypal, Positive and Relaxing, Positive and Arousing, Neutral, and Negative) were treated as independent within-subject variables. The changes in heart rate for interval-2, interval-3, and interval-4 were treated as dependent variables. MANOVA for repeated measures is applied for the statistical analysis on average heart rate. It shows significant main effects on the variable of media type (F (3, 33) =1.888, p = 0.151, Wilks' Lambda) and category (F (12, 24) = 2.364, p=0.035, Wilks' Lambda). There is no interaction between media type and category (F (12, 24) =1.018, p=0.463, Wilks' Lambda). Next, we proceeded to look into the test of (univariate) repeated measures **ANOVA!** (Huynh-Feldt) on the variable category, the changes of the heart rate in the first two time periods shows significance: interval-2 (F(3.979, 129.252) =6.072., p<0.001), interval-3 (F (3.440, 120.406) =3.421, p=0.015), but the changes of the heart rate after the stimulation (i.e. interval-4) does not show significance: (F(3.394, 118.803) = 1.948, p=0.118). In order to graphically illustrate the dynamic of changes in heart rate during the interval-3, which lasts 11 seconds, we plotted two diagrams (Figure 4.5 and 4.6). In Figure 4.5, data series that correspond to different types of media are presented. Changes in heart rate during the interval-3, which are related to the categories of emotional stimuli, can be seen in Figure 4.6.

TIME PERIOD	CATEGORY	AVERAGE HEART RATE				CHANGES IN HEART RATE			
		PICTURE		SOUND		PICTURE		SOUND	
		Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev	Mean	Std. Dev
Interval-2	Archetypal	72.79	10.78	70.79	10.17	-1.24	4.44	-2.34	4.00
	Positive-Arousing	71.89	11.72	70.75	10.51	-1.73	5.00	-2.15	5.08
	Positive-Relaxing	72.98	11.28	71.95	10.29	-0.38	6.80	-1.37	5.25
	Neutral	72.6	11.34	70.91	10.07	-1.90	4.83	-2.17	4.15
	Negative	71.55	11.32	70.97	11.06	-2.20	4.61	-2.32	4.32
Interval-3	Archetypal	72.57	10.68	70.58	10.03	-1.47	3.97	-2.54	4.06
	Positive-Arousing	71.7	11.15	70.69	10.34	-1.92	4.21	-2.22	5.05
	Positive-Relaxing	72.76	11.23	71.72	10.18	-0.60	6.68	-1.60	5.11
	Neutral	72.56	10.95	71.14	9.83	-1.94	4.31	-1.94	4.09
	Negative	71.92	11.00	71.14	10.85	-1.83	4.51	-2.15	4.30
Interval-4	Archetypal	72.45	11.12	70.44	10.01	-1.59	4.99	-2.68	4.83
	Positive-Arousing	71.49	11.22	70.61	10.55	-2.13	5.00	-2.3	5.88
	Positive-Relaxing	72.68	11.93	71.52	10.54	-0.69	7.59	-1.81	5.67
	Neutral	72.52	10.89	71.34	10.41	-1.98	4.69	-1.73	5.85
	Negative	72.36	11.18	71.45	10.91	-1.40	5.79	-1.84	5.09

Table 4.4: Descriptive statistical results of the ECG data in different time periods (Interval-2, Interval-3, and Interval-4, see Figure 4.3) on toward the five categories of pictures and sounds: Archetypa, Positive-Arousing, Positive-Relaxing, Neutral, and Negative (N=36).

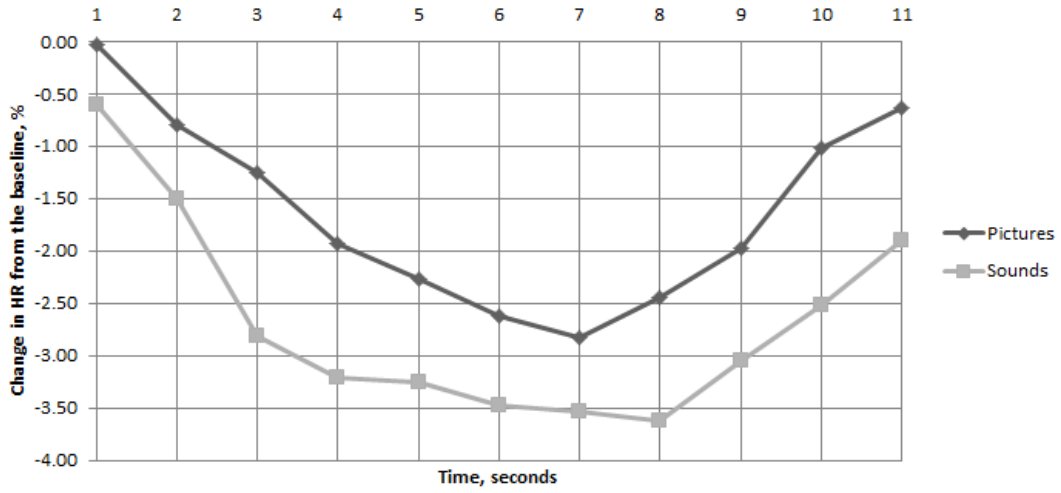

Figure 4.5: Changes in heart rate (HR) from the baseline, which is defined by the interval-1, for different types of media during the interval-3.

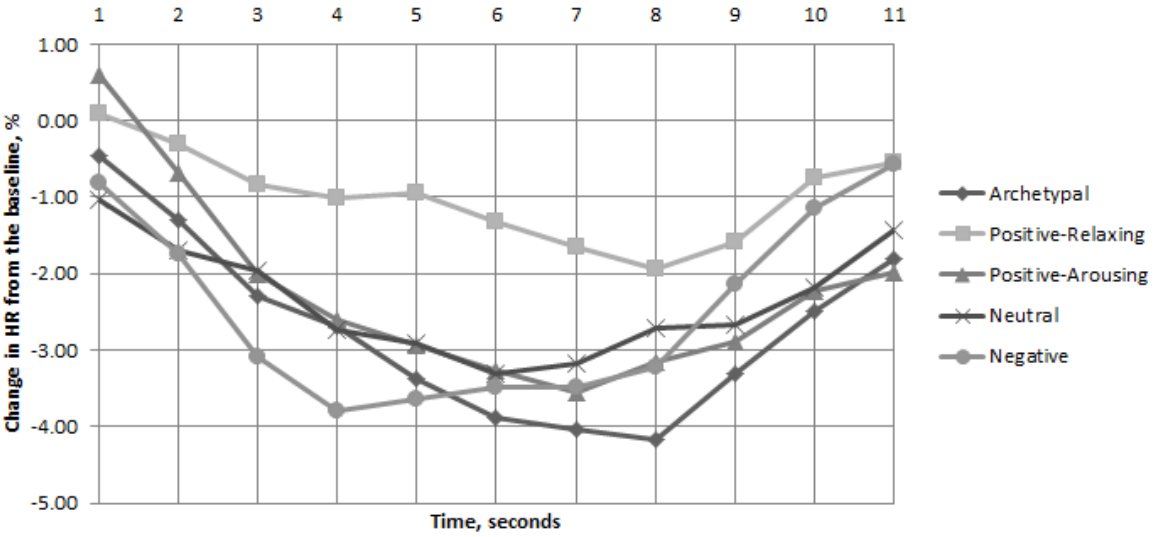

Figure 4.6: Changes in heart rate (HR) from the baseline, which is defined by the interval-1, for five categories of stimuli during the interval-3.

4.4.3 *Cultural Differences*

In this study we had participants from various geographical locations (17 from Asia, 8 from Europe, 8 from the Middle East, and 3 from South America). One interesting question is whether subjects from different cultural backgrounds would feel differently toward the same stimuli. We perform a between-subject statistical analysis on emotional responses, grouping the subjects by geographical continents. For self-reports, the SAM ratings do not show significant effects over different continents ($F(9, 73.163) = 1.840$, $p = 0.075$ (Wilks' Lambda)). As for ECG data, the between-subject comparison do not show significance on cultural differences for the average heart rate ($F(9, 73.163) = 1.459$, $p = 0.180$ (Wilks' Lambda)), as well as the changes of the heart rate: ($F(9, 73.163) = 1.724$, $p = 0.448$ (Wilks'

Lambda)). Therefore, we reject the hypothesis that cultural background might affect people's emotional responses, even toward archetypal content.

4.4.4 *Discriminant Analysis*

As we have confirmed the significant main effects on the media type, we therefore fed the SAM ratings for affective pictures and sounds separately into Linear Discriminant Analysis (Linear Discriminant Analysis (LDA)), and obtained two predictive models. We present the confusion matrices generated by LDA to evaluate how well the model can predict stimuli of each category based on the data of the SAM scale. Only the cross-validated results are reported. The predictive model derived from LDA on the data for affective pictures obtains 55.9% accuracy and the effect size is large (canonical correlation = 0.767). On the other hand, the predictive model derived from LDA on the data for affective sounds obtains an accuracy of 49.2% and the effect size is also large (canonical correlation = 0.767). Based on the obtained confusion matrices (see Table 4.5 and Table 4.6), we can see that all the four stimuli of explicit emotions can be easily recognized, which means that the selected stimuli are nicely chosen to be a benchmark. However, archetypal pictures are more likely to be recognized as the neutral or positive relaxing pictures. Meanwhile, archetypal sounds can be correctly recognized up to 30.1% accuracy. To summarize, although archetypal pictures and sounds are significantly different from other four categories of stimuli of explicit emotions, the predictive models seem still not robust enough for emotion recognition.

Confusion Matrix of the Self-Report Data for Pictures					
Classified as →	AR	PR	PA	NU	NG
Archetypal	12.0	25.0	13.0	**46.3**	3.7
Positive-Relaxing	6.5	**56.0**	23.6	11.6	2.3
Positive-Arousing	6.5	14.4	**61.6**	6.9	10.6
Neutral	8.8	15.3	9.3	**63.0**	3.7
Negative	2.3	0.9	2.8	6.9	**87.0**
Canonical correlation = 0.767, Effect Size = Large, 55.9% of cross-validated grouped cases correctly classified.					

Table 4.5: The confusion matrix of the model obtained from LDA on the SAM ratings for the affective picture categories (in percentage), including Archetypal (AR), Positive-Relaxing (PR) Positive-Arousing (PA), Neutral (NT), Negative (NG). Each row shows the probability of which category the stimulus is classified. The values with underlined digits indicate the accuracy each archetype can be correctly classified. The values with bold style indicate the highest probability in each row.

Confusion Matrix of the Self-Report Data for Sounds					
Classified as →	AR	PR	PA	NU	NG
Archetypal	**30.1**	21.8	9.7	20.8	17.6
Positive-Relaxing	13.4	**45.4**	24.1	13.9	3.2
Positive-Arousing	3.2	16.2	**56.5**	12.0	12.0
Neutral	**30.1**	13.0	13.9	29.6	13.4
Negative	1.9	2.3	7.9	3.7	**84.3**
Canonical correlation = 0.678, Effect Size = Large, 49.2% of cross-validated grouped cases correctly classified.					

Table 4.6: The confusion matrix of the model obtained from LDA on the SAM ratings for the affective sound categories (in percentage), including Archetypal (AR), Positive-Relaxing (PR) Positive-Arousing (PA), Neutral (NT), Negative (NG). Each row shows the probability of which category the stimulus is classified. The values with underlined digits indicate the accuracy each archetype can be correctly classified. The values with bold style indicate the highest probability in each row.

Finally, a discriminant analysis was conducted to investigate if heart rate data can be used to predict the categories of emotional stimuli. The changes of heart rate from the baseline during the interval-3 were used as predictor variables. Significant mean differences were observed at seconds 4, 5, and 6 on the category of emotional stimuli. Although the log determinants for different categories of stimuli were quite similar, Box's M test was significant (Box's M value = 893.599, $p < 0.001$), which indicates that the assumption of equality of covariance matrices was violated. However, taking into account the large sample size (N = 2160), the results of Box's M test can be neglected (Burns & Burns, 2008). A combination of the discriminant functions revealed a significant relation ($p = 0.019$) between the predictor variables and the categories of emotional stimuli, and the classification results showed that 23.5% of the original cases and 22.5% of cross-validated grouped cases were correctly classified. Although these classification rates are not very high, they are still above the chance level (20% in the case of five categories of stimuli).

4.5 DISCUSSION

The experimental results enabled us to draw several conclusions. According to the analysis on self-report data, it is clear that archetypal stimuli (AR) are distinctive from most of the stimuli of explicit emotions (e.g. Positive-Arousing, Positive-Relaxing, and Negative). Although we can still differentiate archetypal and neutral categories, it appears that the emotional responses to these two categories seemed to be very similar to each other. These results address the limitation of the three dimensions in the dimensional model of emotion. Since the SAM scale was designed focusing on the investigation of explicit emotions, it is unclear if it is capable of representing emotions without utilitarian concerns. In fact, the term "neutral" is ontologically ambiguous for a category of affective stimuli, in that those emotions that cannot be well explained by the existent three dimensions might eventually fall into this "neutral" category. For example, IAPS contains some stimuli of 'abstract art' that are also considered to be neutral (e.g. No.7192 in IAPS), as well as daily objects such as a hair dryer (No.7050 in IAPS). Do people feel the same when looking at a picture

of art painting and a hair dryer? If we admit that the emotions in these two scenarios should be different, we should also acknowledge the limitation of the existent emotion models for representing emotions without survival reasons or evolutionary values. In the case of dimensional model, it seems that we need more dimensions in affective space for representing non-utilitarian emotions.

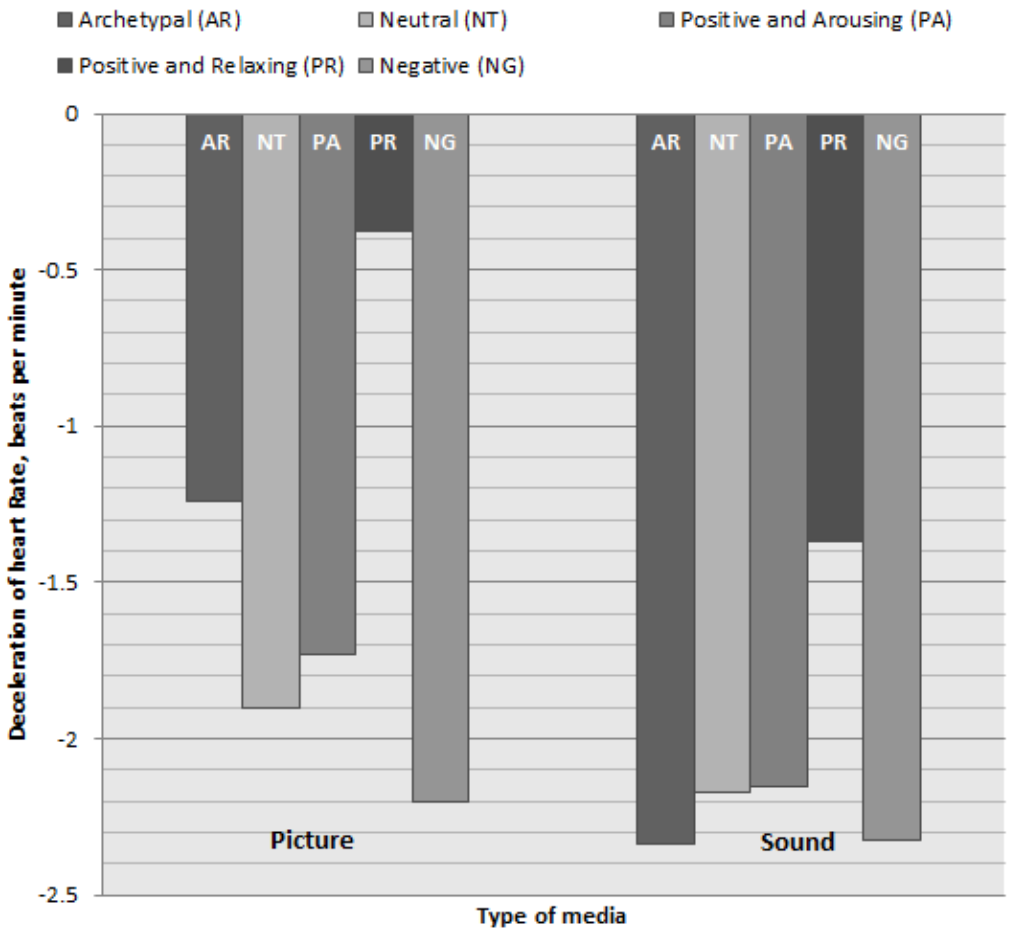

Figure 4.7: The deceleration of heart rate for different types of media and categories of stimuli during the interval-2.

For the analysis of the average heart rate during the demonstration of a stimulus and for the analysis of the change in average heart rate during the stimulus presentation, the statistical tests show a significant main effect of the category of the stimuli on heart rate. As for the second question we drew at the beginning, the results of the analysis on the heart rate data suggest that the emotion induced by archetypal content could be shown in the heart rate pattern. However, it is necessary to note that for the change of the average heart rate, the test was significant only for the interval-2 and the interval-3, while for the average heart rate the test was significant for the interval-2, the interval-3, and the interval-4. According to the previous research about the response of heart rate to emotional stimuli (Palomba et al., 1997), the absence of the significant main effect of category during the interval-4 can be explained by the fact that the largest change in heart rate happens during the first two seconds of a stimulus presentation. Figure 4.7 illustrates the average heart rate

changes measured on the interval-2 with a reference to the interval-1. It can be observed that, independent of the media type and the category of stimuli, heart rate exhibits a general decelerating response. This finding is in accordance with the previously reported results (e.g. Winton et al., 1984; Palomba et al., 1997).

Moreover, deceleration of heart rate, which followed presentation of the archetypal stimuli to the participants, was different from deceleration of heart rate after demonstration of other stimuli. It is obvious that even theoretically heart rate alone will not allow precise classification of emotions because emotion is a multidimensional phenomenon, and heart rate provides just one dimension. Our experimental results support this point of view with the classification rate of 22.5% above the chance level, which is lower than in some studies that focus on a fewer number of emotions and utilize various physiological signals in addition to heart rate (e.g. Kreibig et al., 2007). This result might be due to the fact that we used a small number of affective stimuli in each category, so the robustness of the obtained predictive model would be reduced. Moreover, pictures and sounds are relatively simple comparing to other complex media forms such as movie clips. The subjects might be less immersed by solely watching and listening to the stimuli presented for six seconds.

Nevertheless, this study reveals promising results as the first attempt in this direction. The preliminary results suggest that the emotion elicited by archetypal content is different from explicit emotions that are triggered by utilitarian reasons. More importantly, this phenomenon is universal over people from different cultural background. Therefore, we proceed with this direction. The following studies would include more categories of archetypal content, and use a more complex, emotionally-rich media type in order to enhance the effectiveness of emotion elicitation. Moreover, this study also confirms the validity of using physiological signals to recognize emotions in media content. Other features of the ECG signal could also be useful for measurement of emotions. Along with heart activities, other physiological signals, such as galvanic skin response and respiration rate, should be integrated for future studies. Additional physiological signals are important because eventually they might allow establishing one-to-one links between the profile of physiological response patterns and emotional experiences across time (Cacioppo & Tassinary, 1990).

4.6 CONCLUSION

Our research aims at exploring new affective content to enhance the richness of emotional information that can be used for human-computer interaction. The above preliminary findings demonstrated that archetypal symbolism could be a new resource for developing new affective content for designing emotionally charged communication. Besides the archetype of the Self, many other kinds of archetypal content is still available, e.g. hero and shadow. Emotions that induced by these contents are still unknown. It would be a promising direction to investigate the emotional qualities induced by archetypal content, and utilize the findings to design a better media to communicate emotional experiences for various applications.

5 EMOTIONS IN ARCHETYPAL AUDIOVISUAL CONTENT

5.1 INTRODUCTION

Emotion plays an important role in media experience, particularly for entertainment purposes (Tan, 2008). Along with the advances of digital media technology, the emotional experience delivered by media content becomes richer and more complex. Investigating emotional experiences in media content becomes more challenging for psychologists due to the fact that the media content is usually continuous and interrelated. Different from traditional psychologists who intend to extract essential emotional qualities that human beings might have, e.g. happy and anger, media psychologists embrace the complexity of the emotions in media content and look into how mixed emotions emerge along with the sequence of the media content (Wirth & Schramm, 2005). The interest in emotions induced by media content was first revealed by Münsterberg (1916). As one of the pioneers in psychological studies on films, he argued that the viewer does not experience the reality in the theatre, but rather a mental perception of the fictional reality in films. The experience of viewing films stimulates the mental structures of the mind by means of its structural similarity to the mind itself. This research strand extended with the advances of media technology, ranging from television (Zillmann, 1991) to various kinds of digital media in modern times (Wirth & Schramm, 2005).

Traditional psychological studies tend to focus on specific emotional qualities, such as joy and anger (Ekman, 1992). Researchers, especially basic emotion theorists, consider emotions as a kind of discrete states that are hard-wired biologically, so that emotional experience is actually a process of staying or switching emotional states. These emotions are usually termed as 'explicit emotions' because they are universally recognized and usually can be easily perceived and expressed. There are many ways of eliciting specific emotions in subjects under a laboratory setting (Gross & Levenson, 1995). In our previous study presented in Chapter 4, we have used affective pictures and sounds for emotion elicitation. Comparing to pictures and sounds, film is a rather unique media type as it involves an integration of visual and auditory stimuli. Moreover, films encompass a series of narratives, constructing a continuous stimulation process to the viewer. As for traditional approaches, the transition of the emotional experience is critical to emotion recognition due to the fact that the emotional qualities are *mixed* during the transitions. To reduce the complexity for analysis, they tend to use affective stimuli filled with the same emotional quality (Rottenberg et al., 2007). For example, in order to measure the emotion of anger, the subject should be exposed to a film clip with offensive content throughout the course of the view-

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This chapter is (partly) based on:

Chang, H.-M., Ivonin, L., Diaz, M., Catala, A., Chen, W., & Rauterberg, M. (2013). What do we feel about archetypes: Self-reports and physiological signals. In Proceedings of 21st European Signal Processing Conference-EUSIPCO2013 (Session Tu-L10) (pp. 1–5). Marrakech, Morocco: EURASIP Open Library.

Chang, H.-M., Ivonin, L., Diaz, M., Catala, A., Chen, W., & Rauterberg, M. (n.d.). From symbolic meanings to emotions: A new strategy for selecting affective stimuli to discover unknown emotions. Psychological Reports. Under review.

ing experience. This approach is widely accepted in the field of experimental psychology and Affective Computing. However, other psychologists hold different views toward emotions. Rather than seeing emotions as static mental entities, recent years have seen growing trends considering emotion as a continuous, dynamic mental process that should not be limited in the view of discrete states (Barrett, 2011).

In media psychology, Zillmann (1983) pioneered the *excitation-transfer theory* by taking into consideration the overlap between two sequential stimulus events. This is due to the fact that physiological arousal induced by some events dissipates slowly, so that if two arousing events happen within a certain amount of time from each other, the first event might be misattributed and transferred to the second event (Anderson & Bushman, 2002). He further points out that the residual excitation from one stimulus event will amplify the excitatory response to the next stimulus event even if the emotional valence may vary (i.e. from pleasant to unpleasant, or vice versa). In this regard, this effect is not limited to a single emotion but could occur between different emotional qualities. Zillmann (1983) believes that the transition of emotional experience is not merely a switch between two different emotional states, but a cumulative phenomenon that emerges along with the media content exposed to the viewer. This theory to some extent resonates with our daily experience in viewing media content. Rather than seeing emotions as discrete entities, emotional experience for viewing media content should be seen as a continuous, aggregate and dynamic phenomenon emerging along with the storyline. Researchers also need to take into account the temporal dimension and identify patterns of emotional experience instead of momentary emotional states.

In our preliminary study reported in Chapter 4, we started with the experimental settings of contemporary psychology using affective stimuli with the static media types (i.e. six-seconds exposure of still pictures and sounds) to investigate whether subjects felt differently about archetypal content of the 'Self' archetype and existing affective stimuli of explicit emotions. The initial evidence have revealed that archetypal content may induce emotions that are not yet addressed by contemporary psychology; the distinction between the emotional responses to archetypal content and other existing affective stimuli can be differentiated by cardiovascular activities (i.e. ECG). Most importantly, this phenomenon is valid among subjects from different cultural backgrounds, allowing us to assume that the emotional responses to archetypal content are universally consistent.

Among all kinds of media types, movies are probably one of the most immersive kinds for their combination of visual and auditory modalities (Gross & Levenson, 1995). They also have a relatively high degree of ecological validity, meaning that their dynamic display resembles real life scenarios. Another characteristic of film clips is the capability to elicit intensive emotional responses that lead to activations in cognitive, experiential, central physiological, peripheral physiological and behavioral systems (Rottenberg et al., 2007). For the above reasons, we conducted a new study using the media type of movies in order to investigate emotional experience when viewing archetypal audiovisual content.

5.2 TRIANGULATION RESEARCH METHOD

Traditionally, most researchers have considered introspective judgments about emotional feelings to be fundamentally valid or correct (e.g. Osgood et al., 1975; Bradley & Lang, 2007a) because it is assumed that human beings are capable of conceptualizing their own emotions in a universally recognized way. This approach has widely been used in psychol-

ogy to develop various models of emotion, such as the discrete emotions (Ekman, 1992) and dimensional model of emotion (Russell, 1980). These models have been broadly used and proven to be reliable in empirical research. Thus, many researchers tend to employ these existing models as the foundations of their research on emotions. In practice, most researchers chose an existing model of emotion and selected affective stimuli on the basis of this model. Next, researchers recruit subjects to report their emotions about these stimuli by using self-report techniques (e.g. Bradley & Lang, 1994). Finally, the emotional qualities of these stimuli can be confirmed if the statistical analysis demonstrates significance.

Although contemporary research on emotion largely relies on this approach, several potential problems have to be noted. Firstly, the premise of this approach may lead to so-called *emotion paradox* (Barrett, 2006b). People assume explicit emotions exist because they can 'feel' them as if they are ontologically-objective phenomena while there is insufficient evidence to prove these emotional qualities are biologically bound (Barrett, 2006a). While it has been noted that many emotional qualities are difficult to express, applying existing models as the basis for selecting stimuli may limit the coverage of collections in a pre-defined range. Secondly, existing models are language-dependent and usually based on self-reports; these models are by definition not suitable for research on unconscious emotions (see Section 2.3 for review of models of emotion). Thirdly, traditional approaches only reach 'face validity' but cannot fulfill the requirement of 'construct validity' (Dey, 1993; Kumar, 2010) because the pre-defined emotional qualities serve as the only indicator in empirical research on emotion. This means that traditional approaches could only test 'the accuracy of a measurement' but are incapable of testing 'the degree to which a measurement could reflect what it claims, or purports, to be measuring'.

As we proposed in Chapter 3, our research followed a triangulation paradigm (Moran-Ellis, 2006) using mixed research methods (Johnson & Onwuegbuzie, 2004). We particularly emphasize the importance of the content of the stimuli and analyze its symbolic meaning qualitatively. To investigate the relationship between the content of the stimuli and the induced emotions, self-reports and physiological signals are both included for quantitative measurement of emotional responses. Physiological signal measurement serves as an indirect indicator that reflects another important aspect of emotions and it is more effective for investigating continuously-changing emotional experiences when viewing media content. Rather than assuming introspective judgments about emotional feelings to be fundamentally correct, this approach relies on the premise that self-reports and physiological signals are complementary, and both reflect parts of the nature of emotion. The investigation on emotions would benefit from comparison between the results from both measurements. This approach is suitable for studying emotional experiences that are difficult to access by introspection, e.g. unconscious emotions.

In the present study our primary goal was to empirically explore emotional responses to various categories of archetypal movie clips. As we have described in the introduction, our research do not apply the discrete emotion classification because it does not take into account the continuity of emotional experience when viewing media content. While many previous studies have strived to 'label' emotional qualities coincide along with storylines of movies, we intended to answer several fundamental questions as follows. Firstly, since archetypal content is a new class of affective stimuli, it is yet to discover if emotional experience of viewing archetypal movie clips can be effectively reflected by introspections and physiological signals. Secondly, it is necessary to investigate whether archetypal content may induce unconscious emotion as Jung (1959) had claimed that archetypes were hidden

in humans' unconscious mind. An experiment was conducted in a laboratory setting using the triangulation research method in order to answer the above research questions.

5.3 EXPERIMENT

5.3.1 *Archetypal Movie Clips*

In Chapter 3 we developed a method for analyzing media content on the basis of archetypal symbolism. This method was developed according to the theory of archetypes (Jung, 1959) and has widely been used for movie analysis (e.g. Hauke & Alister, 2001). Rather than analyzing perceptual qualities of the movies such as brightness and filming styles, archetypal symbolism specifically focuses on narratives of movies and their symbolic meaning from a psychoanalytical perspective. We applied the method we described in Chapter 3 to develop archetypal movie clips.

Eight categories of archetypal content were selected for this study, including anima, animus, hero's departure, hero's initiation, hero's return, mentor, mother and shadow. The archetypes of anima, animus and shadow were chosen based on the work of Jung (1959; 1964). The archetypal content of the hero's journey was derived from the work of Campbell (1973). Hero's journey represents the universal patterns of narratives in myths and religions in various cultures, encompassing three main stages: departure, initiation, and return. The archetype of mentor also comes from the research of Campbell and represents a character that helps the hero to acquire knowledge and power. Mother is another essential archetype that represents a superordinate personality of a maiden (Maloney, 2002), which is also included in our experiment. Chapter 3 provided more detailed descriptions about the symbolic meaning for each archetypes.

One short movie clip (approximately five minutes) for each category was edited from commercial movies. The detailed description about the time periods edited from the movies is showed in Table 5.1. All the eight movie clips were reviewed and approved by the external experts from ARAS (see Chapter 3 for the editing procedure). Except archetypal movie clips, five movie clips of explicit emotions were included to serve as a benchmark for comparison of emotional responses in the same laboratory settings (see Table 5.2).

5.3.2 *Emotion Recognition Technique*

Together with emotion elicitation, the other essential issue is emotion recognition. Emotional responses can be measured in at least three different manners: self-reports, physiological reactivity, and behavioral acts (Lang, 1969). These techniques can generally be classified into subjective and objective techniques. Subjective techniques rely on self-reflection about psychological states, such as questionnaires and interviews, whereas the objective techniques are observational data from behaviors, including facial expressions, performance on a task, gestures, body stance or physiological measurement. When using stimuli presentation techniques in laboratories, researchers often apply Self-Assessment Manikin (SAM) (Bradley & Lang, 1994) as a subjective technique, and physiological measurement as the objective technique.

SAM is broadly used in research on emotions, and becomes a very common standard of self-report technique for emotions. The dimensional model to represent human emotions

Archetype	Movie	Length	Start	End
Anima	American Beauty (Mendes, 1999)	5′10″	0:15:02	0:17:20
			0:19:03	0:20:04
			0:36:09	0:37:28
			0:43:39	0:44:11
Animus	Black Swan (Aronofsky, 2010)	5′29″	0:46:40	0:49:24
			1:17:22	1:18:22
			1:19:13	1:20:48
Hero's Departure	Braveheart (Gibson, 1995)	5′08″	0:04:50	0:06:18
			0:09:05	0:10:02
			0:13:17	0:16:00
Hero's Initiation	Braveheart (Gibson, 1995)	6′37″	0:36:11	0:37:00
			0:38:10	0:39:05
			0:39:22	0:41:43
			0:47:21	0:49:01
			0:49:58	0:50:50
Hero's Return	Braveheart (Gibson, 1995)	5′12″	2:43:17	2:46:31
			2:47:08	2:47:48
			2:48:55	2:50:14
Mentor	The King's Speech (Hooper, 2010)	4′46″	0:25:40	0:27:55
			0:35:00	0:36:01
			0:37:14	0:38:44
Mother	All About My Mother (Almodóvar, 1999)	5′08″	0:02:50	0:04:22
			0:04:56	0:07:06
			0:08:28	0:08:57
			0:09:00	0:09:11
			0:10:32	0:10:48
			0:11:52	0:12:19
Shadow	Fight Club (Fincher, 1999)	5′04″	0:51:07	0:51:27
			0:59:18	1:01:50
			1:47:41	1:49:53

Table 5.1: The editing instructions of archetypal movie clips for the second study

Emotion	Movie	Length	Start	End
Positive–Arousing (Amusement)	Mr. Bean (Davies, 1992)	5′11″	0:02:37	0:03:57
			0:04:54	0:08:45
Positive–Calm (Joy)	The Lion King (Allers & Minkoff, 1994)	5′13″	0:15:30	0:18:13
			0:45:19	0:46:48
			0:47:51	0:48:52
Neutral	Coral Sea Dreaming (Hannan, 2010)	5′06″	0:08:01	0:13:07
Negative–Arousing (Fear)	The Silence of Lamb (Demme, 1991)	5′05″	1:39:37	1:44:42
Negative–Calm (Sadness)	Forrest Gump (Zemeckis, 1994)	5′12″	1:02:21	1:07:31

Table 5.2: The editing instructions of explicit-emotion movie clips for the second study

is applied. By giving a score from one to nine for each of the three dimensions—valence, arousal, and dominance, emotions can be plotted into a three-dimension affective space. It is claimed that these three dimensions are capable of representing most of human emotions that are commonly known. The other technique directly monitors bodily changes in physiological states, which are driven by the autonomic nervous system (Kreibig, 2010), including heart rate, skin conductance, skin temperature, respiration rate. Furthermore, in the previous study we also found that heart rates can be used to identify visual and audio stimuli of the archetype of Self (see Chapter 4). These two techniques are used to reflect human emotions in two different ways: explicit and implicit. Although both techniques have been well developed and are broadly used in experiments, the results of these two techniques cannot be completely mapped. It is still unclear which technique reflects the ground truth of human emotions. Therefore, it is reasonable to adopt both techniques in order to have a more comprehensive understanding on emotions toward stimuli with normed contents.

5.3.3 *Physiological Signals*

Electrocardiogram (ECG) is a measurement of the heart's electrical activity conducted with electrodes attached to the skin surface and recorded over a period of time. ECG was monitored at 512 Hz and then cleaned with low-pass, high-pass, and notch filters. ECG contains plenty of information about the cardiovascular activity, and in the psychophysiological domain it is commonly used for the calculation of the heart rate (heart rate (HR)) and heart rate variability (heart rate variability (HRV)). The heart rate is a simple measurement that characterizes the heart's activity in terms of the number of heart beats per minute (Neuman, 2010). The HR was obtained from the ECG signal by identifying beats with an algorithm provided in (Afonso et al., 1999) and computing the average heart rate over a

moving window of 10 seconds. We expected to see a relation between the psychological states of the subjects and their HR because this measure had been widely applied in physiological computing and, according to Kreibig (2010), the HR is the most often reported cardiovascular measure in psychophysiological studies of emotion. Next, several HRV parameters from time and frequency domains were calculated based on the heart beats data with an HRVAS software package (Ramshur, 2010). Time domain parameters included the standard deviation of the beat to beat intervals (SDNN), the square root of the mean of the sum of the squares of differences between adjacent beat to beat intervals (RMSSD), and the standard deviation of differences between adjacent beat to beat intervals (SDSD) (Malik et al., 1996). A pool of frequency domain parameters consisted of a total power, a power in a very low frequency range (VLF, 0-0.04 Hz), a power in a low frequency range (LF, 0.04-0.15 Hz), a power in a high frequency range (HF, 0.15-0.4 Hz), and a ratio of the power in a low frequency range to the power in a high frequency range (LF/HF) (Malik et al., 1996).

Skin conductance describes variations in the electrodermal activity of skin and is associated with processes of eccrine sweating, which are controlled by the sympathetic branch of the autonomic nervous system (Figner & Murphy, 2010). According to Lang et al. (1993), skin conductance is closely related to psychological processes and particularly to the level of arousal. Skin conductance has tonic and phasic components. The tonic component reflects relatively slow changes in skin conductance over longer periods of time lasting from tens of seconds to tens of minutes. Thus, it is indicative of a general level of arousal and is known as the skin conductance level (skin conductance level (SCL)). A different perspective is given by the phasic component of skin conductance, which is called the skin conductance response (skin conductance response (SCR)), because it reflects high frequency variations of the conductance and is directly associated with observable stimuli (Figner & Murphy, 2010). The skin conductance signal was recorded at 512 Hz. Although such a high sampling rate is not imperative for measurement of the skin conductance signal, complex analysis approaches and smoothing procedures can benefit from higher resolution data (Figner & Murphy, 2010). The SCL was obtained from the raw skin conductance signal by applying a low pass filter at 1 Hz. An additional high pass filter was set at 0.5 Hz for the SCR.

Respiration is yet another physiological signal that has been often studied in psychophysiology (Fairclough & Venables, 2006). This signal is correlated with processes in the sympathetic nervous system and is indicative of psychological states of individuals (Boiten, 1998). The raw respiration signal was monitored at 512 Hz and treated with low pass and high pass filters. Then, the respiration rate was obtained from the signal based on the guidelines provided by the manufacturer of the respiration sensor (TMSI BV). Afterwards, the respiration rate was averaged with a moving window of 10 seconds.

Skin temperature (skin temperature (ST)) fluctuates due to localized variations in the blood flow characterized by vascular resistance or arterial blood pressure that are in turn modulated by the sympathetic nervous system (Kim et al., 2004). It has been previously reported in literature (Ekman et al., 1983) that affective stimuli can cause variations in ST of individuals. The ST signal was monitored at 512 Hz. However, the raw data was later harmlessly resampled to 64 Hz because it is a slow changing signal. High frequency noise was eliminated with a low pass filter of 10 Hz that was applied to the resampled signal. Finally, the signal was smoothed with a moving window of 10 seconds.

5.3.4 *Participants*

Twenty-five people were recruited for the experiment, consisting of 12 women and 13 men, Most of them were graduate students. 11 participants were from Europe, 10 participants were from Asia, 3 participants were from Middle East and one participant was from South America. The average age for the women was 23.0 years (Standard deviation = 1.9) and for the men 25.4 years (Standard deviation = 4.5).

5.3.5 *Apparatus*

The laboratory was equipped with a high definition projector that in a cinema like settings projected the film clips on a white wall with dimensions 592 x 222 cm (see Figure 5.1). The couch that accommodated participants during the study was situated at a viewing distance of approximately 4 meters in front of the white wall. Additionally to the projector, a computer screen and a mouse were located near the couch. After watching a film clip subjects were required to use the mouse for providing a self-report about their feelings by rating them against a number of scales, which were displayed on the screen. The procedure of the experiment including presentation of the clips, collection of the feedback, and time tracking was synchronized and automated with a website. Heart activities and skin conductance of participants were monitored with Shimmer wearable wireless sensors that streamed physiological data to a computer via Bluetooth connection (Burns et al., 2010). The three-lead Shimmer electrocardiogram sensor was connected with four disposable pregelled Ag/AgCl spot electrodes. Two of the electrodes were placed below the left and right collarbones and the other two were attached to the left and right sides of the belly. The electrode placed on the right side of the belly served as a reference. The same type of electrodes was used to connect the Shimmer GSR sensor to thenar and hypothenar eminences of the participant's palm on a non-dominant hand for measurement of the skin conductance. A Refa amplifier from TMSI BV in combination with an inductive respiration belt and a temperature sensor was used for the measurement of the respiration and skin temperature. A respiration belt with an appropriate size was strapped around the participant's chest and the temperature sensor was fixed on the subject's belly with a sticky tape.

5.3.6 *Procedure*

The experiment followed a within-subject and double-blind test design. Each participant went through a session of the experiment individually, and each participant viewed all thirteen film clips in a random order (see Figure 5.2). When a session started, the participant was asked to sit on the couch in the laboratory and then asked to read and sign the provided informed consent form. Next, the experimenter demonstrated the required positioning of the physiological sensors on a body, assisted the participant to attach them, and ensured that the sensors streamed signals of good quality. After placement of the sensors the experimenter allowed a time interval of approximately five minutes to pass before presentation of the first film clip. This interval was necessary for the electrode gel to soak into the participant's skin and thereby establish a stable electrical connection (Figner & Murphy, 2010). Meanwhile, the experimenter explained the whole procedure to the participant. The overview further clarified the procedure of the study explaining that several film

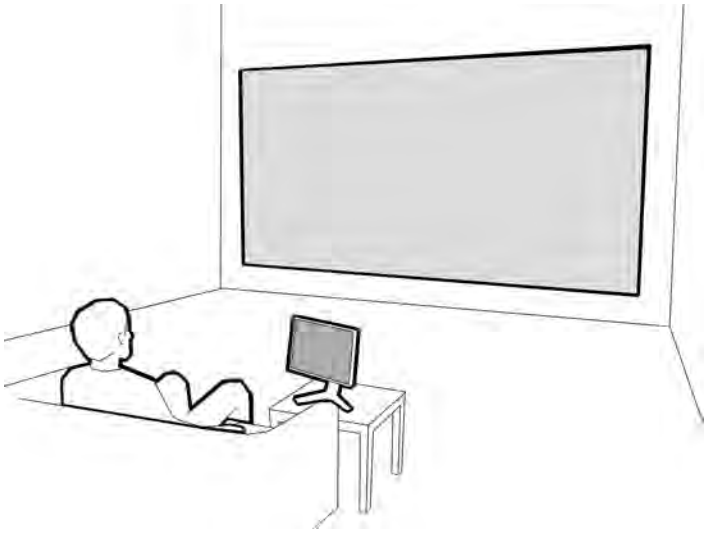

Figure 5.1: The spatial setting for the experiment.

clips would be played, and the participant's physiological signals would be continuously recorded during the film's demonstration. However, the actual goal of the experiment remained undisclosed and, for this reason, no information about the content of the clips was given to the participant. Following the above instruction, the subject was asked to make her comfortable on the couch and refrain from unnecessary movements during the session. The light in the laboratory was dimmed so that the viewing experience became similar to the one in a movie theater.

According to Piferi et al. (2000), a relaxing 'aquatic' video could be used for establishing the baseline. Thus, our experiment started with an example test playing the 'neutral' clip – Coral Sea Dreaming: Awaken (Hannan, 2010) – to help the participant reach a between-subject baseline. A 40-second video of breathing guidance was shown before each experimental movie clip. The purpose was to avoid *excitation-transfer* effect via removing the residual emotional feelings induced by the previous stimulus. The participant was asked to follow the breathing pattern (14 breaths per minute) in order to reach a within-subject baseline (Bloch et al., 1991). The experimental movie clips were shown in random order. After viewing a movie clip, the participant provided an introspective self-report by using computer-based SAM scales. As soon as the participant submitted the self-report for the last film clip, the light in the room was turned on and the experimenter helped the subject with detaching the physiological sensors from her body. Finally, the participant was debriefed and reimbursed.

5.4 RESULTS

5.4.1 *Self-Reports*

The experimental data are organized in three datasets for comparison: the explicit emotion, the archetypal, and the unified dataset (i.e. combining archetypal and the explicit emotion stimuli). We started with the data collected by self-report technique. Since our experiment follows a within-subject design, an appropriate statistical test for this type of design would be MANOVA for repeated measures (O'Brien & Kaiser, 1985). The self-report data (i.e. the

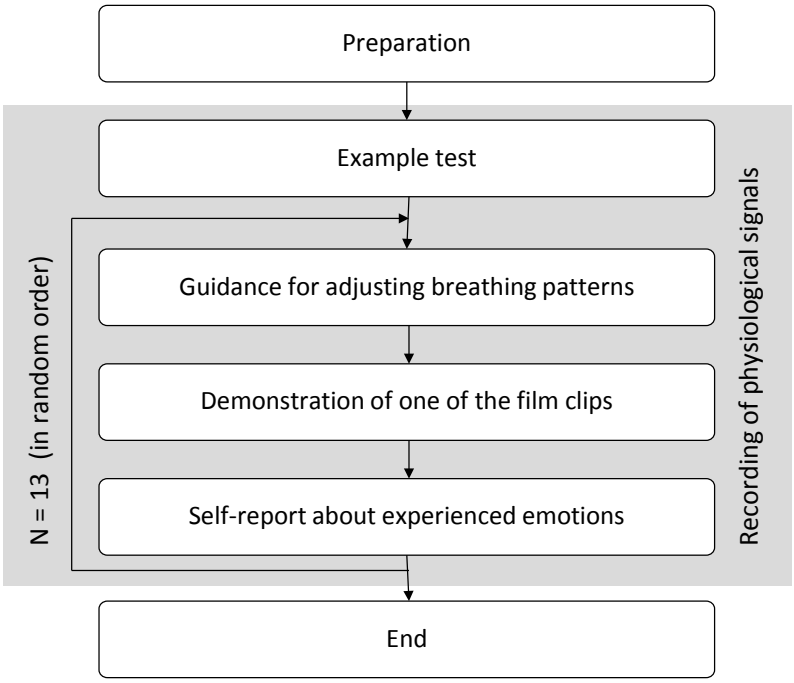

Figure 5.2: The procedure of the experiment. The 'Preparation' stage includes filling in the informed consent form, attaching physiological sensors, and an introduction.

SAM ratings) are comprised of three values: valence, arousal, and dominance. MANOVA for repeated measurements shows a significant main effect of the explicit emotion datasets on the score of SAM [$F(12, 248.992) = 15.196$, $p < 0.001$ (Wilks' Lambda)]. So do the archetypal dataset [$F(21, 477.212) = 8.400$, $p < 0.001$ (Wilks' Lambda)], and the unified dataset [$F(36, 845.747) = 11.501$, $p < 0.001$ (Wilks' Lambda)]. Next, we proceeded to look into the test of (univariate) repeated measures **ANOVA!** (Huynh-Feldt) on the variable category, the three affective ratings all show significance: valence ($F(10.514, 252.336) = 23.348$, $p<0.001$, $\eta^2= 0.493$), arousal ($F(9.968, 239.242) = 14.898$, $p<0.001$, $\eta^2= 0.383$), dominance ($F(8.866, 212.796) = 10.807$, $p < 0.001$, $\eta^2= 0.310$).

5.4.2 *Physiological Signals*

As stated in the introduction, one of the motivations for this study was the question whether the patterns of physiological responses to various archetypal experiences are different and, furthermore, if the difference is statistically significant. We were also interested how physiological activations modulated by the explicit emotions of the participants are different comparing to their responses elicited by the archetypal stimuli. A number of statistical tests had to be conducted in order to answer these questions.

Each subject watched all the film clips that formed our sets of stimuli for the explicit emotions and the archetypal experiences. Thus, the study had repeated-measures design where physiological measurements were made on the same individual under changing experimental conditions. Similar to the analysis on the self-report data, MANOVA for repeated measures was applied for analyzing physiological data. However, certain assumptions of this test were violated for some of the physiological signals' features in our study. Namely

MANOVA does not allow inclusion of time-varying covariates in the model and an unequal number of repeated observations per an experimental condition. The former requirement could not be fulfilled because the physiological baselines that were introduced to the statistical model as covariates consisted of multiple data points. Although this assumption could easily be satisfied by transforming a number of data points into a single feature, we preferred to preserve the richness of our dataset and refrained from, for instance, averaging the baseline record. The latter prerequisite of MANOVA demands an equal number of repeated measurements per experimental condition. It could not be met due to the fact that the film clips presented during the experiment had slightly different length and, consequently, the size of vectors with physiological data varied. While all the clips lasted for approximately 5 minutes, there was a considerable difference between some of the stimuli. The shortest film clip had duration of 4 minutes and 46 seconds whereas the longest one was 6 minutes and 35 seconds.

The limitations of MANOVA can be overcome if the statistical analysis is performed with linear mixed models (Linear Mixed Model (LMM)). LMMs are parametrical statistical models for clustered, longitudinal or repeated–measures data that characterize the relationships between continues dependent variables and predictor factors (West et al., 2006). LLMs have another advantage over MANOVA—they allow participants with missing data points to be included in the analysis. In contrast, MANOVA drops the entire dataset of a subject even if just one data point is absent. A software implementation of statistical procedures included in SPSS Version 19 (SPSS, Inc.) was utilized to answer the research questions pointed out earlier. Physiological responses of the subjects were treated as dependent variables (continuous responses), the film clips represented fixed variables and the physiological baselines measured during the presentation of the video with a breathing pattern before each stimulus were used as covariates. The LMMs main effect tests whether the patterns of the participants' physiological responses are different between various stimuli. The HRV features were analyzed with MANOVA as they met the requirements of this method. All statistical tests used a 0.05 significance level.

The initial motivation of this study was to explore the relationships between the archetypal experiences and their physiological correlations. The statistical analysis was to answer the question whether the archetypal experiences of the participants elicited with the film clips have a significant effect on their physiological signals. The features extracted from ECG, skin conductance, respiration and skin temperature recordings were arranged to form three types of datasets: one with the data for the explicit emotions, another with the data for the archetypal experiences and the unified dataset.

Table 5.3 shows the overview of the analysis results for physiological data. LMMs were fit to each of the datasets with the HR features. The analysis, which the HR entered as a dependent variable, demonstrated a significant interaction effect between the film clips and the heart rate baselines for all the datasets: the explicit emotions dataset, [$F(4, 541.443) = 2.513$, $p = 0.041$], the archetypal content dataset [$F(7, 1028.618) = 3.503$, $p = 0.001$] and the unified dataset, [$F(12, 1521.573) = 3.929$, $p <= 0.001$].

As the HRV features were calculated over the whole duration of every stimulus and were represented with a single data point, they could be easily analyzed with MANOVA for repeated measures. This test showed a significant main effect of the film clips on the HRV parameters of the participants' physiological responses for two of the datasets: the explicit emotions dataset, [$F(32, 329.811) = 2548$, $p <= 0.001$ (Wilks' lambda)] and the unified dataset, [$F(96, 1903.193) = 1987$, $p <= 0.001$ (Wilks' lambda)]. However, the same test

Parameter	Features	Dataset	F value	p value
Electrocardiogram	HR	Explicit	F(4, 541.443) = 2.513	0.041*
		Archetypal	F(7, 1028.618) = 3.503	0.001**
		Unified	F(12, 1521.573) = 3.929	< 0.001***
	HRV	Explicit	F(32, 329.811) = 2548	< 0.001***
		Archetypal	F(56, 872.323) = 1281	= 0.085
		Unified	F(96, 1903.193) = 1987	< 0.001***
Skin Conductance	SCL	Explicit	F(4, 2884,487) = 42.130	< 0.001***
		Archetypal	F(7, 5880.869) = 38.795	< 0.001***
		Unified	F(12, 9868.854) = 27.615	< 0.001***
	SCR	Explicit	F(4, 707.582) = 13.473	< 0.001***
		Archetypal	F(7, 1391.923) = 11.401	< 0.001***
		Unified	F(12, 2109.957) = 10.667	< 0.001***
Respiration	RER	Explicit	F(4, 611.304) = 2.931	0.020*
		Archetypal	F(7, 1071.446) = 1.070	0.380
		Unified	F(12,1686.540) = 1.667	0.068

Table 5.3: The statistical analysis results for physiological data. For extracted features, HR means heart rate; HRV means heart rate variability; SCL means skin conductance level; SCR means skin conductance response; RER means respiration rate. (* means p value < 0.05, which shows significance; ** means p value < 0.01, which shows high significance; *** means p value <= 0.001, which shows very high significance.).

for the archetypal experiences dataset was not significant, [F(56, 872.323) = 1281, p = 0.085 (Wilks' lambda)].

The relationship between the SCL features and the presentations of the stimuli was investigated with LMMs. The statistical tests indicated a significant interaction effect between the film clips and the SCL baselines for the explicit emotions dataset [F(4, 2884,487) = 42.130, p <= 0.001], the archetypal experiences dataset [F(7, 5880.869) = 38.795, p <= 0.001] and the unified dataset [F(12, 9868.854) = 27.615, p <= 0.001]. Next, we ran analysis for the SCR features in a similar manner. A significant interaction effect between the film clips and the baseline covariates was discovered for the explicit emotions dataset, [F(4, 707.582) = 13.473, p <= 0.001], the archetypal experiences dataset, [F(7, 1391.923) = 11.401, p <= 0.001] and the unified dataset, [F(12, 2109.957) = 10.667, p <= 0.001].

Then, we looked at the respiration data and performed tests with LMMs that were fit to the respiration rate measurements. The interaction between the film clips and the baseline respiration rate did not demonstrated significance for the archetypal experiences dataset, [F(7, 1071.446) = 1.070, p = 0.380] and the unified dataset [F(12,1686.540) = 1.667, p = 0.068]. Nevertheless, the same test was significant for the explicit emotions dataset, [F(4, 611.304) = 2.931, p = 0.020].Finally, the features of the skin temperature recordings were analyzed. Again, LMMs built on the skin temperature data were used for the statistical

testing. However, we could not complete the analysis because the statistical software did not achieve a convergence within 100 of iterations.

5.4.3 *Classification*

One of the primary research questions in this study is to examine if the movie clips used in our experiment can be classified according to the subjects' emotional responses. The Linear discriminant analysis (LDA) was performed separately with two datasets: the self-report data and the physiological data. The category of affective stimuli is assigned as grouping variables. The data of emotional responses were fed into LDA as independent variables. LDA allows us to observe how well these stimuli can be differentiated by the given data of emotional responses. Only cross-validated results are reported here because they indicate the capabilities of the model to deal with an unknown data sample. We proceed to the interpretation of the outcome of the classification. The model obtained from the SAM scale featured a classification rate of 28.5% (Canonical correlation = 0.544, Effective size = medium), while the other model obtained from physiological data achieved a classification rate up to 46.5% (Canonical correlation = 0.752, Effective size = large).

Confusion Matrix of the Self-Report Data								
Classified as →	ANI	ANM	DEP	INI	RET	MEN	MOT	SHA
Anima	16	12	4	16	16	**24**	4	8
Animus	4	**52**	4	12	0	4	8	16
Departure	8	0	**40**	4	4	12	28	4
Initiation	12	**24**	12	**24**	16	8	0	4
Return	12	16	12	12	**20**	16	8	4
Mentor	0	0	16	8	24	**44**	8	0
Mother	16	16	24	0	0	12	**32**	0
Shadow	12	**40**	8	8	16	8	8	0
Canonical correlation = 0.544, Effect Size = Medium, 28.5% of cross-validated grouped cases correctly classified.								

Table 5.4: The confusion matrix of the model obtained from the LDA on the self-report data for archetypal movie clips (in percent). ANI means anima; ANM means animus; DEP means hero's departure; INI means hero's initiation; RET means hero's return; MEN means mentor; MOT means mother; SHA means shadow. Each row shows the probability of which category the stimulus is classified. The underlined values indicate the accuracy whereby the stimuli are correctly classified. The values in bold style indicate incorrect predictions.

The confusion matrices obtained from LDA for the two datasets are demonstrated in Table 5.4 and Table 5.5. In these matrices, each row demonstrates how well the obtained model can predict the category of the given stimulus. Consequently, the diagonal cells in the two tables (top-left to bottom right) indicate the classification rate of correct predictions, whereas other cells show the classification rate of wrong predictions. Some categories were less probable to be correctly predicted and might be wrongly classified as other categories.

Confusion Matrix of the Physiological Data								
Classified as →	ANI	ANM	DEP	INI	RET	MEN	MOT	SHA
Anima	**48**	12	4	4	8	8	12	4
Animus	8	**52**	4	12	12	4	4	4
Departure	12	0	**64**	4	4	4	8	4
Initiation	0	8	0	**68**	4	0	0	16
Return	12	4	4	8	**20**	**28**	16	8
Mentor	20	4	0	4	12	**32**	20	8
Mother	16	8	4	0	16	4	**40**	12
Shadow	4	8	0	12	20	4	4	**48**
Canonical correlation = 0.752, Effect Size = Large, 46.5% of cross-validated grouped cases correctly classified.								

Table 5.5: The confusion matrix of the model obtained from the LDA on the physiological data for archetypal movie clips (in percent). Each row shows the probability of which category the stimulus is classified. The underlined values indicate the accuracy whereby the stimuli are correctly classified. The values in bold style indicate incorrect predictions.

This mismatch only indicates a 'miss', but does not suggest any statistical meaning in terms of correspondence. For example, in Table 5.4, the stimulus of shadow was more probable to be classified as animus. This only suggests that the obtained model from SAM is prone to generate incorrect predictions for the stimuli of 'shadow', but cannot lead to an inference that the emotion of 'shadow' is similar to the emotion of 'animus'. This means that only the correct predictions have a valid statistical meaning for further discussion.

Category	Self-Reports		Physiological Signals	
	Classification Rate	Canonical Correlation	Classification Rate	Canonical Correlation
Archetypal Content	28.5 %	0.544	46.5 %	0.752
Explicit Emotion	52.0 %	0.789	44.8 %	0.742

Table 5.6: The Comparison between the classification rate of archetypal content and stimuli of explicit emotions.

Next, we applied the same analysis on the data of emotional responses to the stimuli of explicit emotions. The model obtained from the SAM scale on the stimuli of explicit emotions featured a classification rate of 52.0% (Canonical correlation = 0.789, Effective size = large), while the other model obtained from physiological data when viewing the stimuli of explicit emotions achieved a classification rate up to 44.8% (Canonical correlation = 0.742, Effective size = large). For further comparison, Table 5.6 provides an overview of the results of LDA for archetypal content and affective stimuli of explicit emotions.

5.5 DISCUSSION

5.5.1 *Validity of Measures*

Since the archetypal content is a new class of affective stimuli, we will use the results of stimuli of explicit emotions as references to assess the validity of the results of analysis on archetypal content. The first question in this study is to examine if different movie clips of archetypal content can be statistically differentiated by the emotional responses obtained from self-reports and physiological signals. For the data obtained by the SAM scale, all of the three ratings (i.e. valence, arousal and dominance.) demonstrated significant relationship. Similarly, the physiological signals including ECG and skin conductance showed significant main effect on differentiating different movie clips of archetypal content. The analyses on the data for stimuli of explicit emotions also generate similar results. The only exception is respiration rates. The results of respiration rates for archetypal content did not demonstrated equivalent significance ($p = 0.38$), while the same analysis on emotional responses to stimuli of explicit emotions showed a significant effect on respiration rates ($p = 0.02$). These results are in line with previous studies (Rainville et al., 2006; Villon & Lisetti, 2006), in that ECG and skin conductance are the most prominent indicators for measuring emotions while respiration patterns are less effective in general. A possible interpretation about these results is that respiration patterns can be effective if a wider range of parameters are taken into account, such as respiration amplitude and volume (Boiten et al., 1994). Our experiment was limited by the specification of our equipment, which only allows us to retrieve the feature of respiration rate. Another possible reason is that, unlike heart rate and skin conductance, respirations are not fully spontaneous and automatic. Although respiration patterns could to some extent reflect current emotional states, participants could also adjust their breathing patterns for emotion regulation (Clark & Hirschman, 1990).

5.5.2 *Inferences Under Different Premises*

The second question we intend to clarify is 'if archetypal content may induce unconscious emotion'. Since explicit emotions have been well researched by contemporary psychology, the emotional responses to the stimuli of explicit emotions serve as a reference that allows us to further infer the nature of the emotions induced by archetypal content. The discriminant analyses for the stimuli of explicit emotions showed that the classification rate of self-reports (52.0 % of accuracy) is greater than the results obtained from physiological signals (44.8 % of accuracy). These results are consistent with contemporary psychology which assumes that emotions can be effectively measured using self-reports and the introspective judgments about emotional states are assumed to be fundamentally true. On the contrary, the results of the same analysis for archetypal movie clips demonstrated an opposite trend. While the classification rate of physiological signals for archetypal content is similar to the results of explicit emotions (46.5 % of accuracy), the classification rate of self-reports on archetypal movie clips are substantially low (28.5 % of accuracy). These results suggest refusing the assumption of the contemporary psychology in the case of archetypal content. In order to gain a clearer view on these results, it is necessary to look into different conditions of inferences for constructing possible interpretations.

The conditions of inferences can be twofold, depending on whether the elicited emotions are conscious or unconscious. First, if we assume that the emotions elicited by our

stimuli are conscious, the low classification rate of SAM would lead to the suggestion that more dimensions are required to have a more comprehensive representation for the emotions elicited by archetypal contents. This might be because the current dimensional model was over simplified down to three dimensions, only focusing on prominent emotions that are commonly known, but not comprehensive enough to represent some trivial emotions. Another possibility is that the stimuli of some trivial emotions were filtered out at the selection process, which eliminated the opportunity to find new dimensions. As we demonstrated in the present study, focusing on the content of stimuli might remedy the validity issue of the selection process. On the other hand, our study also confirms the robustness of physiological signals in emotion recognition. Further analyses are required to identify the correlation between the pattern of physiological changes and the presented affective stimuli of archetype, e.g. what is the physiological pattern while a person feels like being a hero?

The other possible condition of inferences is to assume that the elicited emotions are unconscious. The results of the discriminant analyses probably can be explained by the distinction between 'emotion' and 'feeling', proposed by Damasio (2010). He argues that emotions are complex, largely automated programs of actions complemented by a cognitive program that includes certain ideas and modes of cognition. Emotions, so to speak, are the phenomena that are carried out by these actions in our bodies, which can be observed through physiological signals while feelings of emotion are composite perceptions of these actions in body and mind. Since feelings are images of actions rather than actions themselves, they are not necessary to be identical at all times, and an emotion does not have to be perceived as a feeling, either. According to Damasio's argument, our experiment used the physiological signals to capture the traces of emotions, and used the self-report technique to collect the feelings. Traditionally, researchers consider these two as the same phenomenon, and intend to find a thorough mapping between these two data collected from subjects. However, it is still unclear if all kinds of emotions have been consciously felt as feelings. Imagine that if an emotional quality cannot be felt consciously as an emotional feeling, there is no chance that anyone can label it semantically.

5.5.3 *Limitation*

The present study has some limitations. Firstly, there is only one clip for each category of affective stimuli used in the present study. This has limited the statistical power of the results and thus it is not feasible to apply machine learning techniques to build predictive models from the obtained data. Moreover, it is unclear if there were unique patterns of emotional experiences induced by movie clips in the same categories. As we have discussed above, there are at least two different premises for interpreting the experimental results. It appears that the evidence is still insufficient for justifying if the induced emotions were unconscious. Similarly, we also cannot abandon the possibility that the movie clips of archetypal content may elicit unconscious emotion. More evidence is needed for further justification on these hypotheses. This approach can be greatly improved through expanding the pools of movie clips in order to include more movie clips for each category of the stimuli. Finally, we applied convenience sampling for participants from the campus area of Eindhoven University of Technology. For other age groups, it still needs further investigation.

5.6 CONCLUSION

In this study, we emphasized the importance of symbolic meaning of affective stimuli and conducted an experiment to explore the emotional responses to various categories of archetypal content. Apart from static media types such as pictures and sounds (see the preliminary study in Chapter 4), this study specifically focused on a media type of movies, which provides a more immersive, emotionally richer viewing experience. We used the method developed previously to analyze the symbolic meaning in media content (see Chapter 3), and edited the movie clips according to our experimental design. According to the results of our experiment, archetypal content may induce emotions that have not yet studied by contemporary psychology. The induced emotion may either be conscious emotions that cannot be explained by the existing model of emotion, or unconscious emotions that can be observed through physiological signals but are inaccessible through introspection. Although it is unclear which interpretation is valid, it has confirmed the potential of archetypal content for inducing emotions that are worth further researching.

6 MODELING EMOTIONS IN MEDIA CONTENT

6.1 INTRODUCTION

The second study had revealed promising results for measuring emotional responses related to archetypal movie clips using self-reports and physiological signals (see Chapter 5); however, some limitations needed to be noted in order to build computational models for emotion recognition. The most critical limitation was that each category of archetypal media content encompassed only *one* five-minute movie clip, which may lead to several potential epistemic flaws. Although the selection of the archetypal movie clips was evaluated by experts from ARAS, one may argue that the classification of the archetypal media content was actually a classification of 'movie clips' in a sense that any individual movie clips may induce unique emotional responses even if the content is irrelevant to archetypes. In order to validate the universality of archetypal media content, it is required to include multiple samples. On the other hand, one sample for each category was insufficient in its statistical power for generalization, and thus the obtained statistical model is not robust enough for emotion recognition in practice.

Another practical concern about the second study was that the length of the movie clips may be too long for implementing applications. If the predictive model obtained from the experiment was implemented in applications for emotion recognition, the length of the affective stimuli would influence the adaptation speed of the system. For example, if the length was five minutes, the system would require five minutes to start to generate correct predictions when adapting to a new user. In other words, the length of stimulus movie clips should be as short as possible to enhance the efficiency for the final system. This led to a controversy because it takes time to deliver adequate contextual information for emotion elicitation; it is difficult to induce high-intensity emotional responses with a short movie clip. Moreover, short movie clips would also benefit data collection, in that more training data can be collected in the same period of time.

In order to confirm the validity of our previous findings about emotions in archetypal media content, it was necessary to conduct a new experiment with an improved design that allocated multiple movie clips for each category of archetypal media content. Taking into account the above concerns, the new study included 3 movie clips for each category and 7 categories of archetypal media content. The length of each clip was reduced to approximately one minute. The experimental design was similar to the second study one; thus we also prepared 5 categories of movie clips for explicit emotions as benchmarks

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This chapter is (partly) based on:

Chang, H.-M., Ivonin, L., Diaz, M., Catala, A., Chen, W., & Rauterberg, M. (under review). Enacting archetypes in movies: Grounding the unconscious mind in emotion-driven media. Digital Creativity.

Ivonin, L., Chang, H.-M., Diaz, M., Catala, A., Chen, W., & Rauterberg, M. (in press). Beyond cognition and affect: sensing the unconscious. Behaviour and Information Technology.

for comparison. The duration of each session in this experiment was limited in one and half hours. The experimental design of the present experiment was intended to overcome the limitations of the previous one, and thus it was feasible to apply machine learning techniques to modeling the emotional responses induced by the movie clips used in this experiment. The major goal of this study was to build predictive models that can be used for practical purposes, i.e. making predictions to determine if a user is viewing media content that encompasses archetypal symbolic meaning.

6.2 ARCHETYPAL MEDIA CONTENT

In Chapter 3, we presented a new approach to analyze media content according to archetypal symbolism, and formulated a standard procedure for editing the media content into a unified format that can be used in psychological experiments. Furthermore, we have analyzed nine archetypes in modern movies: anima, animus, mentor, mother, shadow, hero's departure, hero's trials, hero's rebirth, and hero's return. In the present study, we took this approach to analyze the abovementioned nine archetypes in movies and edited proper clips as affective stimuli that can be directly used in the following experiment. First, we surveyed numbers of commercial movies in the market to find suitable movies that might contain narratives relevant to these target archetypes. Then, we selected scenes that convey experiences of specific archetypes from a first-person point of view. In order to edit movie clips that can be used in experiments as well as in a media system, the format of the clips needs to be defined first. All the selected scenes should be edited into the same format and build up a dataset of movie clips that is ready for later experiments. The format of the movie clips we edited is described as follows: 1) for adequate statistical power, at least three clips in each category are required; 2) the unified length of each clip is 60 ± 6 seconds; 3) every clip contains scenes selected from only one movie; 4) the transition between scenes uses fade-in and fade-out effects; 5) the screen resolution of the movie clips is 720 by 480 pixels with AVI file format.

To further confirm that the selected scenes authentically represent archetypes, we cooperated with Jungian scholars from ARAS to review the film clips we had collected. They did the review separately for all the clips. Only those clips that they all agreed to consider as archetypal clips were kept in our collection. After several iterations of discussions and strict filtering sessions, we built a set of movie clips that are verified as archetypal content. Although we attempted to use movie clips for all the nine essential archetypes, we could not collect enough amount of clips for animus and mother within the limited span of time (only two clips collected). The main reason is that these two archetypes are less explicit so that it is extremely hard to demonstrate a complete experience of the archetypes within one minute. Therefore, we proceeded with the seven categories of movie clips to the later experiment, which are: anima, hero's departure, hero's trials, hero's rebirth, hero's return, shadow and mentor (see Table 6.1 and Table 6.2). Full descriptions of the symbolic meanings of each archetype have been reported in Chapter 3.

Similar to the second study (see Chapter 5), the affective stimuli of the explicit emotions were used as a benchmark for comparison. Emotions or feelings are commonly represented in affective computing with the dimensional model (Russell, 1980). This model was used to explain emotions in several meaningful continuous dimensions, which construct a so-called affective space. The original model encompassed two dimensions: valence and arousal. The dimension of arousal ranges from calm to aroused states, while the dimension

Archetype	Movie	Start	End
Anima	American Beauty (Mendes, 1999)	0:16:15	0:17:17
	Malèna(Tornatore, 2000)	0:19:18	0:20:20
	Perfume: The Story of a Murderer(Tykwer, 2006)	0:18:03	0:18:18
		0:21:20	0:22:15
Hero's Departure	V for Vendetta (McTeigue, 2005)	0:41:55	0:43:03
	Braveheart (Gibson, 1995)	0:10:10	0:10:46
		0:14:13	0:14:43
	The Lord of the Rings: The Fellowship of the Ring (Jackson, 2001)	2:21:12	2:21:47
		2:22:37	2:23:06
		2:23:10	2:23:16
Hero's Initiation	V for Vendetta (McTeigue, 2005)	1:23:29	1:24:34
	Braveheart (Gibson, 1995)	2:07:39	2:08:37
		2:08:47	2:08:58
	The Matrix (Wachowski & Wachowski, 1999)	2:02:25	2:03:25
Hero's Rebirth	V for Vendetta (McTeigue, 2005)	1:24:59	1:26:00
	Braveheart (Gibson, 1995)	2:15:39	2:16:15
		2:17:35	2:18:01
	The Matrix (Wachowski & Wachowski, 1999)	2:04:35	2:05:45

Table 6.1: The editing instructions of archetypal movie clips for the third study (part 1).

of valence ranges from negative to positive states. Taking into account the theory of basic emotions and the dimensional model of emotion, five categories of explicit emotions were selected for the experiment: amusement (positive-arousing), joy (positive-calm), neutral, fear (negative-arousing), and sadness (negative-calm). These five categories covered most of the essential basic emotions except 'disgust'. The neutral category was assumed to be the origin of the two-dimension affective space (valence and arousal), and the other four explicit emotions were located in each of quadrants of the affective space. The selection of the movie clips for eliciting corresponding explicit emotions were based on the previous studies that also used movie clips for emotion elicitation. The work of Gross & Levenson (1995) and Soleymani et al. (2012b) provides guidance with regard to application of video in emotion research and even proposes sets of film clips that can be readily used as emotional stimuli. In the same manner as for the archetypal movie clips, three clips were selected for every category of the explicit emotions; in total, there were 15 movie clips included in this study (see Table 6.3).

Archetype	Movie	Start	End
Hero's Return	V for Vendetta (McTeigue, 2005)	2:02:40	2:03:04
		2:03:22	2:04:06
	Braveheart (Gibson, 1995)	2:48:56	2:49:08
		2:49:11	2:49:53
		2:49:54	2:50:09
	The Matrix Revolutions (Wachowski & Wachowski, 2003b)	1:53:40	1:53:47
		1:54:02	1:54:05
		1:54:33	1:54:50
		1:55:24	1:55:39
		1:56:02	1:56:29
Mentor	The Lord of the Rings: The Fellowship of the Ring (Jackson, 2001)	2:03:05	2:04:10
	The King's Speech (Hooper, 2010)	1:42:13	1:42:44
		1:42:58	1:43:18
		1:45:33	1:45:52
	The Lion King (Allers & Minkoff, 1994)	0:24:38	0:25:05
		0:25:29	0:26:06
Shadow	The Lord of the Rings: The Two Towers (Jackson, 2002)	1:35:19	1:36:20
	Fight Club (Fincher, 1999)	1:48:24	1:49:32
	The Dark Knight (Christopher Nolan, 2008)	1:24:22	1:25:30

Table 6.2: The editing instructions of archetypal movie clips for the third study (part 2).

6.3 EXPERIMENT

The primary goal of this study was to further confirm the findings of the second study and build predictive models that can be used in practice. An experiment was conducted to examine if all the categories of archetypal movie clips can be differentiated from each other according to participants' emotional responses. For experimental design, we followed the methodological paradigm in experimental psychology that has been well developed specifically for using film clips to elicit emotions under laboratory settings (e.g. Rottenberg et al., 2007; Soleymani et al., 2012b). The only difference is that our movie clips were categorized based on archetypes instead of explicit emotions. As these studies suggest, our experiment applied a within-subject design. Every session accommodated one participant, and every participant were asked to view all the 36 movie clips we collected. Before the presentation of each movie clip, the participant was asked to adjust their breathing to regain the baseline emotional state in order to avoid the overlap of the emotional responses to the previous movie clip. They were guided with a video visualizing a breathing pattern

Category	Movie	Start	End
Positive–Arousing (Amusement)	Funny cats (Angelfish, 2008)	0:00:00	0:01:01
	Funny clip with mice and dogs (MrBallonRond, 2012)	0:04:11	0:04:44
		0:10:08	0:10:36
	Mr. Bean (Davies, 1992)	0:06:10	0:07:13
Positive–Calm (Joy)	Mr. Bean's Holiday (Bendelack, 2007)	1:17:19	1:18:19
	Love Actually (Curtis, 2003)	0:10:17	0:11:21
	The Lion King (Allers & Minkoff, 1994)	0:47:51	0:48:52
Neutral	Coral Sea Dreaming: Awaken (Hannan, 2010)	0:08:01	0:09:01
	Coral Sea Dreaming: Awaken (Hannan, 2010)	0:04:31	0:05:31
	Coral Sea Dreaming: Awaken (Hannan, 2010)	0:38:48	0:39:48
Negative–Arousing (Fear)	Hannibal (Scott, 2001)	1:44:50	1:45:50
	American History X (Kaye, 1998)	1:52:07	1:53:10
	The Silence of the Lambs (Demme, 1991)	1:39:38	1:40:40
Negative–Calm (Sadness)	The Thin Red Line (Malick, 1998)	1:07:08	1:08:09
	Forrest Gump (Zemeckis, 1994)	2:05:55	2:07:04
	Up (Docter & Peterson, 2009)	0:10:22	0:11:26

Table 6.3: The editing instructions of explicit-emotion movie clips for the third study.

(14 breaths per minute) in order to reach a within-subject baseline (Bloch et al., 1991). As a double-blind design, movie clips were played in a random order. Both the experimenter and the participants did not know the sequence of the playlist.

6.3.1 *Emotion recognition*

For gathering self-report data, the Self-Assessment Manikin (SAM) (Bradley & Lang, 1994) was adopted. SAM is broadly used in psychological experiments (e.g. Soleymani et al., 2012a; van den Broek, 2013). It applies the dimensional model to represent human emotion, using three dimensions to construct affective space: valence, arousal, and dominance. It is claimed that these three scales are capable of representing most of the commonly-known human emotions. Similar to the second study, the use of self-reports was to address the research question about whether the induced emotions were conscious or unconscious. As for physiological measurements, we take into account the context of use for later applications and reassess what physiological measurements to be used in this study.

According to the literature in the areas of psychophysiology and affective computing (Cacioppo & Tassinary, 1990; Picard et al., 2001), psychological experiences of people lead

to activations in the ANS that in turn result in specific patterns of physiological responses. In our study, we chose to measure two physiological signals: heart rate and skin conductance. This decision was motivated by several factors. First of all, previous studies in this field demonstrated that features extracted from these signals often contribute the most into the discrimination of psychological states (Kreibig, 2010). Moreover, current technological advancements enable unobtrusive and reliable monitoring of heart rate and skin conductance in natural settings. Unlike measurements like fMRI or EEG that require either placement of a subject in a magnetic scanner or, according to the international 10-20 system (Klem & Lüders, 1999), attachment of up to 21 electrodes to the scalp, the physiological signals chosen for our study can be sensed without causing a subject to feel discomfort.

In the present study, we discarded the measurements of respirations and skin temperature for several reasons. The sensors were difficult to attach properly, and the signals were largely influenced by the participants' movement and ambient environment (e.g. the air temperature). Moreover, the variance explained by these two signals was considerably low according to the previous study we conducted (see Chapter 5). The context of use of these two measurements is limited in laboratory-setting experiments and the current technical equipment for measuring respirations and skin temperature do not assure robust data collection for practical purposes. For example, measuring the participant's respiration rate while he or she is performing physical activities is difficult because the body movement add much noise to the signals. our primary goal of this study is to build a predictive model that can be used in design practice, we decided to exclude these two measurements for developing later applications.

6.3.2 *Participants*

There were 23 volunteers participated in our study. Most of the participants were undergraduate or graduate students at the Technical University of Catalonia. We also recruited several participants of older age. Out of 23 participants, 10 were women, and 13 were men. The average age for the women was 27.80 years (SD = 8.80) and for the men was 27.77 years (SD = 6.13). The participants had diverse national backgrounds (4 from Asia, 15 from Europe and 4 from South America). We required the participants have normal or corrected to normal vision and hearing. Prior to the experiment, each participant signed an informed consent form and was later rewarded with a small present for participation in the laboratory session that took approximately 1.5 hours. The trials were carried out according to the experimental plan and all the collected data were analyzed.

6.3.3 *Apparatus*

The experiment was held in the Usability Laboratory of CETpD research center at the Polytechnic University of Catalonia. The observation room of the laboratory was arranged as a living room to make the participant feel comfortable and relaxed sitting on a sofa. Movie clips were projected onto a white wall; the display dimensions are 325 cm by 175 cm. The experimenter could observe from outside of the room through a one-way mirror so that the participant was left alone while viewing the movie clips and providing self-report data. For physiological measurement, Electrocardiography (ECG) and skin conductance

data were recorded with Shimmer™ wearable wireless sensors (Burns et al., 2010) and sent to an Android device via Bluetooth™ protocol.

6.3.4 *Procedure*

The procedure is similar to the second study reported in Chapter 5 (see Figure 6.1). The participant was invited to sit on a couch in the test room at the laboratory. The participant was then asked to read and sign an informed consent form. After signing the agreement, the participant put on electrodes and physiological sensors following the experimenter's instructions. The connection of the sensors was checked while the participant was filling in a short questionnaire on demographic data. Once the questionnaire was filled in, the experimenter gave a tutorial about the experiment and an example of what the participant should do throughout the session.

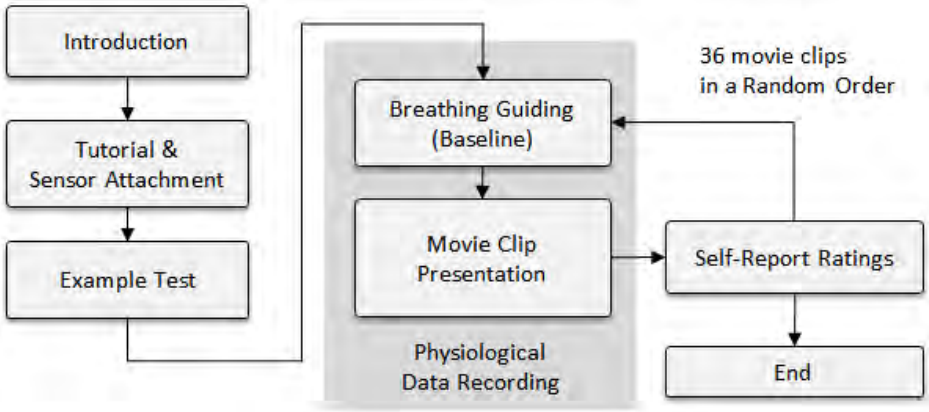

Figure 6.1: The procedure of the experiment. The 'Preparation' stage includes filling in the informed consent form, attaching physiological sensors, and a introduction.

In the example test, a neutral clip extracted from the movie Coral Sea Dreaming: Awaken (Hannan, 2010) was used. The participant was taught how to provide self-report data about her emotion by filling out the SAM scale. We did not disclose any information about archetypes or the content of the movie clips to the participant during the session. After the example test, the light in the laboratory was dimmed to make the viewing experience similar to a real cinema. Then the presentation of movie clips started. Before each clip, the participant followed a breathing-guiding video for 20 seconds to adjust the respiration rate of the participant to the initial baseline (14 breaths per minute). The physiological data recorded during the video with a breathing pattern was later used in the analysis as physiological baseline. After viewing each film clip, the participant provided a retrospective self-report by rating her emotion along the dimensions of the SAM with paper and a pen. After giving ratings, the breathing clip would show again to start the next presentation. The experiment ended when the participant finished viewing the entire collection of 36 movie clips.

6.4 BUILDING PREDICTIVE MODELS FOR EMOTIONS

6.4.1 *Data Mining and Extraction of Features*

In order to make physiological data from different individuals comparable, the baseline values were subtracted from the data corresponding to stimuli presentations. The result of the subtraction was then normalized to a range from zero to one for each subject separately. Since the film clips were approximately one minute long, the data formed temporal sequences. The main goal pursued by the extraction of features is a compression of data sequences to smaller sets of static features. We applied the *sliding window* method for processing our time-series data, which were of low frequency and short length. because it is simple, can be applied online, and proved to be reliable by previous studies in affective computing (Novak et al., 2012). We divided physiological data corresponding to each of the film clips into 12 non-overlapping, five-second segments. The temporal data was averaged over its duration. The number of the segments was empirically chosen. This procedure was performed for HR, SCL and SCR signals. It needs to be noted that SCR signals were calculated with absolute values according to Figner & Murphy (2010). Then, we performed fusion of physiological data coming from different signals through concatenation. As an outcome of the transformation we had an integrated dataset consisting of 44 features that could be used for statistical analysis and classification. Twenty of these features were extracted from ECG including 12 time-series features of the HR signal and eight features of the HRV measures (SDNN, RMSSD, SDSD, aVLF, aLF, aHF, LF/HF, and aTotal). The 12 time-series features were taken respectively from the SCL and SCR signals.

6.4.2 *Statistical Analysis*

The first question that we formulated in the introduction section was whether there is a relationship between archetypal experiences of people and patterns of physiological activations of their bodies. It was also interesting to know if there are any variations due to gender of the participants and how responses elicited by explicit emotions are different from the ones caused by beholding the archetypal appearances. A number of statistical tests had to be conducted in order to answer these and other questions. Each subject watched all the film clips that formed our sets of stimuli for the explicit emotions and the archetypal experiences. Thus, the study had a repeated-measures design where physiological measurements were made on the same individual under changing experimental conditions. Moreover, the subjects provided reports via the SAM ratings after every experimental condition. An appropriate statistical test for this type of design would be MANOVA for repeated measures (O'Brien & Kaiser, 1985). Physiological responses of the subjects and the SAM ratings were treated as dependent variables, the categories of movie clips of archetypal content and explicit emotions represented fixed variables. The main effect of MANOVA tested whether the patterns of the participants' physiological responses were different between various categories. All statistical tests used a 0.05 significance level.

Next, several statistical tests were conducted. We started with analysis of the self-report evaluations provided by the subjects after watching the film clips. MANOVA for repeated measurements was performed for the SAM ratings of valence, arousal and dominance. It demonstrated a significant main effect of the archetypes presented in the film clips on the SAM ratings [$F(18, 351.210) = 10.060$, $p < 0.001$ (Wilks' lambda)]. Similarly, the

Category	Valence		Arousal		Dominance	
	Mean	SD	Mean	SD	Mean	SD
Anima	5.855	1.691	4.522	2.200	5.768	1.824
Hero's Departure	3.971	1.534	4.464	1.844	4.435	2.118
Hero's Trials	3.824	1.675	4.868	2.044	4.382	1.963
Hero's Rebirth	5.884	1.539	4.478	1.891	6.188	1.726
Hero's Return	6.319	1.685	4.841	2.026	6.710	1.872
Mentor	6.275	1.580	3.420	1.710	6.333	1.836
Shadow	4.551	1.345	4.536	2.062	5.145	1.857
PA (Amusement)	7.232	2.059	3.522	2.026	6.768	1.759
PC (Joy)	8.043	1.206	3.087	1.983	7.391	1.437
Neutral	7.406	1.565	1.580	0.715	6.812	1.873
NA (Fear)	2.623	1.516	5.986	2.083	3.522	2.126
NC (Sadness)	3.478	1.779	4.014	1.811	4.130	2.209

Table 6.4: Descriptive statistical analysis of the SAM ratings on different categories of movie clips used in the experiment (SD means standard deviation).

explicit emotions exhibited in the film clips had a significant main effect on the SAM ratings provided by the participants [$F(12, 227.826) = 25.301$, $p < 0.001$ (Wilks' lambda)]. Estimated marginal means of the SAM ratings can be found in Table 6.4. Then, we added gender of the participants as a between-subject factor to the MANOVA tests in order to see if women and men rated their psychological experiences in a different manner. The results of the tests indicated that the interaction effect between the subjects' gender and the archetypes was not significant [$F(18, 334.240) = 1.166$, $p = 0.288$ (Wilks' lambda)]. Neither was significant the interaction effect between the gender of the participants and the explicit emotions [$F(12, 217.243) = 1.476$, $p = 0.135$ (Wilks' lambda)].

When the statistical analysis of the SAM ratings was complete, we looked into the physiological data of the subjects. Multivariate analysis of variance conducted for the features extracted from the physiological signals indicated there is a significant main effect of the archetypes pictured in the film clips on physiological responses of the subjects [$F(216, 583.757) = 1.396$, $p = 0.001$ (Wilks' lambda)]. Another MANOVA test was performed in order to see the relationship between the physiological data and the explicit emotions presented in the film clips. The outcome of this test was significant as well [$F(144, 213.766) = 1.985$, $p < 0.001$ (Wilks' lambda)]. Next, we examined if there was a connection between gender of the participants and their physiological responses to the film clips. The gender was added into the analysis as a between-subject variable. The results of the MANOVA tests demonstrated there were no significant interaction effects neither between the archetypes and the gender [$F(216, 548.182) = 1.034$, $p = 0.379$ (Wilks' lambda)] nor between the explicit emotions and the gender [$F(144, 197.835) = 0.872$, $p = 0.808$ (Wilks' lambda)]. In order to examine if the emotional responses were universal across different cultural backgrounds, we put 'countries' as a between-subject factor in the statistical analyses. However, the sample size of the current study is insufficient for performing between-subject multivariate tests (23 participants vs. 40 features extracted from physiological signals) and the numbers

of participants from different countries were not balanced. We therefore looked into the results of analyses on the interaction between categories of the clips and the nationalities of the participants. For the SAM ratings, there was no significant effects on this matter [F(216, 156.887) = 0.905, p = 0.752 (Wilks' lambda)]. Similar results were obtained from the analysis on physiological signals [F(2592, 1008.114) = 1.091, p = 0.051 (Wilks' lambda)]. The results suggested that cultural backgrounds did not introduce significant effects on the participants' emotional responses to archetypal movie clips.

Our statistical analysis uncovered several interesting findings. There were significant relationships between the categories of archetypal movie clips and the SAM ratings, between the categories of the movie clips of explicit emotions and the SAM ratings, between the categories of archetypal movie clips and the physiological responses, and between the categories of the movie clips of explicit emotions and the physiological responses. In order to further explore these findings, we needed to build and evaluate predictive models that would quantify these relationships. The evaluation was performed through comparison of classification accuracies achieved by the predictive models obtained with five different methods (k-Nearest Neighbor (kNN), Support Vector Machine (SVM), naive Bayes, LDA and Adaptive Boosting (AdaBoost) with decision trees).

6.4.3 *Classification*

We started with predictive models for recognizing archetypal movie clips based on the SAM ratings. Because there were seven categories of archetypal movie clips in this study, the classification task was considerably difficult. The best classification accuracy (28%) for the complete set of archetypes was achieved with the kNN classifier. In order to achieve higher recognition rates, we looked into the heterogeneity among different categories of archetypal content. Within these seven categories, four categories were related to the hero archetype. It is reasonable to compare the accuracy of the subsets that encompass each of the four categories of the hero's journey; every subset included the archetypes of anima, mentor, shadow, and one of the hero archetypes. The kNN method demonstrated the most accurate result (42%) for the subset that included the category of 'hero's departure'. For the subset with the archetype of 'hero's trials', the precision of classification was between 40.9 percent (with SVM classifier) and 43.1 percent (with AdaBoost classifier). It was also the most accurately predicted subset among all the four subsets. The subset with the archetype of 'hero's rebirth' featured the lowest classification rate (38.4% with the kNN classifier) among all of the subsets. Finally, for the subset that included the archetype of 'hero return', the classification methods enabled us to achieve the accuracy of 40.6 percent (kNN). A more detailed overview of the classification results can be found in Table 6.5.

Our next step was to see how accurately the explicit emotions presented in the movie clips could be differentiated based on the SAM ratings given by the subjects. For this purpose, we performed classification with the same classification algorithms as were used for the movie clips of archetypal content. In order to compare the classification rate between movie clips of archetypal content and explicit emotions, it is necessary to have subsets with equal numbers of categories of movie clips. For categories of archetypal content, there were at least four categories in each subset, encompassing anima, mentor, shadow, and one of the hero archetypes. Thus, it is needed to exclude one of the five explicit emotions in order to have a subset that accommodates an equal number of categories for comparison. Similar to the four hero archetypes, we decided to remove the category of 'amusement' or

'positive-arousing emotions' because it was homogeneous to 'joy' (positive-calm emotions) while other emotions were diverse (neutral, fear, and sadness). Therefore, the analysis was conducted with two datasets: the complete dataset that included the self-reported data for the movie clips featuring all the five explicit emotions and the dataset with the data related to joy, neutral, fear, and sadness. Classification results of the second dataset for the explicit emotions and any of the four reduced datasets for the archetypes could be easily compared because they had the same number of classes. The best classification accuracy (50.4%) for the complete dataset of the explicit emotions was achieved with the kNN method. The classification of the subset that did not include the data corresponding to the positive-arousing emotion (amusement) was noticeably more precise (64.9% with the LDA classifier). Table 6.5 provides more details on the classification results for the explicit emotions.

Categories of Affective Stimuli		N	kNN	SVM	Naive Bayes	LDA	Ada-Boost
Anima, Mentor, Shadow,	Hero 1-4	7	28.0	24.2	24.6	24.7	25.5
	Departure	4	42.0	40.2	38.0	40.9	37.0
	Trials	4	42.4	40.9	42.0	42.0	43.1
	Rebirth	4	38.4	37.7	36.2	38.0	34.4
	Return	4	40.6	39.9	39.5	39.5	39.9
Joy, Neutral, Fear, Sadness, Amusement		5	50.4	49.0	49.0	48.4	47.3
Joy, Neutral, Fear, Sadness		4	63.4	63.8	63.0	64.9	63.0

Table 6.5: Classification results obtained from the self-reports data, including valence, arousal, and dominance. The classification accuracy for each classifier is presented (in percent). Five classification algorithms were applied for recognizing movie clips of archetypal content and the explicit emotions. Upper five rows demonstrats the categories of movie clips of archetypal content; the lower two rows are the categories of movie clips of explicit emotions. The highest classification rate in each row was marked underlines. Four hero archetypes (hero 1-4) include hero's departure, hero's trials, hero's rebirth, and hero's return.

Having conducted the analysis of the self-report data, we proceeded to evaluate the feasibility of recognizing emotions induced by the movie clips of archetypal content and the explicit emotions from the physiological data of the participants. We integrated the features extracted from the physiological data into a unified dataset and built several prediction models for testing if the emotions induced by the movie clips of archetypal content and the explicit emotions can be differentiated according to the physiological data. In the case of classifying seven archetypes, the accuracy was in the range between 28.4 percent (AdaBoost) and 36.7 percent (LDA). For the subset with the category of hero's departure, the naive Bayes classifier reached the highest accuracy with 53.3 percent, and the category of hero's return yield an accuracy of 56.1 percent by using the kNN classifier. The classification accuracy of the categories of hero's trials was 57.1 percent by using the LDA classifier as well as the category of hero's rebirth (52.9 %). When the data was rearranged into several subsets, in such a manner that each of them corresponded to only four archetypes, the classification performance achieved 57.1 percent (LDA). This result was accomplished on the

subset with the category of hero's trials. The recognition of the explicit emotions demonstrated similar outcomes. With four classes of the emotions, 57.2 percent of the cases were accurately classified using the LDA method. When five explicit emotions were included into the analysis, the recognition rate decreased to 50.7 percent (LDA). In Table 6.6, we provided further details about the analysis of the complete dataset of the physiological signals.

Categories of Affective Stimuli		N	kNN	SVM	Naive Bayes	LDA	Ada-Boost
Anima, Mentor, Shadow,	Hero 1-4	7	33.4	34.6	33.4	36.7	28.4
	Departure	4	52.9	50.7	53.3	51.4	50.7
	Trials	4	54.1	56.0	55.6	57.1	45.8
	Rebirth	4	49.2	51.4	50.0	52.9	38.0
	Return	4	56.1	52.2	53.6	52.9	49.3
Joy, Neutral, Fear, Sadness, Amusement		5	47.5	49.0	50.1	50.7	44.1
Joy, Neutral, Fear, Sadness		4	54.7	55.1	57.2	56.2	41.6

Table 6.6: Classification results obtained from the data of ECG signals and skin conductance. The extracted features include HR, HRV, SCL, and SCR. The classification accuracy for each classifier is presented (in percent). Five classification algorithms were applied for recognizing movie clips of archetypal content and the explicit emotions. Upper five rows demonstrats the categories of movie clips of archetypal content; the lower two rows are the categories of movie clips of explicit emotions. The highest classification rate in each row was marked underlines. Four hero archetypes (hero 1-4) include hero's departure, hero's trials, hero's rebirth, and hero's return.

As we completed the analysis of the participants' self-reports and their physiological responses to the movie clips, it was necessary to compare the results for further discussion. In Table 6.7, we presented the best classification rates of the predictive models that were built according to the self-report and the physiological data. It needs to be noted that the numbers of categories of affective stimuli were different; only the classification rate with equal numbers of categories of affective stimuli can be compared. Therefore, only the results with four categories of stimuli can be compared. The predictive model generated the best classification rate on the archetypal content was the one with the following four categories: anima, mentor, shadow, and hero's trials (43.1% for self-reports and 57.1% for physiological data). Meanwhile, the best classification rates on the stimuli of the explicit emotions obtained from the predictive models were 64.9 percent for self-reports and 57.2 percent for physiological data. It needs to be noted that, for self-reports, the performance of the model for the archetypal content was noticeably lower than the model for stimuli of the explicit emotions (43.1% and 64.9%), while the performance of their models obtained from physiological data were similar (57.1% and 57.2 %).

In order to compare the results of the present study and the second study (see Chapter 5), it is necessary to use identical features extracted from the physiological data and put these data into the same classification algorithm. In these two studies, we applied SAM scales for self-reports. For the analysis on the physiological data, the features of HRV were excluded in the second study because the variance explained by these features was in-

Categories of Affective Stimuli		N	Self-reports	Physiological
Anima, Mentor, Shadow,	Four Hero archetypes	7	28.0 %	36.7 %
	Hero's Departure	4	42.0 %	53.3 %
	Hero's Trials	4	43.1 %	57.1 %
	Hero's Rebirth	4	38.4 %	52.9 %
	Hero's Return	4	40.6 %	56.1 %
Joy, Neutral, Fear, Sadness, Amusement		5	50.4 %	50.7 %
Joy, Neutral, Fear, Sadness		4	64.9 %	57.2 %

Table 6.7: Comparison of the classification accuracy achieved using the self-report questionnaires and the physiological data. Upper five rows demonstrats the categories of movie clips of archetypal content; the lower two rows are the categories of movie clips of explicit emotions. The highest classification rates for the movie clips of archetypal content and the explicit emotions were marked with underlines. The four hero archetypes include hero's departure, hero's trials, hero's rebirth, and hero's return.

significant. On account of consistency, we excluded HRV and used the LDA classification method to analyze the data of HR, SCL, and SCR for building predictive models particularly for further comparison. The results of the analysis on the present study are as follows. The confusion matrices of the predictive models generated by LDA based on self-report data and physiological data are demonstrate in Table 6.8 and Table 6.9. Each row in these tables shows how well the model can correctly predict the membership of the movie clips in each category. The cells with underlined digits indicate the percentage where the category was correctly predicted, and the cells with bold digits indicate the highest classification rate among all the predicted group members. That is, only those cells with underlined and bold digits are successfully classified by the predictive model.

We started with the self-report data. The predictive model derived from LDA on self-report data about archetypal symbols only obtains 24.2% accuracy (cross-validated) and the effect size is medium (canonical correlation = 0.539). The confusion matrix of the model obtained from the self-report data is demonstrated in Table 6.8. Among all the seven categories, three categories were successfully differentiated based on the self-report data: hero's trials, hero's return, and mentor. Next, the same analyses on physiological data were performed. We extracted useful features from the raw data of electrocardiography and skin conductance: heart rate, skin conductance level, and skin conductance response. These data were then fed to LDA for further evaluation. The confusion matrix of the model obtained from the physiological data is demonstrated in Table 6.9 on the following page.The predictive model generated by LDA on the physiological features reached an accuracy of 34.4% (cross-validated) and the effect size of the predictive model for archetypal symbols is medium (canonical correlation = 0.414).

Confusion Matrix of the Self-Report Data							
Classified as →	ANI	DEP	TRI	REB	RET	MEN	SHA
Anima	7.6	9.1	4.5	0.0	**31.8**	28.8	18.2
Departure	10.6	24.2	**31.8**	0.0	7.6	12.1	13.6
Trials	9.1	21.2	**39.4**	0.0	9.1	7.6	13.6
Rebirth	15.2	7.6	7.6	0.0	**28.8**	22.7	18.2
Return	9.1	1.5	6.1	0.0	**40.9**	24.2	18.2
Mentor	12.1	3.0	7.6	0.0	16.7	**45.5**	15.2
Shadow	12.1	18.2	**27.3**	0.0	13.6	16.7	12.1
Canonical correlation = 0.539, Effect Size = Medium, 24.2% of cross-validated grouped cases correctly classified.							

Table 6.8: The confusion matrix of the model obtained from the LDA on the self-report data for archetypal movie clips (in percent). ANI means anima; DEP means hero's departure; TRI means hero's trials; REB means hero's rebirth; RET means hero's return; MEN means mentor; SHA means shadow. Each row shows the probability of which category the stimulus is classified. The values with underlined digits indicate the accuracy each archetype can be correctly classified. The values with bold style indicate the highest probability in each row. Only three categories (Trials, Return, and Mentor) are successfully differentiated by the predictive model.

Confusion Matrix of the Physiological Data							
Classified as →	ANI	DEP	TRI	REB	RET	MEN	SHA
Anima	**50.0**	9.1	12.1	7.6	7.6	10.6	3.0
Departure	12.1	**27.3**	12.1	9.1	12.1	15.2	12.1
Trials	4.5	13.6	**39.4**	9.1	12.1	6.1	15.2
Rebirth	12.1	13.6	4.5	**36.4**	13.6	9.1	10.6
Return	7.6	7.6	13.6	12.1	**34.8**	18.2	6.1
Mentor	19.7	10.6	9.1	12.1	10.6	**27.3**	10.6
Shadow	12.1	13.6	24.2	15.2	4.5	4.5	**25.8**
Canonical correlation = 0.414, Effect Size = Medium, 34.4% of cross-validated grouped cases correctly classified.							

Table 6.9: The confusion matrix of the model obtained from the LDA on the physiological data for archetypal movie clips. Each row shows the probability of which category the stimulus is classified. The values with bold style indicate the accuracy each archetype can be correctly classified. All the categories are successfully differentiated by the predictive model.

The overall classification rate of the self-report data (24.2%) and physiological data (34.4%) toward archetypal movie clips both are higher than a chance level (14.29% for seven categories). Moreover, the classification rates of the self-report data are mostly contributed by the three categories that can be successfully differentiated (hero's trials, hero's

return, and mentor), which are even less than half of the number of all categories. Meanwhile, all the categories can be differentiated by the predictive model of physiological data at a recognition rate no less than 25%, ranging from 27.3% to 50.0%. It appears that the performance of the predictive model obtained from the physiological data is higher than the one gained from the self-report data.

6.5 DISCUSSION

The results of our experiment suggested that archetypal movie clips in different categories can be correctly classified with recognition rates higher than chance level. This has confirmed the answer to our first research question. In order to answer the second research question, it is necessary to compare the robustness of the predictive models obtained from self-reports and physiological signals. Previous studies collected affective stimuli based on the categorization of basic emotions, and they reported higher recognition rates from self-report data than the results of the physiological data (Desmet et al., 2004). While our results of physiological data showed a comparable accuracy of recognition, the performance of the predictive model obtained from self-report data is significantly lower than previous studies on basic emotions, which is a new finding that related studies have not yet discovered. However, there are many ways to explain this finding, especially when this might relate to some very fundamental questions that have been under debate for years. We consider our results as preliminary findings so that we have to keep them open for all possible explanations.

6.5.1 *Consistency between the Two Studies*

Since the present study was an advanced version of the second study using an improved experimental design, it is important to compare and reassess the results of these two studies for further inferences. The second study has some limitations. There is only one clip for each category of affective stimuli used in the second study, which has limited the statistical power of the results and thus it cannot be used to build predictive models for developing applications. Moreover, it is unclear if there were unique patterns of emotional experiences induced by movie clips in the same categories. These concerns have been solved by expanding the pools of movie clips for each category. In the present study, we used three movie clips for each category of affective stimuli, which allows us to answer the research questions we have put forward in the Introduction section.

These two studies have shown similar trends in their classification rates of the predictive models obtained from the self-report data and the physiological data. In the second study, the classification rate of the predictive model obtained from the self-report data have reached 28.5 percent while the performance of the predictive model obtained from the physiological signals was considerably better (46.5%). The effective size of the model of the physiological signals was also noticeably higher than the effective size of the model obtained from the self-report data. Similarly, in the present study, the predictive model derived from the physiological data outperformed the model obtained from the self-report data (34.4% vs. 24.2%). Although the classification rates are lower than the previous study, they are still higher than the chance level. The decreases in the classification rates can be explained by the numbers of the stimuli in each category in the present study have sub-

	The Second Study		The Present Study	
	Correctly Classified	Effect Size	Correctly Classified	Effect Size
Self-Report Data	28.5 %	0.544	24.2%	0.539
Physiological Data	46.5 %	0.752	34.4%	0.414

Table 6.10: Comparison for the results of the emotion recognition rates toward the archetypal movie clips obtained from the second study (see Chapter 5) and the present study. A leave-one-out LDA classifier was used for both studies. The effect size is explained by Canonical correlation coefficients.

stantially increased. The results of the present study are in accordance with the previous experiment, and have further confirmed the validity of the interpretations we put forward earlier in Chapter 5.

6.5.2 *Unconscious Emotions*

From a methodological perspective, if we assume that it is possible to consciously feel emotion toward archetypal movie clips, a reasonable explanation would be that the existing dimensions of SAM are not comprehensive enough to cover the emotions elicited by archetypal content. The development of the SAM scale mostly focused on quantifying emotions into three dimensions: valence, arousal, and dominance. It appears that these three dimensions are inadequate for representing emotions induced by archetypal movie clips. More dimensions are needed for higher-order emotional qualities. Some topics related to emotion would be inspiring for new dimensions, such as mindfulness (Hamilton, 2006) or spirituality (Moberg, 2010). However, the real challenge is to find proper means of measuring these qualities in psychological studies. Another possible explanation is that the self-report technique is not suitable for measuring emotions other than basic emotions. It might be problematic to ask participants to report their emotions through rational introspection because people do not always tell what they really think (Nisbett & Wilson, 1977). Moreover, it is suggested that emotion belongs to the experiential system, not the rational system of human mind (Kahneman, 2003). The self-report data collected through rational reasoning using might be a 'translated' version of emotional feeling from the experiential system. Therefore, these data might be biased and cannot authentically reflect the true emotional qualities.

Although the above explanations about self-report techniques require more studies for further justification, the analysis on physiological data has shown prominent results for measuring emotional responses toward archetypal movie clips. Although the archetypal movie clips in the same category are edited from different movies, the predictive model obtained from physiological data still allows us to differentiate each category. To some extent these results have provided preliminary evidence for the assumption that people have similar bodily activities while being exposed to archetypal content. Archetypes are unconscious knowledge that cannot be access by the conscious mind. However, it still can be manifest through some unconscious reactions, especially unconscious emotions. In the

context of cinema experience, the results of the self-report data collected by introspective reasoning have indicated the inaccessibility of the conscious mind, but the results of physiological measures showed a relatively effective power to couple the archetypal content with emotional responses. This explanation is also partly in accordance with Damasio's proposition about the distinction between emotion and feeling (Damasio, 2010). He argues that emotions are the phenomena that are carried out by cognitive actions in our bodies, which can be observed through physiological signals, whereas feelings of emotions are composite perceptions of these actions in body and mind. In other words, feelings are images of emotions rather than emotions themselves. Feelings and emotions are not always identical, and not all the emotions can be perceived as feelings. Although Damasio's theory has been broadly accepted and seems valid for supporting the hypothesis that the archetypal movie clips induce unconscious emotion, it is still an open question for future studies to explore the human's unconsciousness.

6.5.3 *Implications for Developing Future Applications*

One of the primary goals of this study is to couple the archetypal media content with its corresponding emotional responses in order to build computational models that can be used in practice. Based on the review provided by Novak et al. (2012), the predictive power of our model obtained from physiological data is in line with other related studies in terms of classification accuracy. It needs to be noted that all the seven categories were successfully differentiated according to the physiological data (see Table 6.8). This means that the emotional responses measured by physiological signals toward each category of the archetypal content showed unique patterns that can be recognized by computational systems. The results suggest that it is feasible to apply the obtained predictive models for developing affective computing systems for various purposes.

More importantly, the results of our experiment have suggested that movie clips belong to same categories of archetypal content induced similar emotional responses even if these movie clips were extracted from different movies. This has provided substantial evidence that supports the validity of the analytical method we have developed (see Chapter 3). It appears that archetypal symbolism is a useful resource for analyzing media content in various movies in terms of emotional experiences. This has provided a new direction for studying media content in addition to perceptual qualities that have been well researched, such as colors and shapes, and shifted the focus to a higher level of understanding - symbolic meaning of media content. In the Third Part of this thesis, we will further discuss how these findings can be applied in design research and design practice.

6.5.4 *Limitations*

The validity of emotion recognition across people has been a difficult problem even in psychology because people may have different reactions while experiencing the same emotion (Russell, 1994). In our study, we intended to examine whether the participants have a similar pattern of emotional responses to the given categories of archetypal content. Although the results suggested that seven categories of archetypal content can be recognized via measuring physiological signals, this finding cannot be generalized as evidence proving

the existence of the collective unconscious. Nevertheless, archetypal symbolism provides a new perspective on analyzing media content, which may be valuable for media design.

The present study did not aim at justifying the validity of Jung's theory specifically on its universality. Therefore, we did not recruit equal numbers of participants from different countries and most of the participants were from Spain, where the study was conducted. Nevertheless, we performed further statistical analyses specifically on the cultural backgrounds of the participants in order to answer this question. There were no significant effects on the interaction between the categories of movie clips and the countries where the participants were born. Although the results to some extent support Jung's theory, more studies are required specifically for assessing the universality of archetypes. Moreover, the number of stimuli for each category were still relatively low (three movie clips). Although the present study have overcome the main limitation of the second study, it is necessary to include more data samples per participant in order to facilitate the generalization of the results.

6.6 CONCLUSION

In this study, we extended from the previous study and conducted an experiment with an improved design, using three movie clips for each category of archetypal content. The results were in line with the previous study and further confirmed the interpretations we have put forward in Chapter 5. In contrast to the results of the stimuli of explicit emotions, the results of archetypal media content showed that the emotional responses of the participants can be correctly classified with the predictive model obtained from the physiological data while the performance of the predictive model derived from the self-report data was considerably low. There were several interpretations for this finding and one of the most promising interpretations was that archetypal media content may induce unconscious emotions. Moreover, in this study, we also applied the method presented in Chapter 3 for analyzing the symbolic meaning of the media content as affective stimuli for the experiment. Although, the primary goal of this study was not to justify the hypotheses in Jung's theory, the findings of this study have confirmed the feasibility of applying archetypal symbolism for analyzing media content. Finally, we applied machine learning techniques in this study to build predictive models that are robust enough for developing applications that can be used in practice. These predictive models serve as the basis of the artificial intelligence that enables affective computing systems to couple media content with corresponding emotional responses. In the following chapters, we turn back to the context of design. Provided with the findings in the present study, we propose to consider archetypal symbolism as a design pattern for media content. The link between archetypal media content and emotions in the viewing experience appears to be the key element that bridges the psychological findings and emotional design.

Part III

IMPLICATIONS FOR DESIGN

7 VISUALIZING EMOTIONS IN MEDIA CONTENT

7.1 INTRODUCTION

Emotion is an essential part of people's mental life. While psychological science strive for exploring the functionality and the ontology of emotion, other fields of study focus on how research on emotions can be applied in real-life applications and seek the possibilities to enhance the quality of mental life. In the engineer field, 'affective computing' was first proposed by Picard (2000), who advocates the importance of emotion while the mainstream engineering studies focus more on machines and technologies rather than human perspectives. One of the visions of affective computing is that future computers (or machines) should be capable of sensing human emotions and acting accordingly, and, in an ideal scenario, computers should even be able to deliver emotional expressions to enhance their communication with human users Picard (2003). The current states of affective computing mainly focus on the development of precise and reliable measurements for emotion recognition and emotion modeling using computational algorithms. The obtained models can thus be applied to real-life applications that support a higher-level of human-computer interaction and even enrich human-human communication.

Although affective computing has grown vigorously and has achieved great success in recent years, its knowledge has not yet been used to support emotional design. This might due to the fact that most designers rely on experience-based approaches rather than systematic approaches in order to cope with various design challenges. Experience-based approaches are based on tacit knowledge that cannot be explicitly described and can only be gained through practices, especially for designers (Mareis, 2012). Experience-based approaches are often used to deal with complex problems in which people can hardly solve through logical thinking and thus can only rely on their intuition for decision making (Dijksterhuis, 2004). On the contrary, systematic approaches are suitable for well-defined problems and less demanding on designers' experiences. Therefore, systematic approaches are mostly used for design evaluations rather than design practices.

The new challenge for design researchers is to integrate systematic approaches into experience-based approaches. Although experience-based approaches are powerful particularly for design practices, they are prone to make mistakes and less consistent (Kahneman, 2003). In the Second part of this dissertation, we have conducted three studies to explore the relationship the emotions in archetypal media content using affective computing techniques (see Chapter 4, 5, and 6). There were two primary findings. Firstly, we applied archetypal symbolism to meaning analysis on media content, and developed a standard procedure for editing archetypal media content from commercial movies for psychological experiments. Secondly, the results of these three studies suggested that emotions induced

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by archetypal media content were either too complicated to express through self-reports or inaccessible to conscious awareness, but these emotions can be classified by using the predictive model obtained from the physiological data. Since experience-based design approaches toward emotional design are based on conscious introspection and self-reports, it appears that a wide range of emotions have not yet been discussed in emotional design. Thus, it is necessary to integrate affective computing into experience-based design approaches in order to facilitate emotional design. In this way, the design process would remain flexible and designers could get useful insights provided by scientific studies.

In order to initiate this undertaking, we started with *mood board making*, which was known as an experience-based technique used for communicating and visualizing emotional qualities. The use of mood boards is versatile. It has long been used for communicating emotional qualities between designers and clients (Cassidy, 2008). The process of mood board making also serves as a resource for creative thinking (McDonagh & Storer, 2004). While mood board making has become an essential skill for design practice, we have seen its potential to be a research tool specifically for investigating non-verbal emotional experience. In order to use mood board making as a research tool for studying emotions, it is necessary to apply psychological methodologies to verify its validity. This would reveal possible disadvantages of using mood board making for research purposes, but also help discover new opportunities to integrate affective computing into emotional design.

We first review the current development of emotion evaluation tools in design research, and then revisit the procedure of making mood boards from a psychological perspective to formulate a framework of mood board making as a research tool for emotional design. According to this framework, we conducted two experiments to examine the effectiveness of mood boards in expressing emotional qualities across interpretations of design-background and non-design-background participants and the validity of mood board making for archetypal and non-archetypal media content. These two studies helped clarify the advantages and disadvantages of using mood board making as a research tool for studying emotion. Next, we developed an application by implementing affective computing technology for supporting the process of mood board making in order to enhance the validity of mood board making and remedy its deficiencies in visualizing the continuous emotional experiences in archetypal media content. A case study was reported for demonstrating the use of this application. Finally, we discuss the implications of this study for emotional design and look forward to future work in this direction.

7.2 DESIGN RESEARCH ON EMOTIONS

Similar to affective computing, Kansei Engineering is a consumer-oriented approach that is used to quantify emotional qualities particularly in products, and generalize design factors that allow designers to refine the current design and even explore new possibilities for design at the early stage of product development (Nagamachi, 1995). Researchers in Kansei Engineering intend to investigate the relationship between consumers' psychological feelings and product features, such form, shape, color, and any perceptual qualities. Designers can thus generate new product concepts by manipulating product features. This method can also be used to evaluate qualities of new concept at early stages of the design process (Barnes & Lillford, 2009). The Japanese word 'Kansei' encompasses broad concepts, referring to all of which are conceived as mental responses to external stimuli, including emotion, senses, and aesthetics (Nagamachi, 1995). Although Kansei Engineering covered

the issues about how customers feel about products, it was developed specifically for aesthetics and product design and did not draw much on psychological theories. This was probably because psychological theories put more emphasis on the functional views of emotions that facilitate the survival of human beings as a species, but rarely discuss non-utilitarian emotions, e.g. aesthetic emotion (Scherer, 2005a) and emotions in media content (Wirth & Schramm, 2005). Therefore, design researchers cannot directly apply psychological theories to research on emotional design. This has led to the challenge for design researchers to mediate psychological theories and approaches into the context of design. Research in Kansei Engineering often uses semantic scales with perceptual and emotional qualities, which may give rise to some concerns about cultural differences and product categories (Khalid, 2006). For example, the expression in Japanese and English on certain perceptual qualities may differ; kitchen appliances and automobiles should use different sets of semantic scales.

The connection between emotion and design has drawn more attention since the term 'emotional design' was coined and popularized by Norman (2005). In recent years, pioneering design researchers have taken the initiative to extend existing psychological theories to build models particularly for product emotions (Desmet & Hekkert, 2002; Desmet, 2003; Hassenzahl, 2008; Diefenbach & Hassenzahl, 2011). Some researchers have shift the focus from physical products to user experience, exploring how emotions influence the overall experience under certain circumstances (Norman, 2005; Diefenbach & Hassenzahl, 2011; Hassenzahl et al., 2010). Jordan (2000) developed a questionnaire specifically for evaluating positive emotional experience about products. This questionnaire encompasses 14 questions about specific emotions, such as entertained, excited, and satisfaction. Taking into account the feasibility across products and cultures, this questionnaire provided optional open-ended questions that allowed the experimenter and the subject to add new words. While Kansei Engineering and Jordan's questionnaire focused on physical products, several new evaluation tools for measuring user experience were proposed in recent years. User experience questionnaire (UEQ) (Laugwitz et al., 2008) used a similar approach to Kansei Engineering but shifted the focus from products to users. Thus, UEQ removed adjectives describing physical appearance of physical products (e.g. shape and color) and included more words for describing cognitive load, emotional feelings and preferences.

While most evaluation tools are intended to derive immediate responses from subjects, a tool called iScale (Karapanos et al., 2012) was developed for observing long-term, continuous user experiences. This tool requires users to recall their long-term experiences periodically while using a new product in their daily lives. Unlike other tools using Likert scales, iScale takes a novel approach, asking users to draw a curve to indicate the changes in their emotional experiences related to the product. However, this curve-drawing approach does not aim to acquire exact emotional qualities, but to serve as a reference for tracing pleasant or unpleasant events that occurred, which allows designers to 'reconstruct' the past and solve potential problems of the product accordingly. However, the abovementioned evaluation tools are language dependent. Although the interpretations in affective meaning are universal at a certain degree (Osgood et al., 1975), various modalities of emotional responses are universally valid and might benefit non-verbal emotion communications, such as facial expressions (Ekman, 1994). PrEmo (Desmet et al., 2004) was developed based on this assumption, using facial expressions and body gestures with animated cartoon characters to illustrate different emotional qualities. Subjects could thus fill this questionnaire through self-reports as an instrument for measuring consumers' emotional responses

specifically to product appearance. In addition to the abovementioned tools, there are more new tools released in recent years (e.g. Huisman et al., 2013; Hole & Williams, 2007).

Most design researchers apply research-based approaches to investigate product emotions (e.g. Norman, 2004; Desmet et al., 2007) and endeavor to develop systematic procedures for evaluating emotional experience. However, how to study emotion in design practice is rarely discussed. Over the past years, designers have been using experience-based tools, such as mood boards, to study emotions. Comparing to systematic tools, experience-based tools are usually quick-and-flexible solutions and do not have strict term of use. On the other hand, the validity of experience-based tools is difficult to validate so that this kind of tool is rarely discussed in empirical studies.

7.3 REVISIT MOOD BOARD MAKING

Considering integrating affective computing into emotional design, we start with mood board making because it is a design tool particularly for studying emotional qualities. In order to verify the validity of mood board making, it is necessary to revisit its procedure and thereby look for possibilities to improve this experience-based tool using systematic approaches.

7.3.1 *A Psychological Perspective*

Mood boards are a collection of visual images gathered together to represent an emotional responses to a design brief (Garner & McDonagh-Philp, 2001). It is a visual and sensory instrument for designers to communicate with each other and also with the clients (McDonagh & Storer, 2004). This tool functions as a non-verbal medium communicating complex and delicate emotional qualities that are difficult to express through languages. The process of mood board making can stimulate insightful discussions (McDonagh & Storer, 2004; Garner & McDonagh-Philp, 2001), providing inspirations at the early stage of concept development (Barnes & Lillford, 2009). In order to support mood board making, various modalities of interactive technologies were applied to developing digital mood board (Lucero et al., 2008), which enable designers and clients to co-create mood boards effectively.

Mood board making were developed solely for designers. Since mood board making is technically easy and simple, some researchers have tried to use mood boards as a catalyst in focus groups (McDonagh et al., 2002). Similar to the context-mapping approach (Visser et al., 2005), mood board making may stimulate more feedback from target users and help designers discover deeper insights about user needs and aspiration towards products. This has shown the potential of mood boards to be used as a tool for capturing emotional experiences in different contexts. Today, mood board making has become an essential skill for designers. Several studies have discussed how to teach and apply this technique in design education (Cassidy, 2008; Garner & McDonagh-Philp, 2001; McDonagh & Denton, 2005). It appears that most designers are trained to translate emotional qualities into mood boards – a visual manifestation that associates with the given content, e.g. products and brands. However, this technique did not gain adequate credits in terms of scientific evidence. It is necessary to assess the validity of mood boards to be an effective tool for studying emotions in design research.

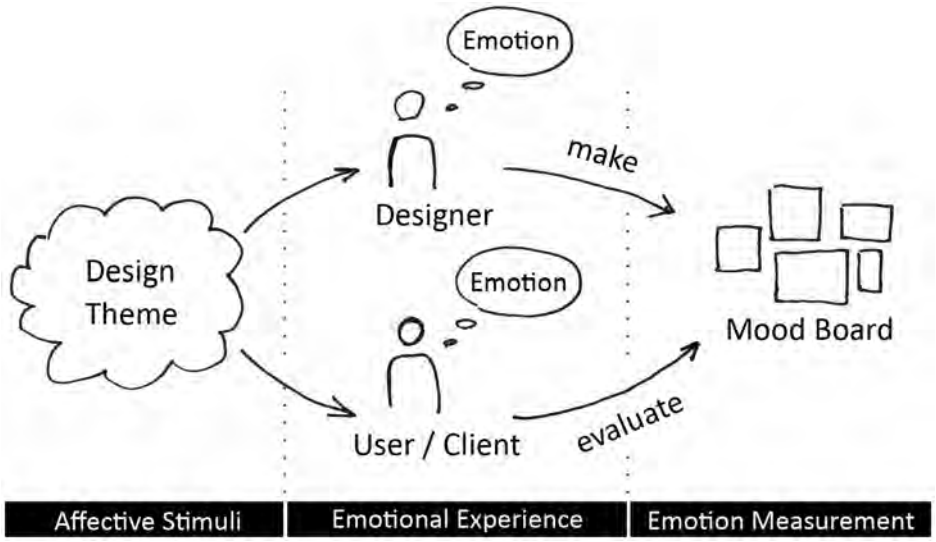

Figure 7.1: A psychological perspective on mood board making in design practices.

A general context of use of mood boards can be illustrated as follows (see Figure 7.1). In the early stage of the design process, one of the primary tasks is to define emotional qualities of the new product. To initiate this undertaking, designers usually start with the 'design theme' of the given project, such as the brand image of the client and the marketing position of the new product. After a thorough understanding of the theme, designers can thus make mood boards to visualize predefined emotional qualities. These mood boards serve as part of the key references for later stages of product development. Designers have to discuss with their clients about the mood boards to identify the common goal of the project, and also talk with target users in order to obtain useful insights. From a psychological perspective, the above process can be decomposed into two stimuli-response processes. The 'design theme' of the given project can be conceived as a mutual affective stimulus to bot designers and users/clients. After both of them have been primed with the emotional experience, designers make mood boards as a self-report outcome, and then users/clients provide their evaluation according to their subjective emotional experience. Designers need to modify their mood boards iteratively in order to reach a certain consensus among themselves and the target users. If we intend to use mood board making as a research tool, it is necessary to assess the validity of these two processes - the making of mood boards and the evaluation of mood boards (see Figure 7.1) - in order to ensure that the final outcome (i.e. mood boards) successfully reflect the emotional qualities in the design theme.

7.3.2 *Mood Boards as a Research Tool for Study Emotions*

In order to take this initiative, we needed to first verify the validity of the evaluation of mood boards. If designers and target users share universal criteria on evaluating mood boards, the evaluation process would thus serve as the reference for testing the validity of mood board making.

For evaluation, previous studies have revealed that design students share a common perception of mood boards (McDonagh & Denton, 2005). The authors recruited a group

of design students to create mood boards according to two general terms, 'masculine' and 'feminine', and asked them to give ratings to the mood boards created by other students depending on how well the mood boards represent the concept of masculine and feminine. The results suggested a consistency for both male and female students in terms of the concept of 'masculine' and 'feminine'. These studies have revealed promising results in this direction, encouraging us take a step forward and taking into account more critical issues that are related to the validity of the evaluation process on mood boards.

First of all, it is necessary to verify if mood boards are emotionally meaningful for both designers and target users (i.e. individuals who are not trained as a designer). While most designers are trained to make mood boards, they are also experienced in interpreting and justifying mood boards. Although mood boards are assumed to be a non-verbal emotional communication tool, it has not yet clarified if users share the same underlying criteria in justifying mood boards with designers. In order to apply mood boards as a universal tool for evaluating emotions for the general population, it is important to examine whether mood boards can be self-explained affective content to both designers and users.

Second, in the study of McDonagh & Denton (2005) the raters (i.e. the design students) also participated in the task of making mood boards. This would lead to a priming effect because the raters had thought attentively about the themes for creating mood boards, and would have anticipated what elements might be included in the final mood boards. We propose to include users as the role of rater in order to avoid priming effects, and this setting is also closer to how mood board making is applied in design practices.

Lastly, the stimuli for eliciting emotions in designers and users should be more immersive, emotionally rich, and generic. Most previous studies used static pictures to demonstrate the visual appearance of products, such as keywords, color, shape, and materials (Nagamachi, 1995; Desmet et al., 2004). However, this content is too feature-specific, and is not suitable for the early stage of product development. Moreover, the selection of media type should also be taken into account. Several psychological studies have suggested that film clips are an effective media type for eliciting emotions (Rottenberg et al., 2007; Philippot, 1993; Gross & Levenson, 1995). Film clips are relatively short, intuitively powerful, and easily accessible; the clips and the procedure for viewing them can be standardized across participants (Lench et al., 2011).

In order to overcome the above mentioned issues, we chose to use TV commercials as a proper resource for affective stimuli in our research (see Figure 7.1). TV commercials have long been used in research on emotions specifically for consumer psychology (Edell & Burke, 1987). TV commercials are suitable for our research because affective reactions to TV commercials are highly related to buying behaviors (Baumgartner et al., 1997) and the symbolic meaning of advertisement is an essential element in visual communications between products and consumers (Rompay et al., 2009). Moreover, mood board making is closely related to the brand image of the product as it is often used in the early stage of product development (McDonagh et al., 2002). TV commercials represent the spirit of the brand of the company and demonstrate the emotional qualities that the company intend to communicate with their potential customers. More importantly, TV commercials were considered as a fruitful resource of media content that contains represents archetypes (Mark et al., 2001; Rapaille, 2001; Tsai, 2006; Caldwell et al., 2010).

While mood boards making is often used in design practice, we propose three research questions about the validity of using mood boards as a research tool for investigating emotions for the general population rather than just designers. The first research question is

whether designers and non-design-background people had universal tendencies in judging the qualities of mood boards. If the answer to the first research question is positive, the second research question is to ask whether individual designers could make equal quality of mood boards for different design themes, for example, different categories of archetypal media content. In the meantime, the third research question is to determine whether archetypal media content stimulated designers' creativity in making mood boards that contained richer emotional qualities. In order to answer the above three questions, two studies were conducted respectively.

7.4 STUDY 1: THE EVALUATION OF MOOD BOARDS

The first study was to examine whether designers and non-design-background people share the same criteria for judging the qualities of mood boards. In the process of mood board making, TV commercials of specific brands serve as the 'design theme'; they can be regarded as affective stimuli from a psychological perspective (see Figure 7.1). Therefore, we put the present study in a hypothetical scenario. At the first stage, twelve professional designers were recruited to create mood boards for each of the selected commercials. Mood board making in the present study should focus on the emotional qualities rather than design features because it was the early stage of the design process. The mood boards were considered as representations of the emotional qualities delivered by the TV commercials. In the second stage, voluntary participants were presented with the same TV commercials for emotion elicitation. After watching each of the commercials, the participants needed to compare their emotional feelings with the emotional qualities represented by the mood boards, and then evaluate these mood boards based on their subjective feelings.

We selected two commercials, of which products should belong to the same category in order to have the results of the two commercials comparable. Two TV commercials of automobile brands, BMW (Rathod, 2012) and Jeep (SistemasNormalesHD, 2013), were selected as affective stimuli. Both of these two commercials were one minute long. The content of these two commercials represents feminine and masculine images based on the definition of Jungian theory of archetypes on 'anima' and 'hero' (Jung, 1964). The selection process followed the analysis method we have developed earlier (see Chapter 3). Twelve professional designers were invited to participate in mood board making. All of these designers are originally from Taiwan and have at least two-year professional experiences as a designer. They first watched one of the two commercials and created an image-only mood board, and repeated the same task for the other commercial. Therefore, 24 mood boards were created for the later experiment (see Appendix B and Appendix C for all the mood boards). The display of the two commercials followed a random order. The designers were asked to make mood boards to describe their own emotional feelings about the content of the commercials and ignore their preoccupied impressions about the brand and its product features. In order to standardize the resources they used for creating mood boards, an online mood-board-making application called 'Moodshare' (Mooooodle Limited, 2011) was used to perform the task. Moodshare was associated with several online media resources, such as Google Image, Flickr, Picasa, and Instagram, which provide the designers a standardized source for creating mood boards.

While mood boards have long been considered useful for designers, in this experiment we intended to verify whether non-design students and design students gave similar rankings over mood boards. If the answer was positive, mood boards could thus be useful for

investigating emotional experience among individuals who were with or without a design background. A qualitative questionnaire was applied to collect more information about the criteria for justifying the quality of the mood boards. Our experiment was conducted at the Usability Laboratory of CETpD research center at the Polytechnic University of Catalonia, and the design studio of the Department of Industrial Design at National Taiwan University of Science and Technology. There were 36 design students and 16 non-design students, including 25 Females and 27 males, volunteered to participate in our experiment. The average age of the participants was 24.46 years old (SD = 4.96). The students were originally from 11 countries; 22 participants were from Asia; 26 were from Europe; 4 were from South America. The experiment followed a within-subject design. Each session accommodated one participant and thus every participant performed all the tasks respectively.

7.4.1 *Procedure*

The procedure of our experiment is as follows (see Figure 7.2). Firstly, an introduction was given to the participant and the participant needed to fill in an informed consent form for the experiment. After signing the agreement, the participant was seated in our laboratory, which was arranged as a usual living room to make the participant feel comfortable and relaxed. The visual part of the video was projected onto a white wall; the display dimensions are 325 cm by 175 cm, while the audio part of the video was delivered via wireless headphones. When the above setting was ready, the light in the laboratory was dimmed in order to make the participant more immersed in the video presentations. The two TV commercials were play in random order. After finishing viewing one of the videos, the participant was then asked to fill the questionnaire. The questionnaire encompassed two parts; the first part was providing keywords to describe his or her emotional experience about the video; the second part was to rank mood boards according to the participant's own emotional experiences about the video.

The keywords served as qualitative data that represented the participant's perceived emotional qualities and denoted the prominent elements that attracted his or her attention. The participant was asked to focus on the content of the video rather than the brand of the commercial although the influence of the brand of the commercial might still affect the judgment of the participant. After this part of questionnaire was finished, the participant was led to the wall that presented mood boards corresponding to the given commercial. All the mood boards were presented at the same time in order to provide an overview, and the participant could look closer into each mood board to give rankings. The mood boards were created earlier by professional designers in the first stage, representing the emotional qualities that were perceived and expressed by them. The participant was asked to give rankings for the 12 mood boards for each commercial according to his or her overall viewing experience. The mood board that was most relevant should be ranked as number 1, and the second relevant as number 2, down to the least relevant which is number 12. The participant performed the same task for both the two commercials respectively.

Figure 7.2: The procedure of the first study of mood boards. First, the participant watched one of the two commercials, wrote down keywords and then gave rankings for mood boards. The same order repeated for the other commercial.

7.4.2 *Results*

In most cases, a Pearson correlation is a valid estimator of inter-rater reliability, but only when meaningful pairings are available between two raters, but it is not suitable for more than two raters. The intra-class correlation (ICC) was developed for estimating inter-rater reliability on quantitative data (Shrout & Fleiss, 1979). We applied the analysis on intra-class correlation using a two-way-random, average-measure model. The results indicated that the inter-rater reliability among all rankings given by all participants is remarkably high (ICC(2, 52) = 0.939, $F(23,1175) = 15.7$, $p < 0.001$, 95% confidence interval for ICC population values: $0.898 < ICC < 0.969$), which indicates that design and non-design students showed similar opinions on how the mood boards matched their emotional experience.

In order to examine if there are significant differences between the rankings of mood boards, we used a non-parametric repeated-measures analysis of variance, i.e. the Friedman Test (Friedman, 1937). For the mood boards of BMW commercial, a Friedman test revealed a significant effect of the designers on the rankings ($X2(11) = 60.461$, $p < 0.001$). Similarly, the same test on the rankings for the mood boards of the Jeep commercial also revealed a significant effect ($X2(11) = 198.855$, $p < 0.001$). The results suggested that there are significant main effects on the rankings of the mood boards for the two commercials respectively.

Therefore, we proceeded to post-hoc analyses. The Wilcoxon-Nemenyi-McDonald-Thompson test was developed specifically for a post-hoc test that enables pairwise comparisons for non-parametric repeated measures data (Hollander & Wolfe, 1999). In Table 7.1, we presented the results of descriptive analyses and the pairwise comparisons between the top three and bottom three mood boards for both two commercials. It needs to be noted that each of the top three mood boards is significantly better than any of the bottom three mood boards. It is noticeable that part of the top three and bottom three mood boards for BMW and Jeep commercials were made by the same designers (designer K and E in top 3;designer H and C in bottom 3). The top ranked mood boards for the two commercials are presented in Figure 7.3 and 7.4. It can be seen that the numbers of the images included in each mood board are different. We performed the Person's Chi-squared test to examine

BMW Commercial (Anima)			Jeep Commercial (Hero)		
ID	Mean (SD)	Post-hoc	ID	Mean (SD)	Post-hoc
K	4.80 (3.23)	K-H: p = 0.003	G	3.65 (2.79)	G-H: p < 0.001
E	4.92 (3.17)	K-B: p < 0.001	K	3.80 (2.87)	G- I: p < 0.001
D	5.22 (3.01)	K-C: p < 0.001	E	4.33 (3.25)	G-C: p < 0.001
H	7.57 (3.13)	E-H: p = 0.006	H	8.82 (2.45)	K-H: p < 0.001
B	8.02 (3.25)	E-B: p < 0.001	I	9.55 (2.60)	K- I: p < 0.001
C	8.43 (2.68)	E-C: p < 0.001	C	9.88 (2.44)	K-C: p < 0.001
		D-H: p = 0.028			E-H: p < 0.001
		D-B: p = 0.002			E- I: p < 0.001
		D-C: p < 0.001			E-C: p < 0.001

Table 7.1: The results of the descriptive analyses and the post-hoc test for pairwise comparison on the rankings for the mood boards [average ranking (standard deviation)]. Twelve designers participated in this study (ID alphabetically ranging from A to L). The upper 3 rows show the top 3 and the lower 3 rows show the bottom 3 of the twelve mood boards.

if there is a significant correlation between the number of the images in a mood board and its ranking. The results showed that there was a negative correlation between the numbers of images and rankings ($r = -0.175$, $n = 1224$, $p < 0.001$). The results were reasonable because more images could accommodate richer information and trivial emotional qualities could be communicated through associations. However, the number of the pictures should be reasonably limited by the context of use because ideally a mood board should allow the viewer to have an overview of all the visual stimuli within it while the content of each picture should be recognizable in order to initiate the process of association.

Figure 7.3: The top ranked mood board for the BMW commercial (by designer 'K' in Table 7.1).

The keywords given by the participants serve as references for inferring the underlying criteria that were used for ranking the mood boards. We applied the Ground theory to code the keywords in order to identify various themes (Ryan & Bernard, 2003). After coding, we conducted a descriptive analysis on the numbers of appearance of words in each theme (see Table 7.2). It can be seen that the participants rarely refer to certain emotional qualities directly, but used a large amount of sensory words, analogies, and metaphors. Combining

Figure 7.4: The top ranked mood board for the Jeep commercial (by designer 'G' in Table 7.1).

the keywords in the same theme allowed us to associate the emotional qualities perceived by the participants, e.g. the feeling of being home.

7.5 STUDY 2: COMPARISON BETWEEN ARCHETYPAL AND NON-ARCHETYPAL CONTENT

The results of the first mood board study have confirmed that design students and non-design students had similar opinions on ranking the mood boards. It is suggested that the participants share a natural tendency in judging the qualities of mood boards even though some of them have no design backgrounds. Next, we proceed to answer the second research question - whether individual designers could make equal quality of mood boards for different categories of archetypal media content. Apart from the second research question, the other research question to be answered is whether archetypal media content stimulated designers' creativity in making mood boards that contained richer emotional qualities.

Two automobile TV commercials with non-archetypal content were selected for comparison. Both of the two commercials were made by the same advertising agency Wieden & Kennedy. One of the non-archetypal TV commercials, *Honda Cog*, utilized a chain of colliding parts taken from a disassembled automobile in order to demonstrate the motion qualities of the mechanical objects in an automobile (Thomme, 2012). The other commercial, *Honda Everyday*, used a series of daily routines behaviors, including driving a car, in order to emphasize the importance of owing a reliable car in modern people's lives (Krug, 2006). Most of the content in the commercial of Honda Everyday was highly similar to the category of neutral emotions in IAPS and IADS, standardized databases for affective pictures and sounds (Lang et al., 1995; Bradley & Lang, 2007a). Both of these two commercials were archived on the Internet and received good reviews for their high qualities of aesthetics. Although these two commercials were considered well-made ones, they contained no archetypal symbolic meaning, and thus served as affective stimuli with non-archetypal media content in the second study of mood boards.

BMW Commercial (Anima)		
Theme	Mean (SD)	Examples
Superior	1.31 (1.39)	Modern, Admirable, Quality, Aesthetic, Stylish, Art
Home	1.25 (1.19)	Relaxing, Happy, Comfort, Safe, Enjoy, Life, Warm
Sensuality	1.19 (1.34)	Breeze, Air, Floating, Soft, Vibration, Smooth, Gentle
Elegance	1.10 (1.09)	Tranquil, Calm, Peace, Harmonious, Slow, Steady
Nature	1.08 (1.45)	Freedom, Liberty, Adventure, Explore, Wild, Jump
Strength	1.00 (1.07)	Velocity, Power, Momentum, Sprint, Streamline, Intense
Feminine	1.00 (1.31)	Emotional, Attractive, Desire, Sexy, Dream, Reminiscing
Jeep Commercial (Hero)		
Craft	1.52 (1.42)	Handmade, Perfection, Concentrate, Texture, Precision
Strength	1.25 (1.52)	Fight, Strong, Rise, Tension, Heavy, Robust, Force
Trials	1.19 (1.68)	Strive, Lonely, Challenge, Battle, Pain, Sweat, Frustrated
Hero	1.08 (1.22)	Epic, Brave, Passion, Determination, Honest, Honor
Rebirth	0.79 (1.04)	New life, Achievement, New horizon, Job well done
Mental	0.77 (1.06)	Expectation, Projection, Motivation, Ambitious, Intention

Table 7.2: The keywords provided by the participants for the two commercials, ordered by the average counts of the appearance of the words in the coding themes (SD means standard deviation).

In order to validate the reliability using mood boards as a research tool, the consistency of the mood board making should be taken into account. It is important to evaluate whether the designers are able to make equal quality of mood boards for different commercials. In the previous study, we invited twelve professional designers participated in mood board making. According to the ranking given by the participants, we invited two of the designers who made the top-ranked mood boards (designer E and K in Table 7.1) and two designers who made the lowest-ranked ones (designer C and I in Table 7.1) to contribute in this study. Their mood boards for archetypal media content continued to be used in the present study (i.e. mood boards for TV commercials of hero and anima archetypes). The task for these four designers in this study was to make mood boards for non-archetypal media content for comparison, i.e. the TV commercials of Honda Cog and Honda Everyday. Similar to the previous study, they first viewed one of the two commercials and made a mood board that described their emotions about it, and then repeated the same procedure for the other commercial. The mood boards made by the designers are shown in Figure 7.5 and Figure 7.6 for example (see Appendix D for all the mood boards). With this experimental design, we can examine whether the designers who made top-ranked mood boards in the previous study could still conduct better performance in this study.

Figure 7.5: One of the mood boards for the mechanical object commercial (by designer 'G' in Table 7.1).

Figure 7.6: One of the mood boards for the daily routine commer (by designer 'G' in Table 7.1).

Therefore, we collected 16 mood boards for this study, including mood boards for the hero archetype, the anima archetype, the mechanical object and the daily routines. Next, we conducted an online survey using these mood boards as affective stimuli. Different from the previous study, the primary goal of this study was to examine whether the mood boards for archetypal media content (the commercials of the hero archetype and the anima archetype) induced richer emotions than the mood boards for non-archetypal media content (the commercials of the mechanical object and the daily routines). According to Zajonc (1980) and Dijksterhuis (2004), it was suggested to use 'preferences' as an essential indicator for retrieving the richness of the emotions and preferences should not be influenced by inferences. In addition, some research also used preferences for evaluating archetypal content (Maloney, 2002). This leads to a key distinction between the present study and the previous study. In the previous study, the participants first viewed the TV commercials and used these viewing experiences as references for ranking mood boards, which involved inferences in that they had to compare what they perceived from the stimuli and their own emotional experiences with the mood boards. In order to remove the impact of inferences on the participants' preferences on the mood boards, we decided to exclude the viewing task for the participants and asked them to report their preferences on the mood boards without any given references. Since the participants were unaware of what content these mood boards were related to, the results would thus allow us to infer whether the mood boards for archetypal media content were more emotionally attractive than the mood boards for non-archetypal media content.

7.5.1 *Procedure*

This study was less constrained because the participants did not need to view the commercials in a controlled setting. In order to facilitate data collection, we used webpage questionnaires, which were more accessible and more convenient for recruiting participants from different countries. Nevertheless, it is important to make this online survey similar to a physical one such as the previous experiment (see the right panel in Figure 7.2 on page 123), which allows the participants to have an overview of all the mood boards for comparison and look closer at the details of an individual mood board when giving ratings. Therefore, we built an experimental webpage using a jQuery plugin, Gridster, which enabled participants to drag and drop mood boards in order to rearrange their positions for visual comparison. The participants could also click on a specific mood board to view the full-size of it and then give a rating of 'attractiveness' for the given mood board.

The invitation to this online questionnaire was spread out through Internet. Before entering the experimental page, the participant was required to read the informed consent form and provide demographic information (e.g. age, gender, nationality, and design or non-design professionals). The experiment started only if the individual participant agreed with the terms. Next, the participant would be led to a tutorial page with five fruit and vegetable pictures in order to get familiar with the drag-and-drop interface and the rating mechanism (see Figure 7.7). After the practice, the participant would enter the core part of the experiment–give ratings for all the sixteen mood boards. The initial screen showed an overview of all the sixteen mood boards and the positions of the mood boards were randomized (see Figure 7.8). The participant could click on one of the mood boards to enlarge the mood board to see the details and give a rating about the attractiveness of the selected

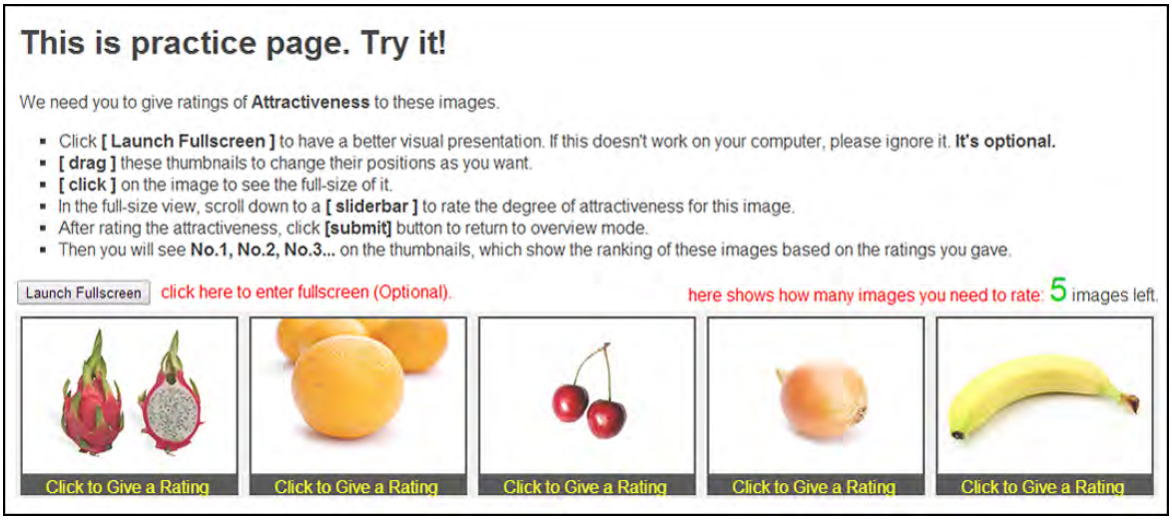

Figure 7.7: The tutorial for the experiment for the second study of mood boards

mood board (see Figure 7.9). The rating score of the attractiveness scale ranged from one to one hundred. After submitting the rating, the screen would go back to the overview.

The participant could start with any of these mood boards, and modify the ratings anytime when they felt necessary. After giving a rating for one of the mood boards, the experimental webpage would instantly calculate and show the ranks for all the mood boards that had been rated (see Figure 7.8). This was to remind the participant to keep her rating standard consistent because her judgment might be influenced by the priming effect that resulted from the previous mood board. After giving ratings for all of the sixteen mood boards, the webpage would rearrange the position of the mood boards according to the ranks of the mood boards. The participant could review the ranking and the ratings and modify the ratings before submitting the final results. The data of which the participant did not finish the whole experiment were discarded in the later analysis. In total there were 178 participants who completed the whole rating tasks. Among the 178 participants, 99 were females and 79 were males; average age was 29.09 (SD=7.91), including 28 nationalities across five continents (Africa, Asia, Europe, North America, and South America). Among all the participants, 79 were with design backgrounds and 99 were with non-design backgrounds.

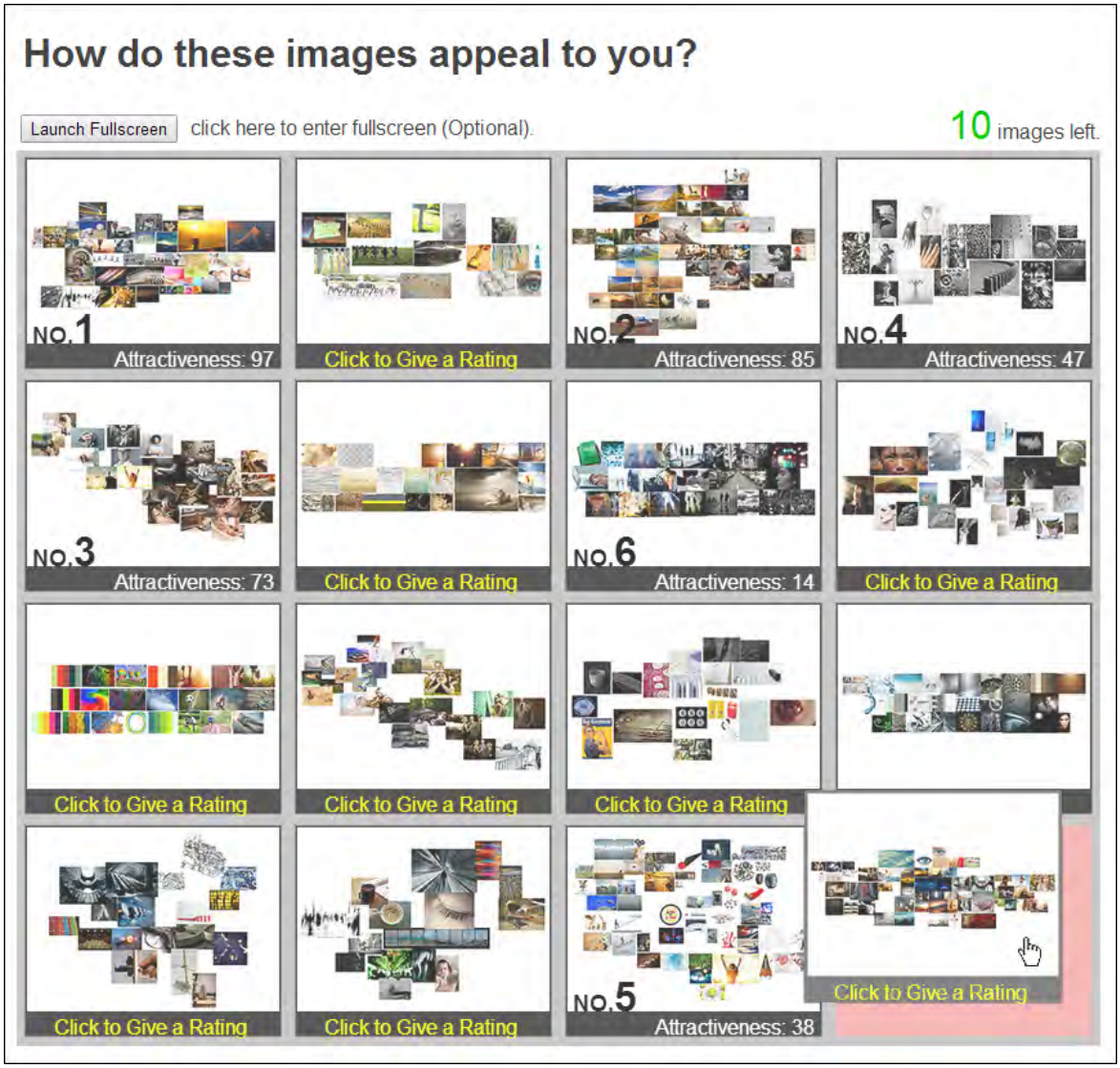

Figure 7.8: The overview of all the mood boards in the experiment. The initial positions of the mood boards were randomly assigned. The participants could rearrange the positions of the mood boards through drag-and-drop mouse behavior. Click on any of the mood boards would enter the rating screen for the participant to give a rating of attractiveness (see Figure 7.9).

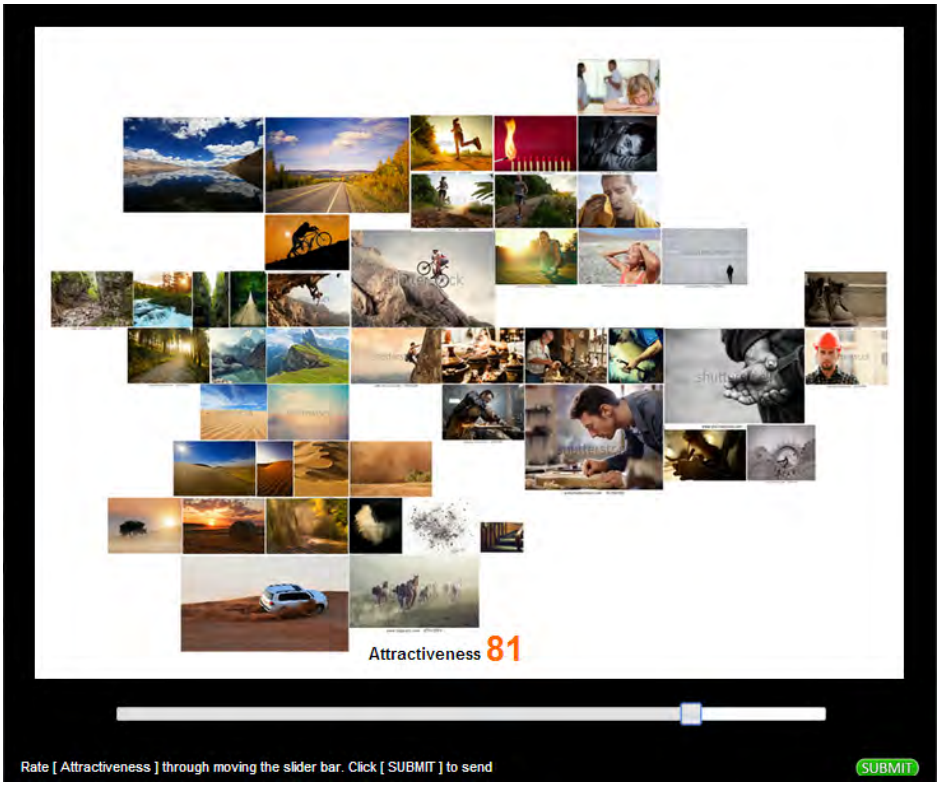

Figure 7.9: The rating screen of the experiment. The participant could use the slider bar to give a rating of attractiveness. After submitting the rating, it would go back to the overview of all the mood boards (see Figure 7.8).

7.5.2 *Results*

We applied the analysis on intra-class correlation using a two-way-random, average-measure model. The results indicated that the inter-rater reliability among all rankings given by all participants is remarkably high (ICC(2, 178) = 0.945, F(15,2655) = 18.3 , $p < 0.001$, 95% confidence interval for ICC population values: $0.899 < ICC < 0.977$), which indicates that all of the participants had similar criteria in giving ratings on the attractiveness of the mood boards. The results were in accordance with the previous study, again confirmed the validity of using mood boards for communicating emotional qualities. We further looked into whether there were differences between the ratings on attractiveness of the mood boards given by the design-background participants and the non-design-background participants.

In order to validate the reliability using mood boards as a research tool, the consistency of the mood board making should also be taken into account. In the present study, two designers who made the top-ranked mood boards (designer E and K) and two for the lowest-ranked mood boards (designer C and I) in the previous study were invited to make mood boards for the other two commercials. Thus, we need to test if the mood boards made by designer E and K are more attractive than mood boards made by designer C and I respectively. In accordance with the previous study, we first transfer the ratings into ranking data and thus used the ranking for the following analyses. The same non-parametric repeated-measures analysis of variance, i.e. the Friedman Test (Friedman, 1937) was used. The 'designer who made the mood board' served as a grouping variable. The

results showed a significant effect of the designers on the ratings on attractiveness ($X2(3) = 17.438$, $p < 0.001$). Therefore, we proceeded to post-hoc analyses using the Wilcoxon-Nemenyi-McDonald-Thompson test (Hollander & Wolfe, 1999).

Next, we proceeded to examine whether the mood boards for archetypal media content were more attractive than the mood boards for non-archetypal media content. In order to answer the research question, the data are categorized into two groups: archetypal (including the hero archetype and the anima archetype) and non-archetypal (including mechanical object and daily routines). The Wilcoxon signed-rank test is considered to be an appropriate statistical analysis for answering the research question (Wilcoxon, 1945). The results of the analysis indicate that the attractiveness of the mood boards for archetypal media content and non-archetypal media content are significantly different ($p < 0.001$). According to the results of the descriptive analysis, the mood boards for archetypal media content (Mean=55.64, SD=23.05) were more attractive than the mood boards for non-archetypal media content (Mean=52.50, SD=24.08).

In Table 7.3, we presented the results of descriptive analyses and the pairwise comparisons among the mood boards made by the four designers. The results indicate that the mood boards made by designer K are significantly more attractive than all the others and there were no significant differences among the mood boards made by designer E, designer C and designer I. It appeared that designer E performed less well in creating mood boards for non-archetypal media content comparing to the mood boards he made for archetypal media content. These results allow us to answer the third research question, that individual designers might perform unequally well in making mood boards for different design themes. This to some extent reflects the nature of mood board making as an experience-based tool for extracting emotional qualities. Variations in the quality of mood board making still occurred even though these four professional designers were highly experienced.

Designer	Mean (SD)	Post-hoc	
K	7.88 (4.63)	K-E: $p < 0.001$ ***	E-C: $p = 0.356$
E	9.00 (4.34)	K-C: $p = 0.013$ **	E-I: $p = 0.209$
C	8.60 (4.77)	K-I: $p = 0.039$ *	C-I: $p = 0.991$
I	8.53 (4.51)		

Table 7.3: The results of the descriptive analyses and the post-hoc test for pairwise comparison on the rankings for the attractiveness of the mood boards [average ranking (standard deviation)]. Four of the twelve designers in the previous study participated in this study. Designer K and E made the top-ranked mood boards in the previous study; designer C and I made the lowest-ranked mood boards in the previous study.

Similar to the previous study, we conducted the Person's Chi-squared test to examine if there is a significant correlation between the number of the images in a mood board and its ranking. The analysis yielded similar results, showing that there was a negative correlation between the numbers of images and rankings ($r = -0.046$, $n = 2848$, $p = 0.014$). In the previous study, the correlation analysis was meant to determine whether the number of images used in mood boards was correlated to the *preciseness* of using mood boards to communicate emotional qualities. On the other hand, the correlation analysis in the present study aimed to verify whether the number of images used in mood boards was correlated to

the *richness* of the emotions in mood boards. Both of the analyses showed significant results, which suggested that designers should consider using more images in mood boards for communicating trivial emotions and meanwhile enhancing the attractiveness of mood boards.

7.5.3 *Summary*

Designers are usually assumed to be more sensitive to affective content than users and clients because designers are more experienced in visualizing emotional qualities. Although the participants with non-design backgrounds were less experienced in conceptualizing and visualizing emotional qualities, they share similar criteria with the design-background participants for judging the qualities of the mood boards because the inter-rater reliability among all the participants are noticeably high. However, it needs to be noted that these two studies are different in their judging mechanism in terms of psychology. In the first study, the participants were first presented with the TV commercials as references for judging the mood boards. For executing this task, two mental capabilities might get involved in the decision-making process. We assumed that the participants would use *associations* for judging the quality of the mood boards according to their own emotional experiences. However, it was also possible that the participants made *inferences* to compare the content of the commercials and the content of the mood boards and did not use their own emotional experience as the primary reference for ranking the mood boards. While inferences are considered to be part of the rational system of human mind, associations belong to the experiential system (Epstein, 1994; Kahneman, 2003). It was unclear which of these two mental capabilities contributed more on their judgment about ranking and rating the quality of the mood boards. In order to clarify this confusion, in the second study the participants' judgment about the quality of the mood boards were solely based their own *preferences* about the mood boards without viewing the TV commercials. Since several studies have used preferences as an indicator for measuring emotions in decision-making tasks (e.g. Zajonc, 1980; Dijksterhuis, 2004), the results further confirm that the participants were utilizing their experiential systems rather than using the rational system for their decision making in the given task.

The results of these two studies have confirmed the validity of using mood boards as a tool for investigating emotional experience among a general population. Furthermore, since the mood boards used in our study were made without adding any text, it has revealed the capability of mood boards to express non-verbal emotional qualities. Traditional research on emotion tends to use direct measurement, such as self-reports on specific emotional qualities 'excited'. Although this approach is effective in most cases, it is prone to filter out trivial emotional qualities that are difficult to express through languages. The results of our studies suggest that mood boards have the potential to be used as an indirect measure using visual images as cues for associating complex, trivial emotional qualities. Since images are language independent, mood boards may overcome the limitation of traditional approaches for studying emotions in design. According to the results of the correlation analysis on the number of the images in the mood boards and the ranking of the mood boards, it is suggested to include more images in one mood board in order to enhance the richness of its emotional qualities. While this finding seems obvious, there are more factors that have not yet been taken into account, such as the layout of mood boards.

The real challenge is to keep the balance between the number of the images and other factors related to mood boards in order to enhance the expressiveness of mood boards.

One of the underlying motivations for the two studies was to determine whether archetypal media content could stimulate designers' creativity in making mood boards with richer emotional qualities. In the second study, the statistical analysis revealed that the mood boards for the archetypal media content are more attractive than those for non-archetypal media content. Therefore, we can conclude that using archetypal media content as stimuli would help designers create emotionally-richer content, e.g. mood boards in our study. However, the results of our studies could not answer the question about whether archetypal media content was emotionally richer comparing to non-archetypal media content. As we mentioned earlier, the nature of mood board making is an experience-based tool and the validity of the outcome (i.e. mood boards) would largely depend on the designer's expertise in dealing with various kinds of media content. In the second study, some designers performed equally well in extracting emotional qualities for both archetypal and non-archetypal media content (e.g. designer K) while other designers could not make equal-quality mood boards in both cases (e.g. designer E, C, I). It appears that using mood board making as a research tool for studying emotions requires the supports from systematic approaches such as affective computing.

7.6 VISUALIZING EMOTIONS IN MEDIA CONTENT: ARCHEBOARD

The abovementioned studies have indicated two limitations of applying mood board making to research on emotions. Firstly, although the inter-rater reliability of mood board *evaluation* was shown to be significantly high, it is difficult to control the quality of mood board *making* because designers may be more sensitive to specific kind of media content than other kinds. The experiential system of human mind is a slow-learning and less precise progress (Epstein, 1994; Kahneman, 2003). Since mood board making is essentially an experience-based tool, it takes time for designers to represent the emotional qualities in the content that they are not familiar with. Moreover, it has always been a great challenge for psychologists to investigate continuous emotional experiences in media content (Zillmann, 1983). The primary difficulty is to measure the transition between different emotions and its impact to the overall experiences (Anderson & Bushman, 2002). In addition, most of the studies relied on self-reports as the main reference for measuring emotions, which influences the emotional experiences to be measured (Soleymani et al., 2012a). When it comes to using mood boards to present continuous emotional experiences, it is even more difficult because mood boards are static visualizations that cannot demonstrate the changes in emotions with time. It appears that mood board making has its natural limitations in order to be used as a research tool for investigating emotions in media content.

While these limitations of mood board making can hardly be overcome using traditional approaches, we have seen the great potential of integrating affective computing technologies to remedy the above problems. As we have illustrated in Figure 7.1, mood board making includes emotion elicitation (i.e. viewing the media content) and emotion recognition (i.e. the making of mood boards). After viewing the media content for eliciting emotions in themselves, designers thus recognize their emotion states through introspection and make mood boards as a way of self-reports on the emotional qualities in the media content. Most previous studies on emotion have utilized self-reports as the basic technique for emotion recognition. Self-reports are based on the fundamental assumption that humans are able to

precisely identify their emotional states through introspection (e.g. Bradley & Lang, 2007b). In the field of emotional design, researchers also apply this approach to investigating product emotions and user experience (e.g. Desmet, 2012; Laugwitz et al., 2008). However, if we put self-reports into design practices such mood board making, it is necessary to integrate systematic approaches to remedy the weakness of experience-based approaches.

Researchers in the affective computing field exploit advances in physiological measurements to monitor continuous emotional experiences. Physiological measurements allow researchers to develop applications with real-time emotion recognition and this approach was considered to be more implicit in a sense that the participants are not distracted by self-report questionnaires and can thus fully concentrate on the given tasks, such as viewing media content (Soleymani et al., 2012a). In Chapter 5, we have discussed how physiological measurements can be useful for overcoming the difficulties in investigating continuous emotional experiences in media content. We also demonstrated how to generate predictive models from physiological signals for recognizing emotions in media content in Chapter 6. Thus, the current challenge is to exploit this knowledge to support the process of mood board making.

7.6.1 *Implementation*

In order to achieve this goal, we developed two applications to handle the two separate parts of experimental processes of research on emotion: emotion recognition and emotion representation. For emotion recognition, one of our colleagues implemented the experimental procedure of our previous experiment (see Chapter 6) into an application of Android mobile device, called ArcheSense (Ivonin et al., under review). ArcheSense encompasses the process of data analysis on physiological signals and the process of model training using machine learning algorithms. Since this application was built on the mobile platform, it is easy and convenient for researchers to conduct experiments to collect physiological data and generate results that can be directly used for various purposes. ArcheSense also allows researchers to load these generated models for real-time emotion recognition and save these predictions as a record of the continuous emotional experience within a given period of time. The technical specification of installing and using ArcheSense requires a 7-inch tablet Android device and one set of Shimmer wearable sensors of ECG and skin conductance (see Figure 7.10). The value of ArcheSense is to simplify the process of data analysis and model training and allow researchers to use the obtained computational model directly in practice without spending time on implementing the computational models into mobile devices. When using ArcheSense for on-line recognition, the user (i.e. either a designer or a researcher[1]) needs to define a proper length for the time window for generating predictions. For example, if the time window is five seconds, ArcheSense would generate a new prediction every five seconds. For reviewing a one-minute movie clip, ArcheSense would generate twelve predictions in total, and thus the user could observe the transitions of emotional experience with a five-second interval.

The other essential part of research on emotion is emotion representation. We developed a desktop application, ArcheBoard, in order to support mood board making according to the predictions generated by ArcheSense (see Figure 7.11). While ArcheSense mainly fo-

1 These applications can be used by designers or researchers. In the text we call them 'the user' to avoid confusions.

Figure 7.10: Technical specification of ArcheSense requires a 7-inch tablet Android device and a set of Shimmer sensors for ECG and skin conductance.

cuses on the technical challenges in terms of affective computing, the development of ArchBoard aimed to represent the scientific results in a way that can be used in design practices. ArcheBoard was built upon the Adobe AIR environment, which can be freely installed in various computational platforms. The data storage of ArcheBoard utilizes the JSON data format, which has been widely used in recently years. In other words, ArcheBoard is not necessarily bonded to ArcheSense and is capable of reading any plain text file with a specific structure. Researchers can process their data using the techniques they are familiar with and load the results into ArcheBoard for visualization and initiate the design process. The motivation for developing these applications was not to take over the role of designers in making mood boards, but to serve as a design tool that provides an initial version of mood board for designers to start with. The initial mood boards are based on the predictions generated by the classification model according to the real-time physiological signals. Since the classification rate of the computational model is not high enough to provide precise results, the initial mood boards should be considered as a reference that still requires further evaluation and modifications. As we have concluded in the previous two studies about mood boards, both design and non-design participants were capable of judging the quality of mood boards. Designers could get quick feedback from the participants or other designers about the resulting mood boards and improve them iteratively in order to have a better representation for the emotional qualities in the media content.

The starting screen of ArcheBoard briefly introduces the procedure of importing required data for conducting studies (see the top panel of Figure 7.12). There are four stages in ArcheBoard and the first three stages are designed for the user to import corresponding files in order to proceed to the final stage–the review stage. The design of the graphic user interface took into account the consistency and accessibility in order to make the procedure clear, easy to use, and understandable. On the left side of the screen there is always a mouse-over sliding menu. This menu is universal portal that allows the user to access to any of the four stages. Even if the user had already entered the review stage, the user could still access to any of the first three stages to load another file for reviewing other studies or media content. The color of the tags of the menu is consistent with the color scheme of the corresponding screen. Thus, the user would easily recognize the progress of importing data. After importing the correct file at the first three stages, the user could

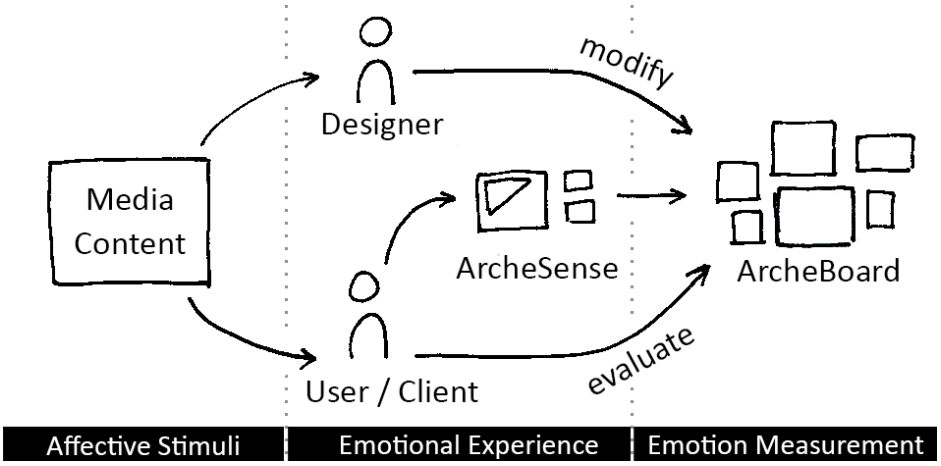

Figure 7.11: The process of using ArcheSense and ArcheBoard for supporting research on emotions in media content. This diagram is adapted from Figure 7.1.

proceed with click on the large arrow on the right side of the screen; the current screen would thus slide to the left side and the next screen would appear accordingly. This style of transition between stages was designed to inform the user which stage he or she was at.

The first stage, Gallery, is for importing pictures for mood board making (see the bottom panel of Figure 7.12). The user could define their own categories of pictures and include more pictures to expand their collections. The user could also edit the name of the category or delete some of them if necessary. However, it needs to be noted that the name of the categories should be identical with the categories in the predictive model of emotion. For example, if the user included the media content of anima, hero, and shadow for model training, there should also be the categories of anima, hero, and shadow in the gallery of ArcheBoard. Thus, ArcheBoard could map the results of prediction using corresponding pictures to represent the emotion in the media content. The second stage, Video, is for importing the media content to be reviewed (see the top panel of Figure 7.13). The current version of ArcheBoard is able to read most of the popular format of digital videos, e.g. mp4. The user could select one clip at a time for review and change to another movie clip if necessary. The media player in this stage allows the user to view the loaded movie clip to ensure if the clip is correctly selected. The third stage, Study, allows the user to import the data of predictions generated by ArcheSense or other emotion recognition applications (see the bottom panel of Figure 7.13). The data should be formatted into the JSON syntax and follow the specific structure[2]. The user need to import corresponding files in the first three stages correctly in order to initiate the fourth stage–Review. In the Review stage, there are two modes available for different context of use. In the next section, we will describe how these two modes can be used in design and research.

2 The template file is available for downloading at https://dl.dropboxusercontent.com/u/1226237/template.sense

Figure 7.12: The screenshots of ArcheBoard (part I). The top panel demonstrates the introductory screen of ArcheBoard and the bottom panel shows the screen of the first stage of ArcheBoard. The starting screen of ArcheBoard briefly introduces the procedure of using ArcheBoard for reviewing the emotional experience in media content. The first stage allows the user to import their collections of affective pictures as the materials for creating mood boards. The user could click on the next button at each stage to enter the following stages.

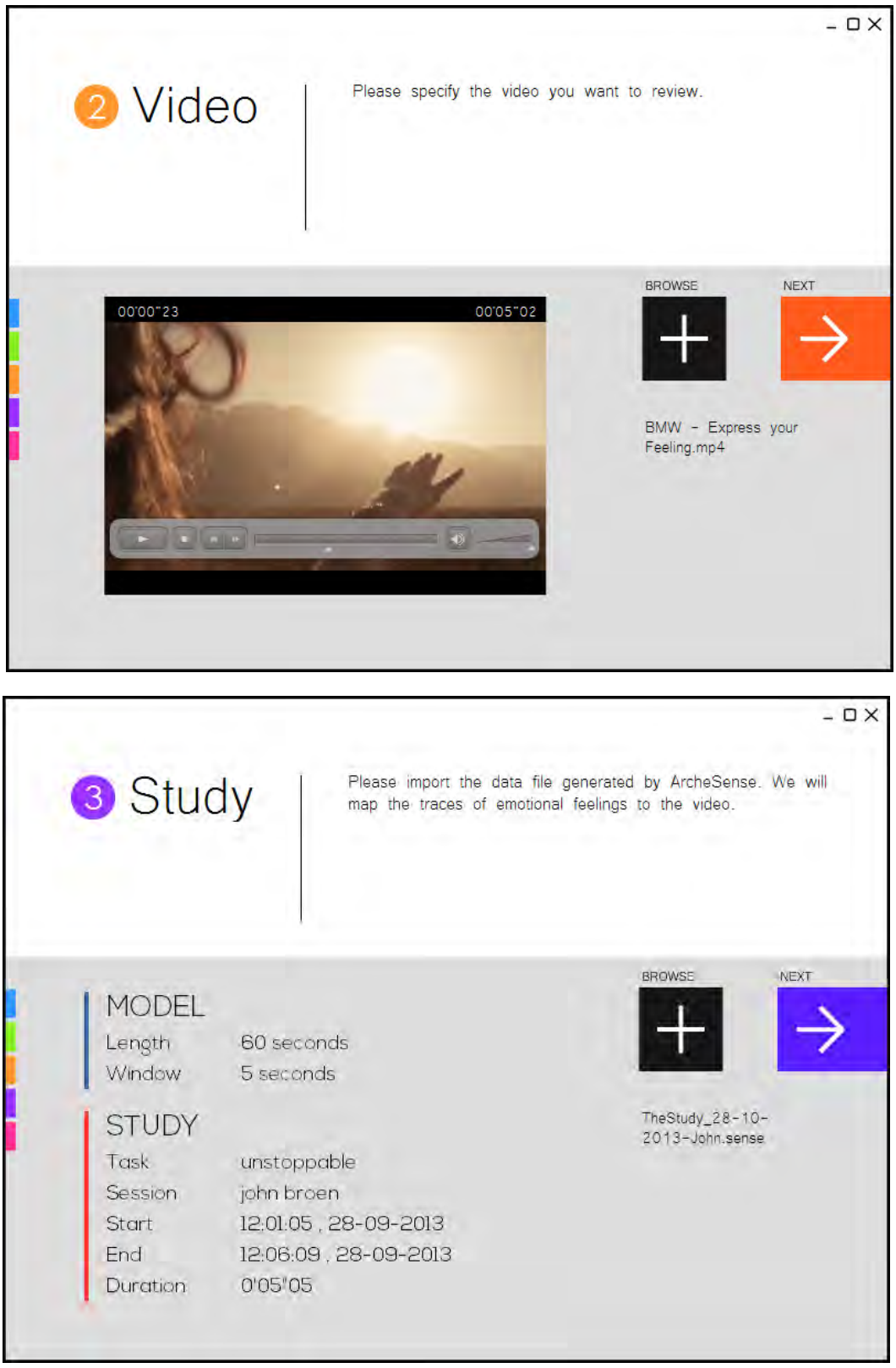

Figure 7.13: The screenshots of ArcheBoard (part II). Continued with Figure 7.12, the top panel demonstrates the screen of the second stage and the bottom panel shows the third stage of ArcheBoard. The second stage allows the user to import the media content to be reviewed. The third stage requires the user to import the file of the predictions generated by ArcheSense or other online emotion recognition applications. In the third stage, the user could click on the next button to enter the review stage.

7.6.2 *Image Mode*

The first mode of the Review stage of ArcheBoard is for mood board making. One of the motivations for applying affective computing techniques in emotional design was to overcome the limitation on studying continuous emotional experiences. Therefore, the time axis is extremely important for reviewing emotions in media content. Rather than create a mood board to generalize the overall emotional experiences in the given media content, ArcheBoard was designed to visualize the changes in the emotional experiences along with the timeline. Thus, the user is required to define a time window when using affective computing applications for emotion recognition (e.g. ArcheSense). These applications would make predictions according to the data within this sliding time window throughout the whole period of the movie clip. This data was required to import to ArcheBoard in the third stage, and ArcheBoard would create a mood board for each time window according to the predictions generated by the affective computing application. In the case of five-second time window for reviewing a one-minute movie clip, ArcheBoard would automatically generate twelve mood boards. In the image mode of ArcheBoard, the media player is designed to play the movie clip loaded in the second stage. This media player is also the main controller for reviewing the emotional experience along with the timeline of the media content. The user could simply play the movie clip or navigate to specific scene in the movie clip, and ArcheBoard would generate new mood boards or load saved mood boards for the given time window of the media content. Thus, the continuous emotional experience can be visualized with a series of mood boards generated by ArcheBoard according to the on-line predictions obtained from the physiological signals (see Figure 7.14). In order to further modify the mood board for the given time window, the user needs to stop playing the video to enable the editing functions for mood board making.

The mechanism of generating mood boards is described as follows[3]. Each of the predictions includes the probabilities for each category of emotions and the sum of the all these probabilities would be 100 percent. First, ArcheBoard would calculate the display area of the current screen, and then calculate the area for each category of emotions according to the probabilities. Next, ArcheBoard would randomly select one picture from the same category of the gallery. The size of the pictures would be based on the probabilities of the emotions predicted by the computational model. For example, if the emotion of 'hero' was predicted as 30 percent of probability for the current time window, the area of the picture of 'hero' would approximately be 30 percent of the display area. Other emotions that are less likely being felt for this moment would be represented with pictures that are relatively small. Since the sum of the probabilities is 100 percent, the initial mood board is made of pictures of which number is equal to the number of the categories included by the predictive model.

While the video keeps playing and moves to the next time window, the previous mood board will fade away to the left side of the screen and the mood board for the current time window will fade in from the right side of the screen. The user could stop playing the video for editing the mood board for the given time window. The user could double-click on blank space to add more descriptions by entering keywords. The position and the size of the pictures and keywords can be modified freely (see the bottom panel in Figure 7.14). The information about the probabilities for each category of the emotions can be access by

3 A video for demonstrating the image mode of ArcheBoard can be access through the following link https://www.youtube.com/watch?v=3UWWw0ozZrs

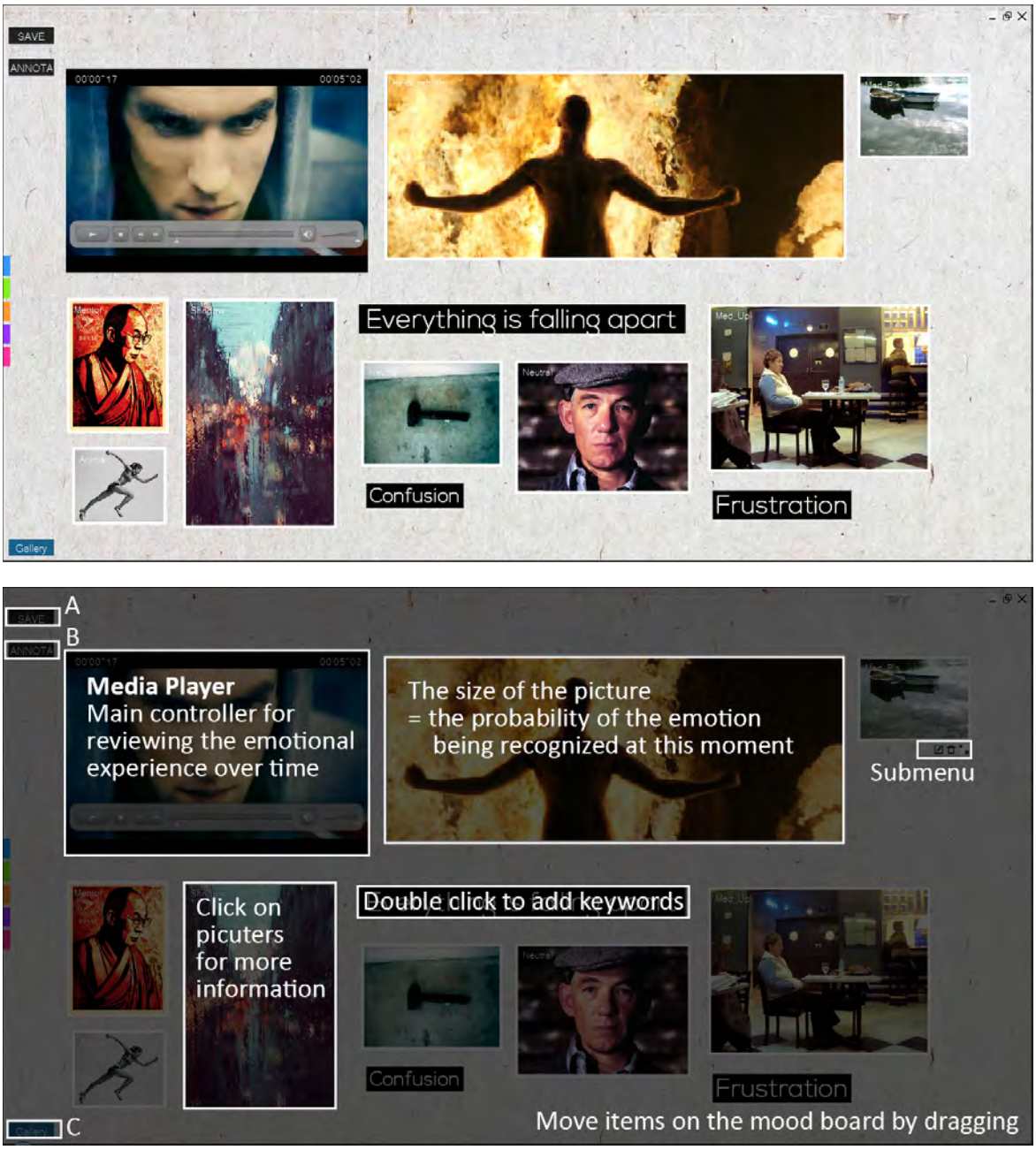

Figure 7.14: The image mode of ArcheBoard. The button A is for saving the generated mood boards; the button B is for switching to the annotation mode; the button C is for opening the gallery panel for adding new pictures to the mood board. Each item has a submenu for editing, deleting, and resizing.

clicking on the pictures. The user could also add more pictures from the gallery or delete the inappropriate ones if necessary. The main reason for this design is to cope with the transition between various emotions particularly for the continuous emotional experience in media content; the emotions could be *mixed* at a given moment (Wirth & Schramm, 2005). The predictions generated by computational models provide an overview of the probabilities for each category of the emotions that might emerge within the given time window. Although the predictions may suggest that some emotions are more likely to appear comparing to others, it is necessary to compare the results and the media content in order to have a clearer view of the emotions within the given time window. Moreover, affective computing techniques for emotion recognition still cannot replace a human agent in most cases because the accuracy of the generated predictions is not robust enough. Therefore, ArcheBoard was to provide an initial version of mood boards as a reference for designers to start with. The predictions generated by the computational model would remedy the weakness of traditional mood board making. When the designer is unfamiliar with the given media content, the generated mood boards would cover the trivial emotional qualities that might be ignored. Moreover, while traditional mood board making cannot capture the transitions of the emotional experience, ArcheBoard could generate mood boards along with the timeline of the media content, which allows the user to visualize the changes in emotions. The user could thus extract mood boards for specific scenes in the media content and use them as materials for design and research.

7.6.3 *Annotation Mode*

The image mode of ArcheBoard was developed for supporting designers to extract and visualize emotional qualities in media content; the resulting mood boards can thus be directly used in design practices. However, the image mode might not be entirely suitable for researchers who are not design-background, e.g. psychologists, because it requires a designer to modify the initial mood boards for the final results. In order to enable ArcheBoard to be used for research on emotion outside the design community, the annotation mode was developed for supporting researchers to conduct qualitative interviews to investigate the emotional experience along with the timeline. In the field of human-computer interaction, some researchers have developed several techniques for evaluating long-term or continuous user experience over time (Kujala et al., 2011; Karapanos et al., 2012). In order to help the subjects recall more details about the experience they had gone through, these researchers asked the subject to draw curves to represent their emotional states over time. The results of their studies have suggested that the subjects provided more information than free recall and value-account recall. Taking this into account, the annotation mode of we have applied curve drawing into ArcheBoard as a way for guiding the participant to report their emotional experiences for viewing the given media content.

The screen of the annotation mode of ArcheBoard is shown in Figure 7.15. The top-left panel is the media player that plays the video loaded in the Video stage of ArcheBoard. The bottom-left panel shows all of the categories of the emotions predicted by the computational model and the bottom-right panel of the screen shows a longitudinal timeline. In the timeline panel, the time window is highlighted and moves along with the timeline of the video being played by the media player on the top-left panel. The scale of the timeline can be modified by clicking on the zoom-in and zoom-out buttons at the top-right corner of this panel. The researcher could check the items in the category panel to make the cor-

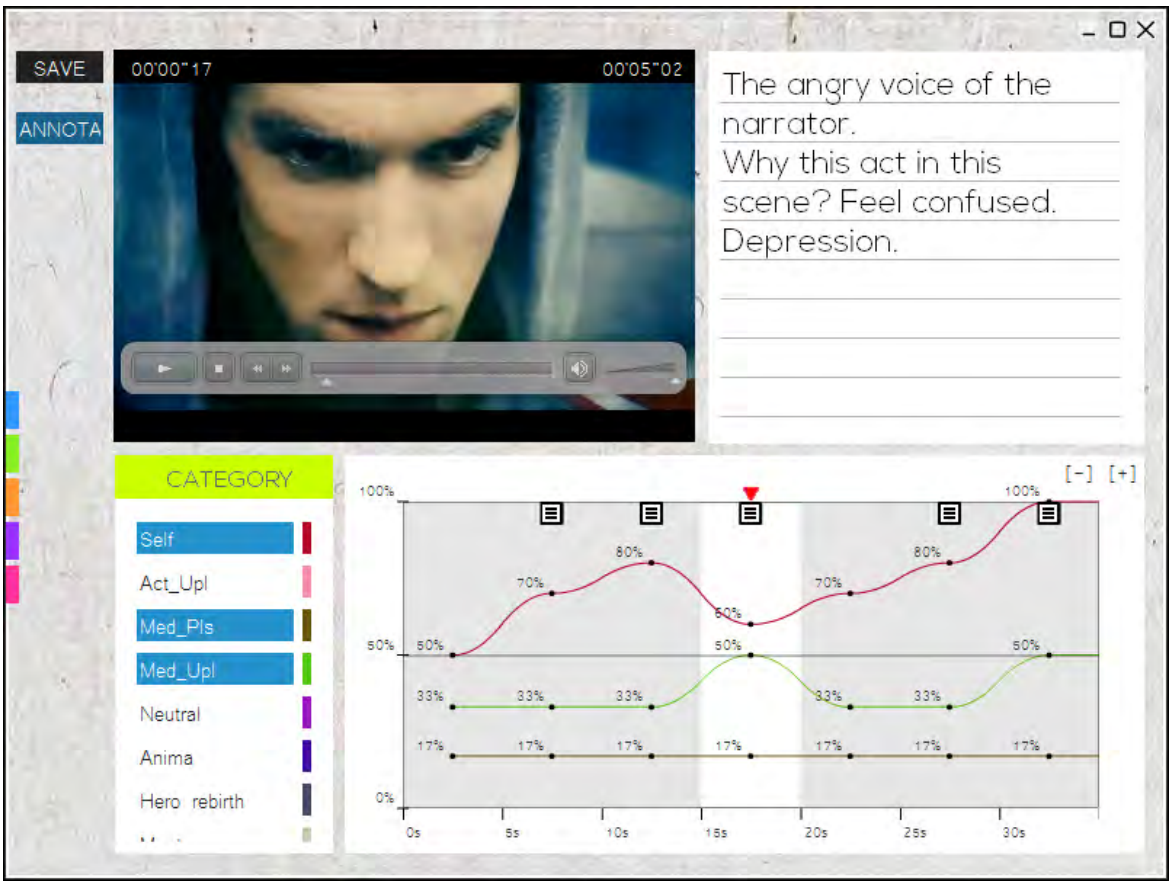

Figure 7.15: The annotation mode of ArcheBoard.

responding curves visible in the bottom-right panel. It needs to be noted that the first item in the category panel is 'Self', which means self-reports. When this item is checked, the participant could adjust their level of 'valence' of their emotional experience by mouse-dragging at the given time window, ranging from zero to 100 percent. Thus, the mark of the rating on valence would connect along with the timeline as a curve that represents the participant's self-reported emotional experience over time. After giving a rating for the timeline panel, the participant could also use the top-right panel to provide more qualitative data by adding annotations for the given time window. If the participant leave add an annotation for a time window, a booklet icon will be attached to the top of the given time window for indication.

The procedure of using annotation mode of ArcheBoard is as follows. First, the participant is required to view a target video that the researcher intends to study; meanwhile, the researcher uses an on-line emotion recognition application such as ArcheSense to record the whole period of time. Next, the researcher imports all the required data into ArcheBoard, including the video and the data of the predictions for the emotional experience over time. The participant is then asked to review the video using ArcheBoard and give their ratings on valence for each time window at the same time (i.e. curve drawing). The participant could add annotations to the given time windows to describe what they perceived, felt, and understood about the media content. The researcher could also sit next to the participant to have follow-up questions in order to extract more information from the participant. The experiment ends when the participant finishes the review. Thus, the

researcher could check the emotions in the category panel to see the changes of the probabilities of all the emotions being predicted. The most interesting part of the results would be the mapping between the dramatic changes in self-reports on valence and the changes of other emotions. For example, in Figure 7.15 the valence dropped while the probability of the 'medium-unpleasant' emotion increased, which confirmed that the participant was experiencing an unpleasant emotion within the given time window.

7.7 CONCLUSION

In this chapter, we revisit mood board making from a psychological perspective and conducted two studies to examine its validity of being a research tool for studying emotions in media content. The results of our studies indicated that the design and non-design participants had similar criteria for judging the quality of the mood boards. Moreover, our studies also revealed that the mood boards of archetypal media content were more attractive than non-archetypal media content, which suggested that the mood boards for archetypal media content contained richer emotional qualities. However, traditional mood board making is a technique that relies on the experience of the designer, which leads to several limitations using mood board making as a research tool for studying emotion.

In order to overcome these limitations, we proposed to integrate the affective computing techniques into mood board making because we have conducted a study for building the predictive model for mapping archetypal content and it emotional responses using physiological measurements. This model can thus be implemented in the applications we developed. The first application–ArcheSense–was developed for emotion recognition while the other application ArcheBoard was developed for supporting mood board making and research on continuous emotional experiences in media content. There are two contexts of use for ArcheBoard. Designers could use the image mode of ArcheBoard to extract emotional qualities in media content and put the resulting mood boards directly into practice. On the other hand, researchers could use ArcheBoard as a research tool for conducting qualitative studies on continuous emotional experiences in media content. ArcheBoard also allows researchers to have an overview comparing the self-report data and the predictions generated by computational models.

The two studies about mood boards and the development of ArcheBoard have demonstrated a complete process for integrating affective computing techniques into design and research on emotions. The weakness of experience-based approaches could thus be overcome using systematical approaches (e.g. supporting mood board making with affective computing). It is promising to apply affective computing to other techniques in emotional design.

8 DESIGNING EMOTION-DRIVEN MEDIA

8.1 INTRODUCTION

In the field of human-computer interaction (Human-Computer Interaction (HCI)), there have been tremendous endeavors in recent years to build an intelligent system that is capable of communicating with humans in a natural way. Affective computing, as a branch of HCI, specifically aims at enhancing the communication between human and machine by expanding the emotionally-charged channel (Scheirer & Picard, 1999). Researchers have made considerable progress moving from user interfaces based on the physical level of user activity to a multimodal interaction that takes into account affective states of users. This has expanded the vision of research in the HCI field, and pushed HCI into the next paradigm where interaction goes beyond the traditional input-output mechanical process through a physical interface. Various applications of physiological technology are employed to measure and recognize human emotion, and thus intelligent systems are empowered to react not only to users' explicit conscious behavior but also to users' affective states even unconsciously. The advances in Affective Computing considerably facilitate the development of applications in different fields, especially digital media.

The scope of media systems is remarkably broad in the domain of entertainment applications. The current state of entertainment computing systems can be classified into two dimensions: presence of the audience and the activeness of the experience (Nakatsu & Rauterberg, 2009). Physical presence and mental presence are the two poles of the 'presence' dimension. Between these two extremes, integrated presence refers to a proper combination of a certain amount of physical activity and mental engagement (Stapleton et al., 2002). The other dimension is activeness of the experience. This dimension indicates at which level of activeness the audience gets involved in the media experience. Depending on the level of interaction, media systems range from passive to active forms. Passive forms of interaction provide content to the participants and require relatively less inputs from them, such as watching movies. On the contrary, active forms of interaction rely on the participants to play the active role in experiencing or even generating the content, such as sports and art creation. Traditional media are analog and continuous narratives, such as dance and musical performance, in which the audience passively perceives the presented media content on the stage (Manovich, 2002). In order to enhance the interactivity, new types of digital entertainment encourage the audience to engage in the stories in different ways. For example, the audience is invited to take part in the storyline in real time by act-

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This chapter is (partly) based on:
Chang, H.-M., Ivonin, L., Diaz, M., Catala, A., Chen, W., & Rauterberg, M. (in press). Enacting archetypes in movies: Grounding the unconscious mind in emotion-driven media. Digital Creativity.
Chang, H.-M., Ivonin, L., Diaz, M., Catala, A., Chen, W., & Rauterberg, M. (in press). Unspoken emotions in movies: The basis of emotion-driven storytelling systems. Informatik-Spektrum.

ing as the protagonist or the director of the narrative. This mechanism has been adopted in many video games, particularly in role-playing games. While various applications have been developed along with these two dimensions, the central part of these two-dimension taxonomy has not been noted (see Figure 8.1). A more complex, integrated, interactive genre of entertainment systems has provided many new possibilities for future applications, e.g. interactive movies and entertainment robots (Nakatsu & Rauterberg, 2009).

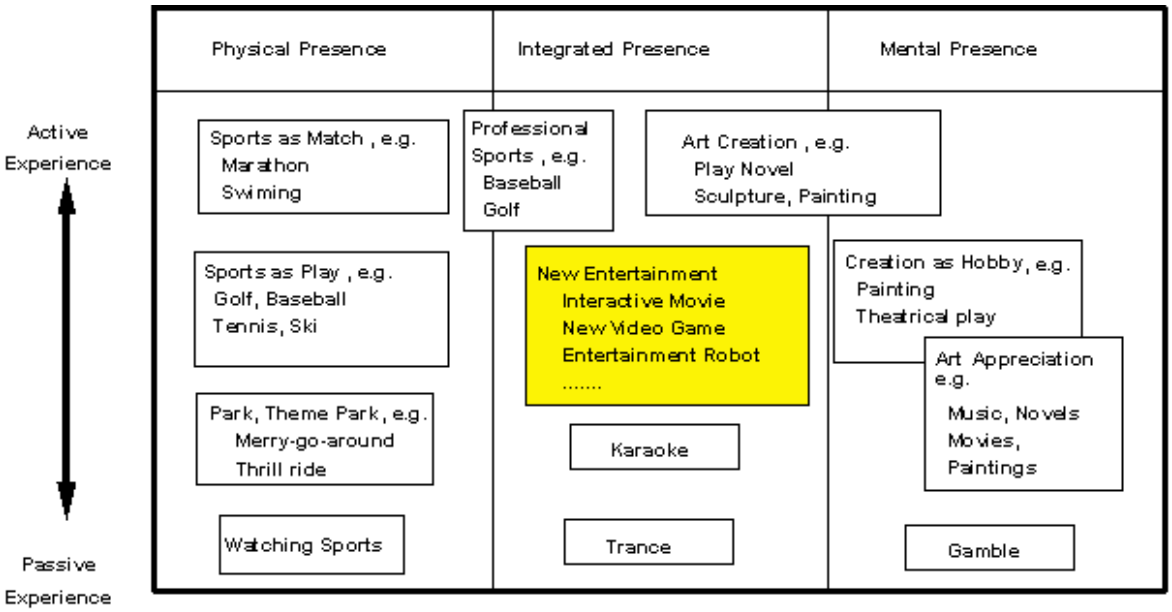


Figure 8.1: A new genre of media design in the taxonomic framework of entertainment applications (Nakatsu & Rauterberg, 2009).

As part of this new genre, we introduce a new type of interactive media system, *emotion-driven media system*, which uses the audience's emotional states as an input and generates content accordingly. Emotion plays the key role in entertainment experience, and emotional reactions to the media content fulfill not only the need for enjoyment but also an unconscious need for training one's capability of dealing with the imagined events (Tan, 2008). The audience provides his or her emotional states to initiate the viewing behavior actively and meanwhile receives the generated content passively in order to complete the active-passive experience. In addition, the audience also needs to be physically present to provide their emotional states, e.g. physiological measurements, and be mentally present to perceive the content simultaneously. This can be considered as an integrated presence of the audience when interacting with an emotion-driven media system. Tikka (2010) set a nice example of new paradigms for applying affective computing in developing digital media: enactive media. The theoretical foundation of the idea originates from enactivism in cognitive science, which takes a 'groundless' stance that resists the mind-body dualism, and argues that mind, body, and world are interrelated and interdependent (Varela et al., 1992). Extending enactivism to the cinema experience, Tikka considers cinema as a metaphorical externalization of embodied mind, saying that the mind of the audience and the image of the cinema emerge and interplay with and within each other (Tikka, 2004; 2006). The audience and the cinema need to be put together into a systematic context that mutually and continuously creates its own meaning. Based on this phenomenological argu-

ment, she made an attempt to develop a media system that technically brings the audience and the narratives together in an enaction (Tikka, 2010).

Two of the most important notions of the enactive mind theory are autonomy and sense-making (Froese & Di Paolo, 2011). The idea is that a living organism (i.e. the audience) is autonomous in a way that it not only responds to the external world (i.e. the media) in the traditional sense of producing the appropriate action for a given situation, but actively regulates the conditions of its exchange with the world (Di Paolo et al., 2010). This exchange process is inherently significant to the living organism, who directly participates in the generation of meaning by his or her action. In essence, the audience enacts the whole system; the system would be disembodied without any audience; an enactive media system together with its audience creates a looping cycle to form a self-contained and self-organizing system–a system that the autopoiesis theory described as a living organism (Maturana & Varela, 1980). To enable the whole system, emotion, as the key coupling between the audience and the media, is highlighted as the central part of the functioning mechanism (see Figure 8.2). The content of the media system dynamically changes with the audience's real-time emotional states while her emotional states are also influenced by the generated content (Tikka, 2010). The concept of enactive media not only establishes a new paradigm of emotion-driven media systems but also raises many interesting research questions on various aspects. For example, how do designers develop the content for the media system? In addition, how do designers couple the content and the audience's emotional states in a methodologically valid way?

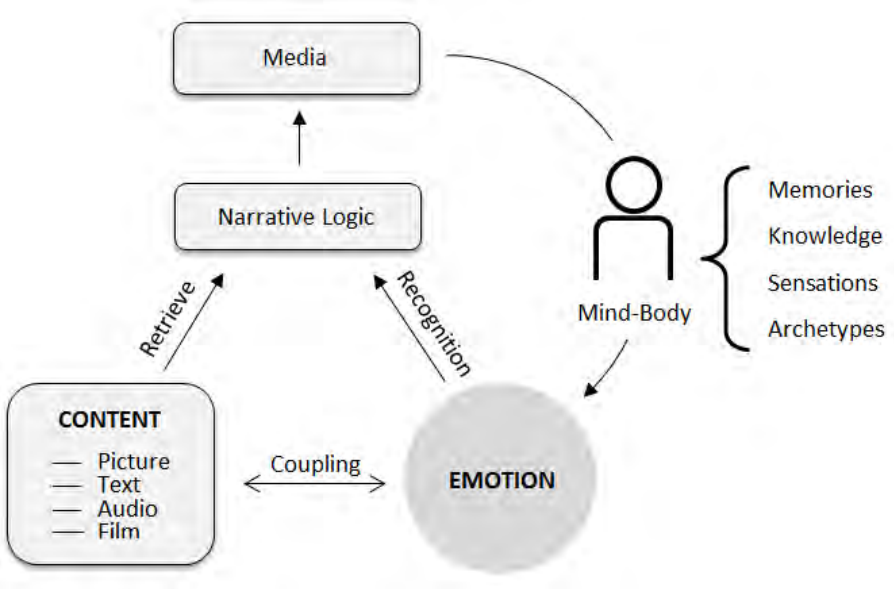


Figure 8.2: The conceptual framework of an emotion-driven media system.

In Chapter 3, we presented a method for analyzing media content using 'archetypal symbolism' as the main reference, and provided a standard procedure for editing the media content into affective stimuli that can be used in empirical studies. In Chapter 6, we applied this method into practice and conducted an empirical study for investigating the correlations between the media content and the emotional responses of the audience. In this chapter, we intend to look for new possibilities for applying the outcome of these studies into design of emotion-driven media systems. We propose a new concept of emotion-

driven media system – archetypal media system. We introduce the conceptual framework of archetypal media systems and discuss what experience this new type of media system could bring to the audience and the epistemic meaning of this concept in terms of design.

8.2 ARCHETYPAL MEDIA SYSTEM

Although media content can be presented in various forms, e.g. prerecorded film clips, audio tracks or text excerpts, or even real-time behaviors (Kaipainen et al., 2011), the narrative of media content plays the key role in delivering the artistic meaning of the whole work to its audience. For developing emotion-driven media systems, the most challenging part is to make the content meaningful in terms of emotions. Designers need to take into account what emotion is to be induced while the audience is watching a specific scene, and then consider how this induced emotion can connect to other emotions to form a story. Most researchers have used a story-based approach. They position the audience as a second author to tell the author's story in different ways, i.e. the second-order authorship (Tikka, 2010). The designer needs a complete story as the basis for the media content, and then decomposes its storyline into a number of meaningful scenes. By mapping proper emotional states to each scene, the author could construct a narrative space as a predefined script for dynamic storytelling (Tikka et al., 2006). This process is illustrated in Figure 8.3. In other words, the original story remains, but the storyline is dynamically reshuffled by the audience according to the real-time changes in his or her emotional states (see Figure 8.4). However, this approach is specific for one story and cannot be generalized to other stories. Although the storyline is dynamic, the story will be monotonous to the audience when they have gone through the whole linear storyline.

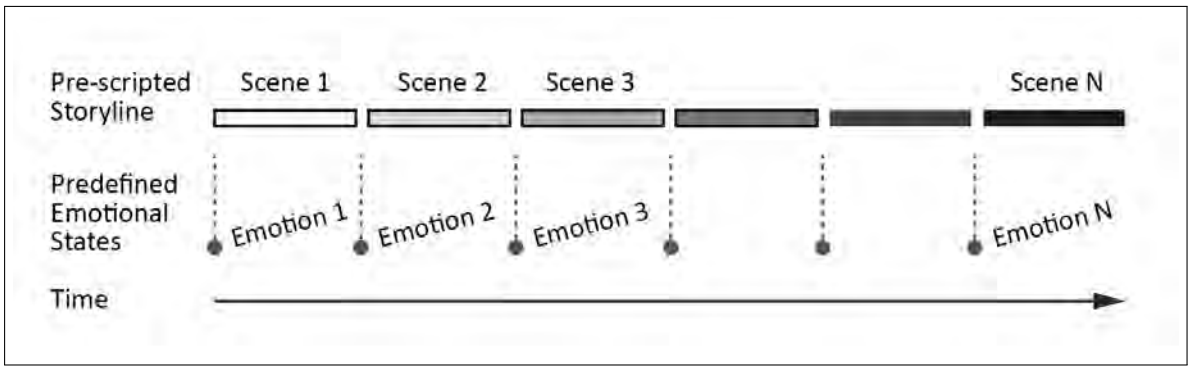


Figure 8.3: The process of mapping between the media content and its emotional response.

We propose a new approach – the theme-based approach – to prepare the content without taking an initial story as a reference. This approach requires meaningful 'themes' to be a generic classification for specific scenes and thus collect scenes across different movies according to these themes. In order to apply these themes in emotion-driven media systems, the links between the themes and corresponding emotional responses have to be unique. It is necessary to examine whether the content in each theme induces a unique pattern of emotional responses that can be reliably recognized by computational systems. The theme-based approach overcomes the limitation of the story-based approach and allows designers to be more flexible in creating media content or collecting media content

across various movies and stories. This allows emotion-driven media systems to provide *mixed, richer* content depending on the real-time emotional states of the audience.

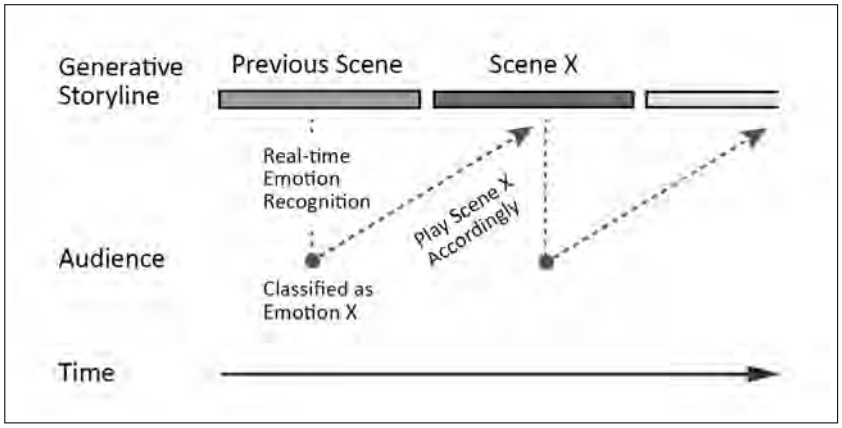


Figure 8.4: The mechanism of creating a generative storyline on the basis of the real-time emotion recognition of the audience. The mapping of the scene and the emotional responses is based on the process presented in Figure 8.3.

The concept of archetypal media system resonates on one of the primary motivations of this thesis (see Chapter 1). While humans tell stories that reflect on the society, these stories in turn shape the human society as it is today. Myth, the oldest form of narrative, represents a primitive worldview before the human history. In Chapter 3, we described how myths are connected to the unconscious part of human mind from a psychological perspective. We further developed a method for analyzing media content on the basis of the theory of archetypes. Applying this method into the concept of archetypal media system, archetypes can be considered as the main 'theme' of the content of the media system. In order to carry out the concept of archetypal media system, it is necessary to investigate whether each category of archetypal media content induces unique emotional responses, especially using physiological measurements. However, very few studies have been conducted to investigate the relationship between the archetypal media content and the emotional responses of the audience.

8.2.1 *Coupling Emotional Responses with Media Content*

When an archetype becomes activated and is experienced with associated feelings and thoughts, it will result in a complex within the personal unconscious (Walters, 1994). According to Jung, a complex within the personal unconscious is an independently organized conglomeration of emotions and ideas that are specific to an individual and are products of interactions among a number of archetypes (Jung, 1959). Although the stimulated emotions and thoughts cannot directly be accessed by our conscious introspection, the physiological measures still provide us with chances to infer the unconscious emotion. Since emotion plays a central role in coordinating humans and the media in an emotion-driven system, it is necessary to investigate the correlation between the elements of the content and the induced emotional responses in order to build the interactive mechanism afterwards. Each element of the content should be indexed by corresponding emotional responses. However, the real challenge is to confirm the validity of the correlations between emotional responses and the content. Precisely recognizing human emotion from these physiological

data is still challenging (Picard, 2003). This might be due to the fact that an ultimate definition of emotion is still unavailable. This is not surprising because for the last century the same situation has also perplexed psychologists, who are still debating the nature of human emotion (Lindquist et al., 2013). Some researchers claim that there are only a small number of basic emotions that are 'hardwired' into brain circuits, such as anger or sadness (e.g. Ekman & Cordaro, 2011). Meanwhile, others argue that emotions are constantly constructed by the human mind so that emotions should not be of discrete, natural kinds (e.g. Barrett, 2011). In the case of our study, it is contradictory to take the former assumption because the fundamental assumption of the enactive mind is that psychological events are enacted, not pre-existing. It would be more feasible to assume that emotions are not just basic kinds but an ongoing psychological phenomenon that is enacted when a living human is embodied in the world.

In light of this, we do not attempt to identify basic emotional qualities in each clip due to the fundamental conflict of theory, but concentrate on whether these categories of archetypal movie clips can be differentiated by the emotional responses so that the media system is able to react accordingly. Emotion is assumed as the mediator between two parallel processes: consciousness and unconsciousness (Rauterberg, 2010). While conscious thought and intentional behavior have been investigated for a long time, the importance of the unconscious mind has long been overlooked by mainstream science and just started to attract more attention to contemporary research (Westen, 1999). The common biased view in cognitive psychology often equates unconsciousness with subliminal information processing, which is too trivial to enter our consciousness. However, a growing body of recent studies indicated that many thoughts, behaviors, and decisions are formed or made unconsciously before we are consciously aware of them (Dijksterhuis, 2004; Gigerenzer, 2007; Wilson & Bar-Anan, 2008; Custers & Aarts, 2010). It is suggested that the unconsciousness functions as a higher level of human mind that precedes the arrival of consciousness in terms of its unintentional nature and the inherent lack of awareness (Bargh & Morsella, 2008). While the focus of mainstream science attends to this new direction, the field of psychoanalysis and psychotherapy has long been studying the unconscious mind. To measure emotional responses in laboratory settings, researchers often apply either self-report techniques or physiological measurement. The most simple and straightforward way to measure the content of a mental representation of emotion is often considered to be self-reports, which rely on the participant's conscious introspection (Barrett et al., 2007a). However, this technique requires extra efforts from the participants that might distract them from the affective stimuli (Soleymani et al., 2012a). On the other hand, physiological measurement directly monitors bodily changes in physiological states. These spontaneous bodily changes are initiated by the autonomic nervous system (Kreibig, 2010), which provides a great opportunity to measure unconscious emotion (Miller, 1992).

8.2.2 *Empirical Evidence*

In Chapter 3, we have developed a method for analyzing media content using 'archetypal symbolism' and suggested a standard procedure for editing archetypal content into affective stimuli that can be used for building computational models using Affective Computing techniques. Since the emotion toward archetypal content is a new research topic, it is still unknown whether it is conscious or unconscious. In order to have a more comprehensive view of the emotional responses to archetypal content, it is suggested that both

self-reports and physiological measures are included for emotion recognition. By comparing the results from the two measurements, it is possible to infer whether any unconscious emotions are induced while viewing archetypal media content. Thus, in Chapter 6, we conducted an empirical study for investigating the correlations between the media content and the emotional responses of the audience. We prepared seven categories of archetypal media content using the method we developed in Chapter 3 and included five categories of explicit emotions for comparison. For each of the categories, we edited three movie clips to ensure the statistical power of the computational model.

Our first research question is to ask whether each category of archetypal content induces unique emotional responses that can be classified with recognition rates higher than chance level. If the answer to the first research question is positive, the second research question is to examine which technique of the emotion recognition (self-reports or physiological measures) is more robust for classifying each movie clip category. According to the results of the experiment, the classification for the archetypal content using the computational model obtained from physiological signals reached 34.4 percent of accuracy, which was higher than the chance level of seven categories (i.e. 14.29%). For self-reports, the classification rate only yielded 24.2 percent of accuracy although it was higher than chance level as well. Therefore, the answer to our first research question is positive, in which the emotional responses to different categories of archetypal content can be classified higher than chance level. Next, we proceeded to compare the robustness of the two different kinds of measurement: self-reports and physiological signals. The results show that the model obtained from the physiological signals performs better than the model generated from the self-report data (34.4 % is greater than 24.2 %). Nevertheless, in the case of the media content of explicit emotions, the classification rate of the self-report data is higher than the results of physiological signals (64.9 % versus 57.2 %).

According to the work of Reingold & Merikle (1990), measuring unconscious mental activities should take both direct and indirect approaches, and then make inferences according to the comparison between the direct and indirect measurements. In this study, self-reports served as a direct measurement of the emotional responses and the physiological measurement was considered as the indirect one. Since the indirect measurement is more robust than the direct measurement, we came to the conclusion that the emotions induced by the archetypal media content might be unconscious (see Chapter 6 for more detailed discussions).

8.2.3 *Novelty of Archetypal Media Systems*

The primary feature of emotion-driven media is to include the audience as a 'participant' who get involved in the process of media content delivery through providing his or her emotional states. The audience passively receives the media content while actively providing emotional states that drive the mechanism of the media content delivery. According to the framework of Nakatsu & Rauterberg (2009), the viewing experience of emotion-driven media is shifted from a passive position to a mutually-passive-and-active experience. As we have mentioned about the story-based approach, if we assign one original story as the media content, the audience will see a story being told in many different ways depending on their emotional responses to the separate scenes of the story. Thus, Tikka (2010) positions the audience as a second author, who holds the power to shuffle the storyline of one original story. However, the story-based approach only applies to one story at a

time and does not take into account the pattern of the narratives. Archetypal symbolism and the universal structure of monomyth enabled us to analyze various media content and categorize similar scenes in different movies into a theme. The results of our empirical study suggest that each of the categories of archetypal media content is related to unique emotional responses. Therefore, we argue that archetypal media systems enable the *first-order* authorship. When using the theme-based approach, the media content is expandable and dynamic. Thus, before the audience is attached with the system, there is no original storyline but a universal pattern of stories that lays the fundamental structure for any media content. The audience, who enacts the system through providing physiological signals, acts as the first author of the narrative while being the audience of his or her self-generated media content by mashing up the archetypal media content.

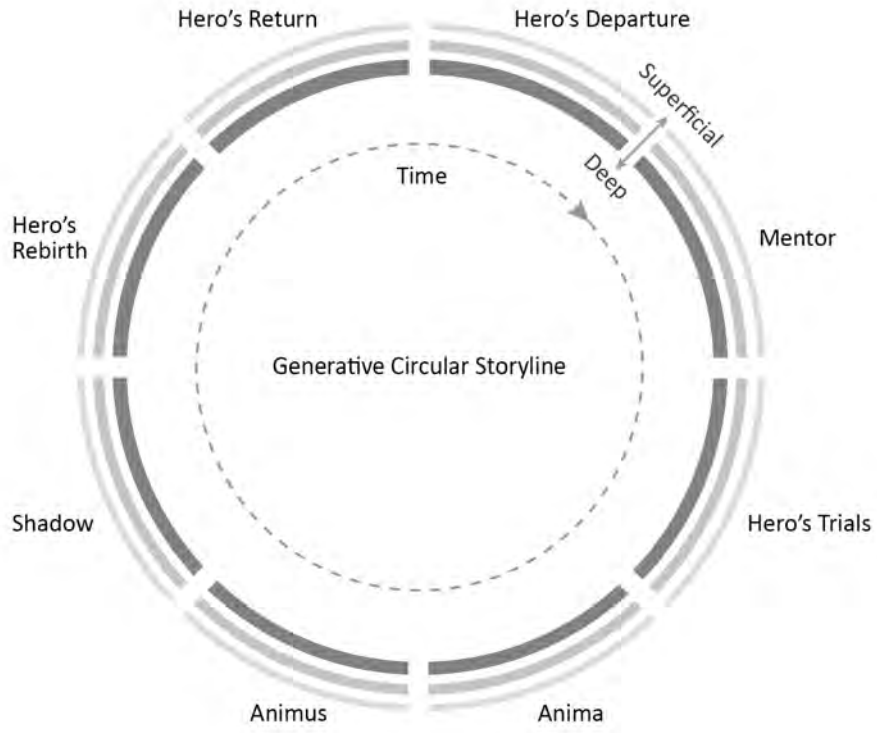


Figure 8.5: The generative circular storyline of archetypal media. Each category of media content contains movie clips from different movies. The media content in each of the categories can be expanded by using the analytical method presented in Chapter 3. The audience can construct mash-up storylines across different stories by providing their real-time emotional responses. The richness of the storyline depends on the scale of the collection of the media content. Ideally, the level of involvement would go deeper if the audience is fully emersed in the self-provided storyline.

Another novelty of the archetypal media is to generate narratives recursively in real-time. The media content appears as a generative circular storyline (see Figure 8.5). The content of archetypal media system can be expanded using the method we developed earlier (see Chapter 3). The underlying reference for the analysis on the media content is based on the archetypal symbolism (Gronning et al., 2007) and the hero's journey (Campbell, 1973). It needs to be noted that the hero's journey is a recursive structure; a short journey could

be part of the life-long journey; a long journey can also be identified as multiple short journeys (see Figure 3.4 on page 47). In this way, the viewing experience of the archetypal media system can be considered as an inner journey of the audience. This journey is recursive, generative, endless narratives depending on the size of the collections stored in the system. According to Jung's theory, the encounter of the archetypes in one's unconscious mind is a way to achieve the wholeness of a person's spirit (Jung, 1959). This so-called *individuation* is a developmental psychic process in which the components of the immature psyche and the experiences of the person's life become integrated over time into the whole personality, including the conscious self and the unconscious mind (Jung, 1967). In the concept of archetypal media system, the individuation can be achieved through *enaction*. As we have introduced enaction in the introduction section, the audience *enact* emotion-driven media system through providing their emotional states to generate the content and meanwhile making the generated content meaningful to themselves. This looping cycle forms a self-contained and self-organizing system (Maturana & Varela, 1980), which embodies the process of individuation in Jung's theory. Although archetypal media content has its symbolic meaning in terms of archetypal symbolism, the audience still has to make their own meaning to enact individuation while viewing the content.

8.2.4 *Implications for Media Design*

As we pointed out earlier, the theme-based approach focuses on common affective elements across different stories while the story-based approach can only be applied to a specific story. Most interactive storytelling mechanisms fulfill the requirement of involving the audience in the decision-making moment in the story. Although the audience is not entirely passive, interactive storytelling overall is still pre-scripted, meaning that the whole story still follows a linear structure, albeit in a more flexible manner than exists in conventional storytelling. Built upon the original idea of emotion-driven storytelling, the present study establishes several advantages. The theme-based approach allows designers to expand their collections of media content in a more flexible way and the generated outcome would have richer content, encompassing various scenes and characters appearing in different movies. This study demonstrated a standard procedure for identifying universal elements in various movies and a psychophysiological approach to evaluating these movie clips. This will allow developers to build and expand their own collections of movie clips for developing emotion-driven storytelling systems. These collections of movie clips can also be used as references for screenwriting

For designing the content of emotion-driven media, archetypal symbolism can be considered as a design pattern of narratives that are universal to stories in different cultures. Due to the fact that many myths, legends, and fairytales in different cultures share the same structure and components, many scholars in different fields have endeavored to generalize a universal pattern that fits all kinds of stories (e.g. Campbell, 1973; Propp, 1984; Lévi-Strauss, 1955). These structures can still be seen in modern screenwriting (Vogler, 2007; Field, 1984). Although it is still debatable whether these patterns cover all stories or movies exhaustively, these structures can be considered as a useful reference for designing the content of media systems. For example, the collection of movie clips about the 'mentor' archetype is a useful resource for designers to create media content that is intended to deliver the feeling of being safe, being guided, and kindness. Our study stands as a showcase for utilizing archetypal symbolism as a design pattern to develop the content of

emotion-driven media systems for the narratives that fit the theory of archetypes and the structure of monomyth.

8.3 CONCLUSION

These new findings about emotion and archetypal content might shed some light on several new directions both in the design of emotion-driven media systems and research on the unconscious mind in cognitive science. In terms of design, we proposed a new approach – the theme-based approach – for developing media content for emotion-driven media systems. Our study included seven essential archetypes in the present study as a starting point and has confirmed that archetypal content extracted from different movies can induce a similar pattern of emotional responses across individuals, which was robust enough for emotion recognition. These new findings have expanded the possibility of developing new types of emotion-driven media systems in addition to the traditional story-based approach. While the results of this preliminary study are promising, there are more archetypes that are mentioned in Jungian movie analysis, such as trickster and shapeshifter. To apply archetypal symbolism in practice, it is suggested that more archetypes should be included to establish a basis for experimental evidence.

9 GENERAL DISCUSSION

9.1 INTRODUCTION

Myths and other forms of narratives were created to explain how the world appears as it is today (Dundes, 1988). It is argued that humans share an implicit knowledge and use this knowledge to interpret the external world (Barrett, 2012). In ancient times, ancient people transferred their interpretations about the physical world into myths. Thus, myths depict a genuine worldview of mankind in a narrative form. Along with the development of science, myths are no longer being considered as facts, but they transform into various forms of narratives, e.g. novels, dramas, and movies, and remain influential to our society. Our research was initially motivated by the idea that myths might be profoundly connected with the unconscious mind, and nowadays these unconscious thoughts are still manifested in the modern media.

Since the concept of the unconscious mind is too broad, we specifically focused on emotion in media content that fitted into the structure of myth. Psychologist Jung (1959) proposed the theory of archetypes, arguing that human beings share a universal layer at the deepest level of their unconscious mind, and all the narratives thus are representations of the ideas in the collective unconscious. Jung theories initiated the research direction that aimed to find the connection between human unconscious and narratives in media content, namely 'archetypal symbolism' (Gronning et al., 2007). Nowadays, various kinds of narratives have pervasively spread via digital media and have become an important part of modern entertainment. Although the media types change over time, the content of the narratives in modern media still fits into the universal structure of archetypal symbolism.

Emotion is an essential part of media experience (Wirth & Schramm, 2005; Konijn, 2012). It helps transfer the information in the higher-dimension of human mind – the unconscious – to the conscious (Rauterberg, 2010). It also shapes humans behaviors and influences the decision-making processes in an implicit manner (Zajonc, 1980; Dijksterhuis, 2004; Bechara et al., 2005). According to Jung's theory of archetypes, it is necessary to take into account the possibility that emotions may be unconscious particularly when being immersed in archetypal media content. We started our investigation through exploring the emotions in archetypal media content and looking for the possibilities to apply this knowledge into emotional design (see Chapter 1). In our review, research on emotion can be classified into three complementary building blocks: theories, models and measurements. Theories of emotion are about the ontology and functionality of emotions; models of emotion are conceptualizations that can be used for representing specific emotions; measurements of emotion are various kinds of indicators that can be used to extract information about emotion. Each of these three building blocks consists of different fundamental premises and epistemic viewpoints. By manipulating these three building blocks, researchers could thus have a clearer view on selecting proper approaches for their studies.

The question of whether emotions can be unconscious is still open to debate. This question has gone beyond a methodological level and requires an epistemological overview of research on emotion. While there is still no definite answer to this question, it is necessary to take a neutral position and review current theoretical and practical perspectives

in emotion research. To initiate this direction, we conducted a literature review for research on emotions including recent studies about unconscious emotion (see Chapter 2). In our review, research on emotion can be classified into three complementary building blocks: theories, models and measurements. Theories of emotion are about the ontology and functionality of emotions; models of emotion are conceptualizations that can be used for representing specific emotions; measurements of emotion are various kinds of indicators that can be used to extract information about emotion. Each of these three building blocks consists of different fundamental premises and epistemic viewpoints. By manipulating these three building blocks, researchers could thus have a clearer view on selecting proper approaches for their studies.

Over the past two decades, psychologists have been debating about whether emotions are discrete states (Barrett, 2011). This debate has led to an epistemological dilemma, which is called 'the emotion paradox' (Barrett, 2006b). When a person feels a certain kind of explicit emotions, e.g. happiness, he or she would tend to presume that happiness is an atomic kind of emotion that exists as a natural fact regardless there is still no strong evidence showing that certain basic emotions are hard-wired in the brain circuit (Barrett, 2006a). If a researcher intends to identify a specific emotion from a period of emotional experience, this research question has already been biased by the presumption that emotions are natural kinds. In order to tackle this epistemic problem, we propose to select affective stimuli focusing on the content of the stimuli rather than specific emotional qualities. This means that we did not intend to identify specific emotional qualities in the media experience, but to examine whether the same categories of archetypal media content would induce similar emotional responses. We introduced a method for analyzing media content using archetypal symbolism as references, and developed a standard procedure for editing archetypal media content that can be used in empirical research on emotion (see Chapter 3).

In addition to the analysis on the media content, it is necessary to include both direct and indirect measurements for comparison in order to interpret the results in an unbiased way (Reingold & Merikle, 1988). These two measurements are equally important particularly for research related to the unconscious because the cognitive processes of the conscious and the unconscious are inter-related (Reingold & Merikle, 1990). In our research, the direct measurement of emotion was a self-report questionnaire – Self-Assessment Manikin (Bradley & Lang, 1994); the indirect measurement of emotion was physiological signals of ANS, e.g. cardiovascular activities and skin conductance. The formulation of the triangulation consists of these two measurements along with the analysis on the media content.

In this thesis, we presented our work with three sequential parts: theoretical framework, explorations, and implications for design. In the first part of the thesis, we reviewed psychological research on emotions and defined the main approach – the triangulation approach – in order to establish the theoretical framework for the later explorations (see Chapter 2 and 3). Building upon this framework, we formulated four research questions about emotions in archetypal media content at the beginning of the thesis (see Chapter 1). In the second and the third part of the thesis, we presented a number of studies and several design applications based on our findings. In this chapter, we provide our answers to these research questions and also point out the limitations. Finally, we summarize our conclusions and discuss several potential research directions for future work.

9.2 ANSWERS TO THE RESEARCH QUESTIONS

RESEARCH QUESTION 1. *How to analyze media content for scientific studies using archetypal symbolism?*

As proposed earlier, the content of the media content plays a key role in solving the emotion paradox. To initiate our exploration into emotions in media content, the first step was to develop a method for the analysis on media content. Rather than analyzing the perceptual qualities such as colors and sounds, we proposed to analyze the symbolic meaning of media content, which was the outcome of the sense-making process. Sense-making is a higher level of mental process that interprets the external world using several layers of category knowledge, e.g. personal, social, or cultural layer of knowledge. According to Jung (1964), archetypal symbolism can be considered as a universal layer of knowledge shared by all humans in their collective unconscious (Carminati et al., 2013). We developed a heuristic method for analyzing media content on the basis of archetypal symbolism (see Chapter 3). In order to analyze the symbolic meaning of media content using this method, it is necessary to consider the media content from a holistic view rather than look into perceptual qualities of the content separately Lévi-Strauss (1955). This method requires the researchers to project themselves into the narratives in order to observe the experience of the character from a subjective viewpoint (Mar & Oatley, 2008). Additionally, the researchers need to avoid critical thinking and personal judgment on the character while being in the process of analysis because this would hinder the construction of association (Lin et al., 2011; Liang & Chang, 2013). This analytical method is a trial-and-error, iterative process of comparison between the researchers' subjective experiences toward the media content and the description for the target archetype.

Studying emotions in media content using scientific methodologies has several practical concerns. In order to include the outcome of the analysis on media content into empirical experiments, we demonstrated a standard procedure for editing media content, particularly movie clips, into a unified format. Firstly, we suggested defining the categorization for the media content intended to study, such as the archetype of anima and mentor, and then collect adequate amount of movies clips that bear symbolic meaning corresponding to the archetypes to be studied. Next, the researcher should define the requirement for their experimental settings, such as the file format, the length of the movie clips, the resolution of the play screen, and the transition style between scenes. Moreover, in order to ensure the validity of the edited movie clips, the final step of the procedure was to have the edited clips reviewed by experts in related fields. In our studies, we worked in cooperation with researchers from The Archive for Research in Archetypal Symbolism (ARAS) to help verify our movie clips. We re-edited our clips according to the reviewers' suggestions and had the revised movie clips evaluated again by the experts iteratively until they all agreed on the final outcome of the editing process.

This analysis method was aimed to tackle the emotion paradox and connect the content of the media content and the viewers' emotional responses in practice. Putting this method into practice, we successfully developed two sets of affective stimuli that contained archetypal media content for the later experiments (see Chapter 5 and 6). Thus, this method is considered to be valid for future studies particularly on analyzing symbolic meaning of media content.

RESEARCH QUESTION 2. *Does archetypal media content induce unique emotional responses?*

In the second part of the thesis, we conducted three empirical studies in order to examine whether archetypal media content induced unique emotional responses. The first study was a preliminary study using two relatively simple media type of affective stimuli, i.e. static pictures and digital sounds. One new class of affective stimuli was included in this study along with stimuli taken from standardized databases – IAPS and IADS. Most of the content of the affective stimuli collected by IAPS and IADS were related to explicit emotions such as anger and disgust, which have been studied by current research on emotions (Lang et al., 1995; Bradley & Lang, 2007a). Thus, the emotional responses to these standardized stimuli served as a reference for comparison in order to investigate whether archetypal media content induced emotions different from explicit emotions. For archetypal pictures and sounds, since the archetype of Self was considered to be a fundamental one among many archetypes (Jung, 1959), we selected the archetype of Self as the starting point in our research line. The pictures of mandala and the sounds of Om were therefore collected for representing the Self according to archetypal symbolism (Jung, 1964). The experimental design was in accordance with previous studies in psychology (see Chapter 4 for more details). Following the triangulation approach, we recorded the self-report data for direct measurement and the ECG signals for indirect measurement. The results for both measurements indicated that the emotional responses to the pictures and sounds of the archetype Self were significantly different from the emotions induced by the standardized affective stimuli of explicit emotions. Although only one category of archetypal content was included in this study (i.e. the archetype of Self), this had confirmed the potential of this research line. We therefore were motivated to continue our exploration into media content of other essential archetypes.

Several improvements were achieved in the following two studies. First, we collected and edited more categories of archetypal media content (eight in the second study and seven in the third study). Second, we used another type of media – movie clip. Comparing to pictures and sounds, film is a rather complex media type and it enables more immersive media experience in the audience because it involves an integration of visual and auditory modalities. Moreover, it is capable of delivering a series of narratives whereas pictures and sounds are relatively static and limited in terms of emotion elicitation. However, the complexity of movie clips increased the difficulties in emotion recognition because emotional experience is continuously changing along with the storyline and the transition of the emotions would influence the overall experience (Wirth & Schramm, 2005).

In the second study, we took up the challenge of studying continuous emotional experiences in movie clips. The method reported in Chapter 3 was applied for analyzing archetypal media content and editing the media content in a unified format. The length of each of the movie clips was approximately five minutes and one clip for each category of archetypes. In this study, we included eight movie clips; each of the clips represented one archetype respectively. In order to evaluate the validity of our experiment, we also included movie clips for explicit emotions to serve as a benchmark for comparison. For emotion measurement, we used more physiological signals, including ECG, skin conductance, and skin temperature, in order to have a more comprehensive view toward the emotional responses. The results of the second showed that the recorded data for each archetypal movie clip can be successfully classified through conducting a discriminant analysis. The classification for archetypal movie clips reached 46.5% of accuracy for physiological sig-

nals and 28.5% of accuracy for self-reports (see Chapter 5 for more details). This allowed us to answer the second research question, that the emotional responses induced by different archetypal movie clips were unique. However, these results cannot be generalized that archetypal movie clips in the same category could induce similar emotional responses because only one clip was used to represent each of the archetypes in this study.

In order to overcome this limitation, we conducted the third study with several improvements. The primary goal of the third study was to build computational models that can be used in practice. It also allowed us to reassess the results we obtained in the second study. Hence, we followed the experimental design of the second study and enhanced the statistical power by increasing the amount of the stimuli from one to three clips for in each category. Moreover, we shortened the length of the movie clips from five minutes to one minute in order to control the duration of the experiment to avoid biased results caused by fatigue of the participants. The third study revealed similar results, showing that the participants' emotional responses over different categories of archetypal movie clips can be classified with a probability higher than chance level. The classification for categories of archetypal movie clips yielded 34.4% of accuracy for physiological signals and 24.2% of accuracy for self-reports (see Chapter 6 for more details). Integrating the results of the second and the third study, we therefore came to the answer that each of the categories of archetypal media content we used in our experiments induced unique emotional responses.

RESEARCH QUESTION 3. *If the answer to research question 2 is positive, could archetypal media content induce unconscious emotion?*

In order to answer this research question, we have to review the existing evidence about explicit emotions. As mentioned in the introduction section, most studies consider introspection into emotional feelings as the ground truth due to the belief that human beings were capable of introspecting into their own emotions and express them in a common way (e.g. Bradley & Lang, 2007b). These emotions are considered to be 'explicit' because they are of high intensity and usually associated with concrete scenarios, such as violence causes the emotion of fear and erotic content induces excitement. Since these emotions are relatively easy to recognize and describe, empirical research has found that self-reports were likely to be more valid over other indirect measures (Mauss & Robinson, 2009). In the case of our second and third studies, two sets of affective stimuli of explicit emotions were used in our experiments for comparison and the results for these affective stimuli were in line with the previous studies, in that the accuracy of classification over different categories of stimuli using self-reports was greater than the accuracy using physiological measurement (e.g. 64.9% for self-reports and 57.2% for physiological signals in the third study). This has confirmed the validity of our experimental design and hence we could look into the results for archetypal media content. Nevertheless, the rationale of interpreting the results for explicit emotions did not fit into the case of archetypal media content. The statistical analysis for archetypal media content yielded opposite results, showing that the accuracy of classification obtained from the physiological signals was noticeably higher than the accuracy of classification gained from the self-report data (e.g. 43.1% for self-reports and 57.1% for physiological signals in the third study).

In order to explain the results for archetypal media content, we have to put aside the presumption of considering the results of self-reports as the ground truth, and take the triangulation approach for making inferences in order to answer the research question (see

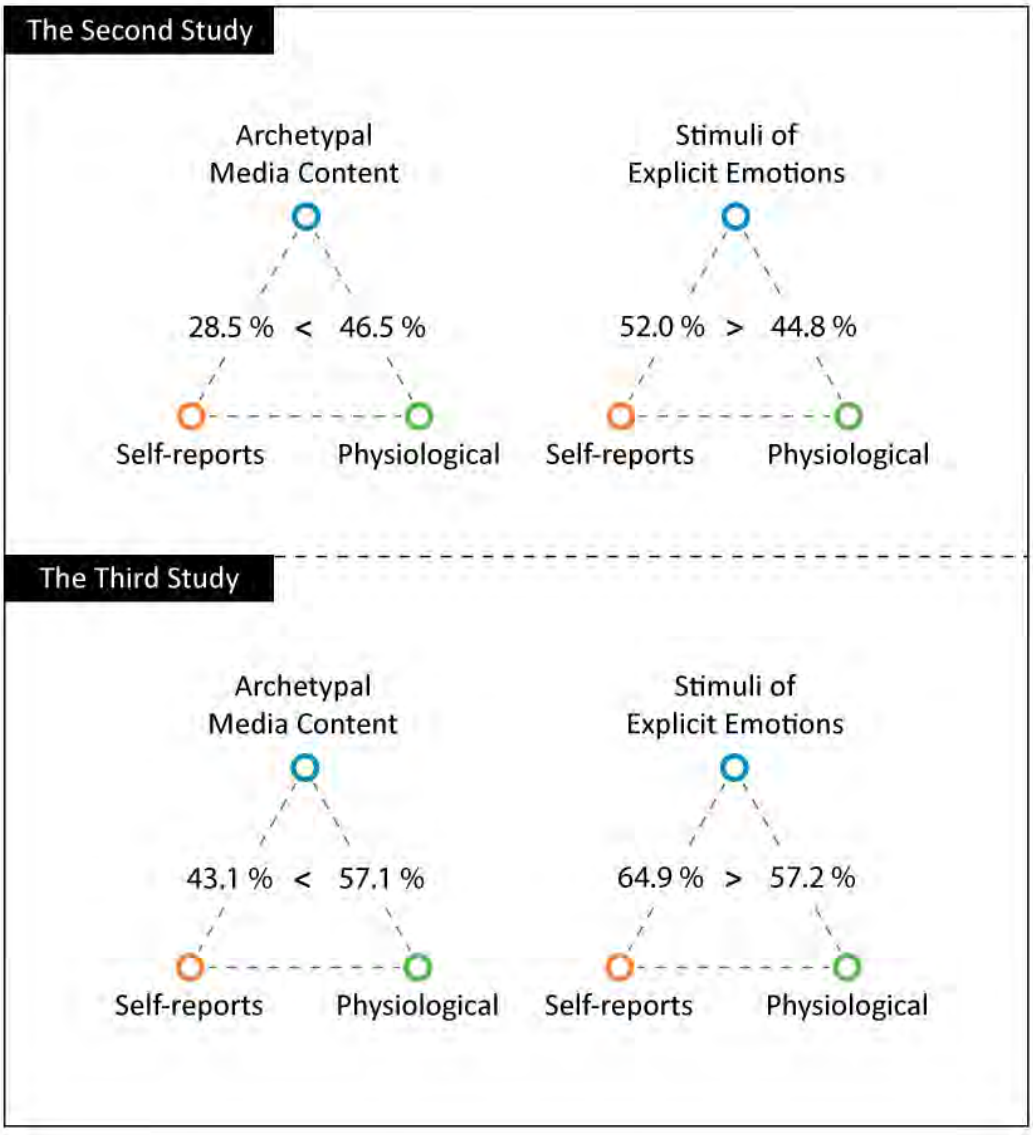


Figure 9.1: Comparing the results of the second study and the third study from a tringulation view. The numbers represent the accuracies of classification obtained from the discriminant analyses on the self-report data and the physiological data [in percent].

Figure 9.1). It needs to be noted that the accuracies of classification on the physiological data are equally balanced for the stimuli of explicit emotions and archetypal media content in the two studies. In the second study, the accuracy of classification for stimuli of explicit emotions using physiological signals is 44.8 percent, which is similar to the accuracy for archetypal media content 46.5 percent. Similarly in the third study, the accuracies for stimuli of explicit emotions and archetypal media content are approximately equal to each other (57.2% and 57.1%). However, the accuracies of classification obtained from the self-report data differ from each other considerably. While the self-reports about the stimuli of explicit emotions is more accurate, the accuracy of classification for archetypal media content using self-reports is noticeably lower than the results obtained from the physiological signals. Since we have confirmed the validity of using physiological signals for measuring emotional responses, it is reasonable to infer that emotions induced by archetypal media content cannot be well observed using self-reports.

While using self-reports for measuring emotions, it is necessary to take into account the availability for introspection and the validity of the means for reporting. In our review of research on emotion, we proposed to consider the availability for introspection as the defining criterion of conscious emotional process (see Chapter 2 for more details). If we consider the unavailability for introspection as the cause for the low accuracy of classification using self-reports, it is plausible to conclude that the emotions induced by archetypal media content are unconscious at a certain level. Conscious and unconscious mental processes are not dichotomy but interrelated (Reingold & Merikle, 1990). When the participant is consciously awake, it is impossible to capture the unconscious mental processes directly without the interference of the conscious mental activities. One feasible way to observe the unconscious mental processes is to compare the sensitivity of direct index and indirect index. According to Reingold & Merikle (1988), if the sensitivity of indirect index is greater than the sensitivity of direct index, it can be inferred that the sensitivity of indirect index to unconscious mental process is greater than zero, and thus the unconscious mental process have made an impact to the overall mental process. In the case of our research, the sensitivity of the physiological measurement (i.e. indirect index) was proved to be greater than the sensitivity of the self-report data (i.e. direct index). On the basis of the rationale, we can therefore infer that the emotions induced by archetypal media content were partly unconscious.

Another possible explanation for the low accuracy of classification using self-reports is the validity of the means for reporting one's subjective emotional experience. One can argue that the emotions were actually available for introspection but difficult to report correctly because the index was not suitable for describing the given emotions. The self-report technique we used in our experiment was the SAM scale questionnaire, which included three dimensions – valence, arousal, and dominance (Bradley & Lang, 1994). With these three dimensions, SAM was claimed to cover most explicit emotions and has been broadly used in numbers of studies in different fields (e.g. Höök et al., 2011; Lottridge et al., 2011). Therefore, it is reasonable to infer that the emotions induced by archetypal media content were different from the explicit emotions that were commonly known. These emotions required new dimensions for conceptualization. There are several new concepts relevant to emotions, such as mindfulness (Hamilton, 2006) or spirituality (Moberg, 2010). Nevertheless, whether the current version of SAM was sufficient for representing emotions in archetypal media content still requires further justification.

Of course, we cannot exclude the possibility that the above two concerns happened at the same time. In other words, even if SAM was insufficient for representing the conscious part of the emotions induced by archetypal media content, we cannot firmly exclude the possibility that these emotions were partly unconscious, and vice versa. According to the above inferences, our answer to this research question was that the emotions elicited by archetypal media content were likely to be partly unconscious in any case.

RESEARCH QUESTION 4. *How to measure and represent emotional experiences in media content in order to facilitate the design process?*

In the second part of this thesis, we explored the emotions in archetypal media content using both self-reports and physiological signals. With the advances of Affective Computing, we were allowed to create computational models for emotion recognition obtained from the physiological data recorded in the experiment (see Chapter 6). As abovementioned, the accuracies of classification using physiological signals were relatively robust for both stimuli of explicit emotions and archetypal media content. These computational models can therefore be used for emotion recognition in real practice. There are several advantages of using computational models for emotion recognition. First, this approach is reliable, consistent, and fast in processing data. Moreover, this approach allows researchers to study continuous emotional experiences without interrupting the participant, in particular for observing the transitions in emotional experiences while viewing media content. Most importantly, the computational models are capable of recognizing unconscious emotions, which cannot be achieved by using self-reports. Although Affective Computing is considered to be a powerful tool for emotion recognition, it has not yet been used in emotional design. The main challenge was to integrate Affective Computing into design practice and research on emotion.

To initiate this undertaking, we started with investigating experience-based research tools for design, such as mood board making. Mood boards are a collection of visual images gathered together to represent emotional qualities (Garner & McDonagh-Philp, 2001). Mood board making has been used not only for design practice but also for communication and inspiration (Cassidy, 2008). Nowadays, this technique is considered to be an essential skill for professional designers, and broadly used in design education (Garner & McDonagh-Philp, 2001; McDonagh & Denton, 2005). Some researchers proposed that mood board making can also be an experience-based research tool for designers (McDonagh & Denton, 2005). However, the validity of using mood board making as a research tool for studying emotion has not yet been examined. We conducted two studies in order to verify whether people with and without design backgrounds share the same criteria for judging the quality of mood boards (see Chapter 7). The inter-rater reliability among all rankings given by all participants is remarkably high. It was found that the design-background participants and non-design-background participants had highly similar opinions on ranking the mood boards made by twelve professional designers. As expected, mood boards were proved to be a valid means for visualizing emotions.

In the second study about mood boards, we also examined whether archetypal media content could stimulate designers' creativity in making mood boards with richer emotional qualities. Four professional designers were asked to make mood boards for four TV commercials respectively; two of them were archetypal media content selected by using the analysis method we developed in Chapter 3; the other two commercials were non-archetypal, containing content about movement and daily routines. In order to compare

the richness of the emotional qualities expressed by the mood boards, it was suggested to measure level of preferences (Zajonc, 1980; Dijksterhuis, 2004). An online survey was held for collecting data from voluntary participants. The participants were asked to give ratings of attractiveness for all the sixteen mood boards without knowing the source that these mood boards intended to reflected on (i.e. the TV commercials). The results of this survey showed that the mood boards for archetypal media content were more attractive than the mood boards for non-archetypal media content. Therefore we concluded that archetypal media content enabled designers to create mood boards with richer emotional qualities. This study confirmed the feasibility to apply archetypal symbolism into emotional design, in particularly for analyzing media content.

The above two studies about mood boards allowed us to verify the validity of using mood board making as a research tool for visualizing emotions in particular for archetypal media content. However, mood board making was still constrained by its making processes. First of all, it was difficult to ensure the quality of mood boards made by the same designer. Our studies revealed that some designers did not perform well consistently for all the TV commercials. It was mainly because this technique entirely relied on the designers' experience and lacked a common standard to start with. Secondly, it was difficult for designers to visualize continuous emotional experience using mood boards because it would take too much effort to create mood boards along with the timeline of the media content. In order to overcome these limitations, we developed two complementary applications – ArcheSense and ArcheBoard – for supporting emotional design and research. One of our colleague implemented the computational models obtained from physiological data we collected previously in Chapter 6 into ArcheSense for the purpose of emotion recognition. Therefore, emotional responses can directly be measured through physiological signals without interruption when viewing media content. ArcheBoard reads the outcome of ArcheSense and generates initial mood boards along with the timeline of the media content accordingly. The image mode of ArcheBoard provides automatic-generated mood boards for designers to start with, and designers may thus be less likely to ignore trivial emotional qualities or unconscious emotions in making their mood boards. For research purposes, the annotation mode of ArcheBoard can plot the outcome of emotion recognition into curve diagrams similar to iScale (Karapanos et al., 2012); designers can thus add annotations to the diagrams along with the time axis in order to reconstruct the media experience.

In Chapter 7, we demonstrated a complete process of integrating Affective Computing into emotional design. Mood board making is a typical experience-based technique for designers to extract and represent emotional qualities. We examined the validity of mood board making and also pointed out the limitations of it. In this context, Affective Computing allowed us to remedy the weakness of mood board making particularly for emotion recognition. Our application ArcheBoard was developed specifically for visualizing emotions in media content in two different ways, which can be used for research and design purposes. In addition to ArcheBoard, we also proposed a new concept of media system – archetypal media (see Chapter 8). The main idea was based on our explorations into emotions in archetypal media content. Since it was found that each of the archetypal media content correlated to a unique physiological pattern, it allowed a digital media system to provide proper content according to the audience's real-time emotional states. The method for analyzing archetypal media content can be used to expand the collections of media content of the archetypal media system. This generative-storytelling, emotion-driven me-

dia system is considered to be a new genre of digital media systems, which co-create the story with the audience's unconscious mind.

9.3 LIMITATION

In our research, we have put the utmost efforts on building our theoretical framework and experimental design according to the state of the art in related fields. However, it needs to be noted that some limitations have not yet been overcome and still require future studies to clarify.

Although our research was enormously inspired by the theory of archetypes, we did not aim to examine the validity of Jung's theory particularly on its universality. The theory of collective unconsciousness has long been criticized for its unfalsifiability because most of its research largely relied on analysis about individual data, which cannot be generalized to the general population (Jones, 2003; Walters, 1994). The core concept of this theory is beyond the scope of our research and yet requires future studies for further justification. In the context of our research, we considered archetypal symbolism as a design pattern for narrative media content, and thereby we intended to explore the emotions corresponding to the narrative structure. Although the results suggested that seven categories of archetypal content can be recognized via measuring physiological signals, this finding cannot be generalized as evidence proving the existence of the collective unconscious. Nevertheless, archetypal symbolism provides a new perspective on analyzing media content, which may be valuable for media design.

While using the theory of archetypes as the main resource for analyzing media content, we have to take into account the possibility that these emotions might be unconscious. The unconscious part of human mind has drawn more interests in recent years (e.g. Bargh & Morsella, 2008; Custers & Aarts, 2010; Dijksterhuis & Aarts, 2010). This has motivated researchers to reconsider the possibility that emotions might be unconscious under certain conditions (e.g. Berridge & Winkielman, 2003; Öhman et al., 2000a; Winkielman & Berridge, 2004). In the case of emotions in archetypal media content, we took the chance to verify whether emotions induced by archetypal media content were unconscious. Although the results of our experiments are promising, it has to be noted that the self-report data and the physiological data were not entirely comparable if we take a closer look. In general, the number of observations extracted from physiological data is usually greater than the number of observations taken from self-reports. This is due to the natural limits of using self-reports for measuring emotion. While using self-reports, the subject is inevitably being distracted when trying to introspect into his or her own mental activities. This makes it even more difficult for measuring continuous emotional experience. This limitation is bounded with the limit of the mental processing of the human mind. Nowadays, researchers are still looking for more natural, effortless, and less distracting ways of self-reports for measuring emotion.

In addition to the abovementioned hard limitations, there are also some limitations that can be solved in the foreseeable future. In our third experiment, we included three movie clips in each of the categories of affective stimuli and we had 21 clips for archetypal media content and 15 clips for explicit emotions. Although this number of clips has remarkably exceeded other similar studies using movie clips for emotion elicitation (e.g. Rottenberg et al., 2007; Soleymani et al., 2012b), the sample size of the stimuli is relatively low for training computational models. It is suggested to edit more movie clips for each category

of the affective stimuli in order to enhance the performance of the computational models. Similarly, the advances of the classification algorithms and signal processing techniques can also be anticipated for improving the accuracy of the prediction models. In our analysis, we applied most of the mainstream machine learning algorithms for training models. We look forward to more powerful algorithms for classification to be developed in the future. Moreover, the robustness of signal processing procedures also needs to be taken into account. For instance, filtering out motion artifacts from the physiological signals can certainly improve the quality of the datasets for model training.

9.4 FUTURE WORK

In the studies presented in this thesis, we demonstrated a complete procedure starting from psychological theories, empirical experiments, to implementing applications for supporting research and design for emotion. While design is gradually growing as an individual field of study apart from science and engineer (Cross, 2001), we look for the opportunity to integrate scientific findings into design processes. Although these are promising findings, further research is needed to more extensively explore unconscious emotion and archetypal media content. We now address three directions for future research.

9.4.1 *More Empirical Evidence about Unconscious Emotion*

In our research, we specifically focused on unconscious emotion. Throughout the thesis, we kept a neutral position to interpret the evidence obtained from our empirical studies and yet cannot exclude the possibility that emotions might be unconscious under certain conditions. With the evidence provided in our studies, it is unclear to what extent and at which moment emotions might become unconscious. In fact, the existence of unconscious emotions is still open to debate mostly because researchers have different definitions and premises in their theories as we have presented in Chapter 2. Apart from traditional approaches taken by previous studies, we took a novel approach using the theories in psychoanalysis, the self-report questionnaire using dimensional model, and the physiological measurements. According to the three-building-block framework in Chapter 2, there are many potential combinations have not yet been considered. Hence, Researchers could find new paths to explore further evidence for validating the existence of unconscious emotions.

9.4.2 *Other Psychological Phenomena about Archetypal Media Content*

Growing interests in the unconscious mind have emerged in various fields in recent years. In addition to unconscious emotion, there are also other exciting topic about the unconscious of human mind, such as unconscious perceptions (Monahan et al., 2000), implicit memories (Squire, 1992) tacit knowledge (Turner, 2012), implicit attitude (Gattol et al., 2011), and unconscious decision-making (Dijksterhuis, 2004). Since we have started the investigation into unconscious emotions, it is promising to explore other psychological phenomena associated with archetypal media content. As mentioned in the beginning of the thesis, myths and narratives are inseparable from the human society. Human beings create stories and the stories in turn shape the society as we see it today. Archetypal symbol-

ism provides a different perspective to look at the underlying structure under the surface of the stories. However, the influences of archetypal media content toward the audience are still yet to discover. In our research, the analytic method presented in Chapter 3 was used to analyze symbolic meaning in movies on the basis of archetypal symbolism (see Chapter 3). We consider this analytic method as a generic means for identifying various media types of archetypal content, such as literary works and video games. With various types of media content, it enables researchers to explore other psychological phenomena triggered by archetypal media content. This would also broaden our understanding about the relationship between narratives and the human society at large.

9.4.3 *Apply Affective Computing into Emotional Design*

Affective Computing mainly focuses on emotion recognition. Therefore, Affective Computing is mostly used in applications for evaluation, such as monitoring game experience (Mandryk & Atkins, 2007). In addition to evaluation, we see more opportunities in applying Affective Computing into emotional design, which aims to deliver better emotional experience via using specific design approaches that take into account various emotional qualities. In Chapter 7, we demonstrated how to improve design processes by using empirical findings obtained from our studies. The development of ArcheBoard was based on the computational models obtained from our third study presented in Chapter 6. It allows designers to overcome the limitations of traditional mood board making by using the knowledge of Affective Computing. With the same empirical results, we further proposed a new concept of emotion-driven media, which positioned Affective Computing as the core element for constructing digital media systems. In addition to these two examples demonstrated in this thesis, we believe that there will be more new concepts in application domains, especially for entertainment and media design.

9.5 CONCLUSIONS

We started this thesis with the motivation to research into the unconscious of human mind. There are numbers of resemblance across different cultures and religions particularly in their myths and stories. Nowadays, these narratives still profoundly influence the human society, shaping the world as it is today. This phenomenon funded the basic assumption of the theory of the collective unconscious, which argues that all humans share a deepest layer in the unconscious. While this theory is still unfalsifiable, we looked into the relationship between emotion and archetypal media content. We developed a method for analyzing media content on the basis of archetypal symbolism in order to extract universal content that bears specific symbolic meaning, and conducted a series of three experiments to explore the emotional responses to these archetypal media content. According to the results of our empirical studies, it was found that the participants share similar emotional feelings when viewing archetypal media content, and these emotional responses can be clearly classified through physiological signals while self-reports performed noticeably worse than the results of previous studies about explicit emotions. Therefore, we came to the conclusion that emotions induced by archetypal media content may partly be unconscious, and yet, we cannot make further inferences with the given evidence due to the natural limits of

self-reports. This is a promising finding; as such media content bearing specific symbolic meaning induces unique patterns of physiological signals.

Applying the empirical results into real-life applications is another difficult challenge for researchers. In this thesis, we took the challenge of applying Affective Computing into emotional design. One application was developed to visualizing continuous emotional experiences using physiological measurement. The other example was a conceptual work, a new genre of digital media system, which provides content based on the audience's real-time physiological feedback. The core knowledge of these two concepts was based on the computational model we obtained in our previous studies. Since these computational models were capable of recognizing unconscious emotion, the use of these applications enables users to interact with computers unconsciously. These two concepts may serve as good examples for integrating affective computing into emotional design. While most design research fully concentrates on the rationales in design, we looked into the irrational part of human mind and made one of the first attempts to employ unconscious emotion to emotional design. This thesis demonstrated a thorough procedure starting from theoretical framework, explorations, to implications for design. We hope our work could provide a starting point for initiating a new line of research, and we look forward to new findings about the unconscious mind and more novel applications that enrich our mental lives.

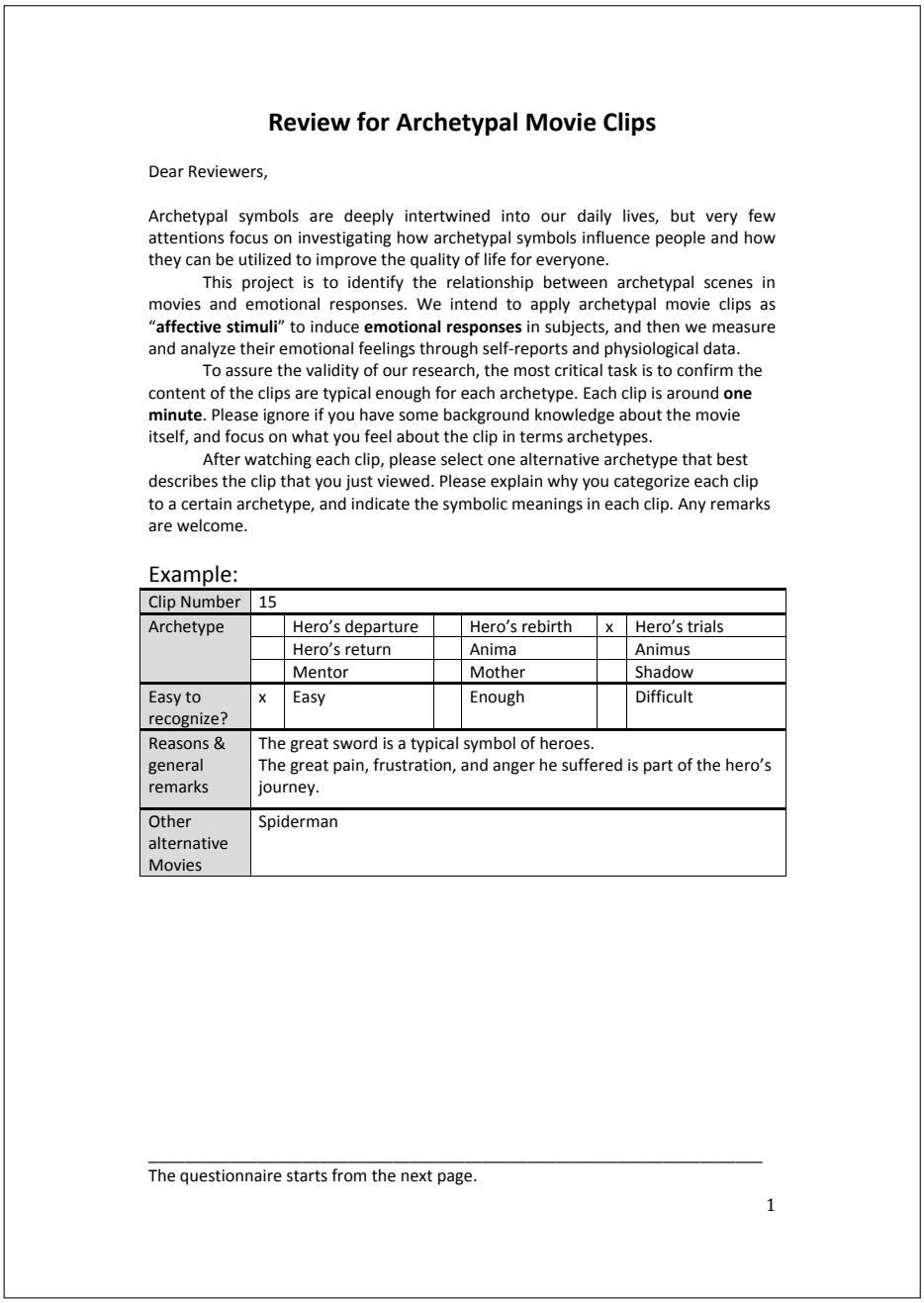
Part IV

APPENDIX

A

REVIEW FORM FOR ARCHETYPAL MEDIA ANALYSIS

In this appendix, we show the review form for ARAS experts to review the movie clips we edited (see Figure A.1 and Figure A.2).



Review for Archetypal Movie Clips

Dear Reviewers,

Archetypal symbols are deeply intertwined into our daily lives, but very few attentions focus on investigating how archetypal symbols influence people and how they can be utilized to improve the quality of life for everyone.

This project is to identify the relationship between archetypal scenes in movies and emotional responses. We intend to apply archetypal movie clips as "**affective stimuli**" to induce **emotional responses** in subjects, and then we measure and analyze their emotional feelings through self-reports and physiological data.

To assure the validity of our research, the most critical task is to confirm the content of the clips are typical enough for each archetype. Each clip is around **one minute**. Please ignore if you have some background knowledge about the movie itself, and focus on what you feel about the clip in terms archetypes.

After watching each clip, please select one alternative archetype that best describes the clip that you just viewed. Please explain why you categorize each clip to a certain archetype, and indicate the symbolic meanings in each clip. Any remarks are welcome.

Example:

Clip Number	15					
Archetype		Hero's departure		Hero's rebirth	x	Hero's trials
		Hero's return		Anima		Animus
		Mentor		Mother		Shadow
Easy to recognize?	x	Easy		Enough		Difficult
Reasons & general remarks	The great sword is a typical symbol of heroes. The great pain, frustration, and anger he suffered is part of the hero's journey.					
Other alternative Movies	Spiderman					

The questionnaire starts from the next page.

1

Figure A.1: The review form for external experts to review the movie clips (part I).

Your Name: _____

Clip Number						
Archetype		Hero's departure		Hero's rebirth		Hero's trials
		Hero's return		Anima		Animus
		Mentor		Mother		Shadow
Easy to recognize?		Easy		Enough		Difficult
Reasons & general remarks						
Other alternative Movies						

Clip Number						
Archetype		Hero's departure		Hero's rebirth		Hero's trials
		Hero's return		Anima		Animus
		Mentor		Mother		Shadow
Easy to recognize?		Easy		Enough		Difficult
Reasons & general remarks						
Other alternative Movies						

2

Figure A.2: The review form for external experts to review the movie clips (part II).

B

MOOD BOARDS FOR THE ANIMA ARCHETYPE

In this appendix, we show the mood boards for the BMW commercial (Rathod, 2012), which represents the anima archetype (see Figure B.1 to B.12). These mood boards were created by twelve professional designers who had at least two-year professional experiences as a designer. These mood boards were used in the study reported in Chapter 7.

Figure B.1: The mood board for the BMW commercial by designer 'A'.

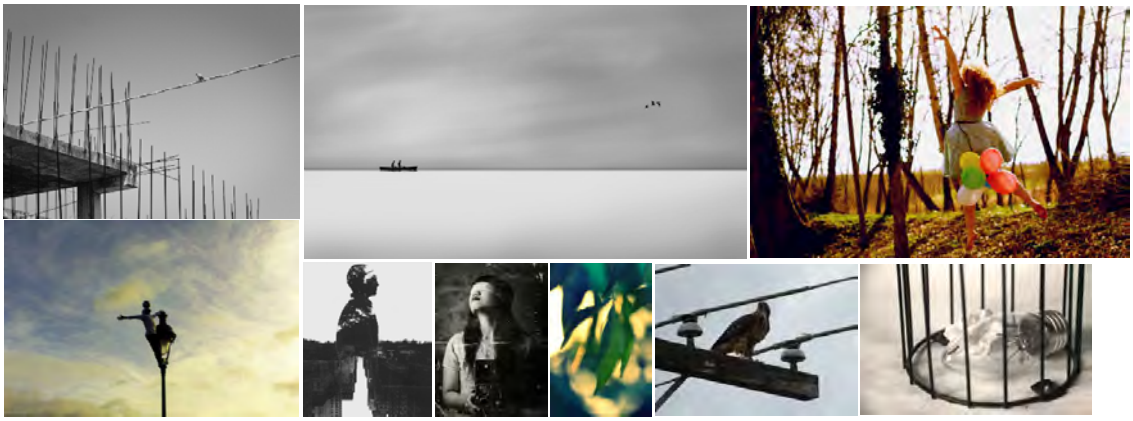


Figure B.2: The mood board for the BMW commercial by designer 'B'.

Figure B.3: The mood board for the BMW commercial by designer 'C'.

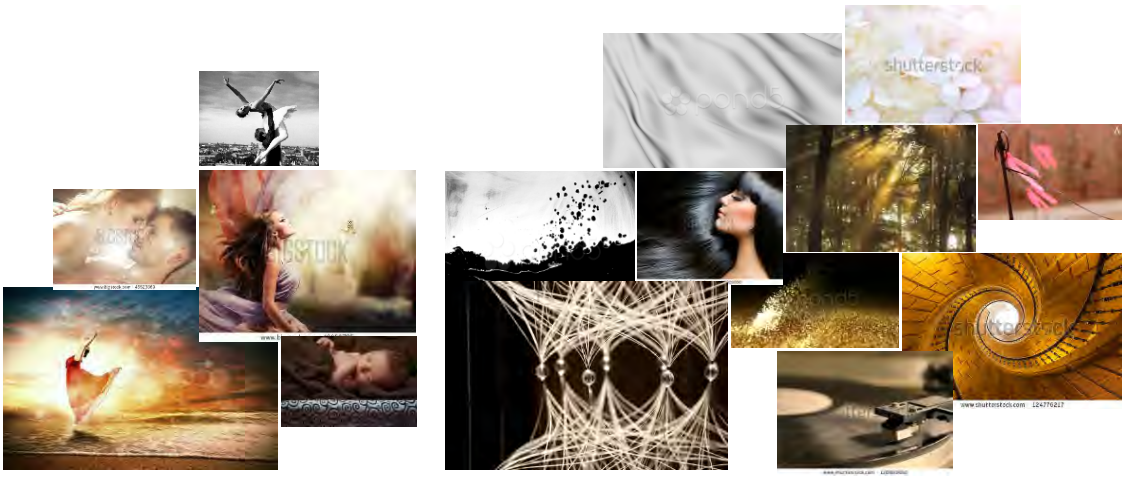


Figure B.4: The mood board for the BMW commercial by designer 'D'.

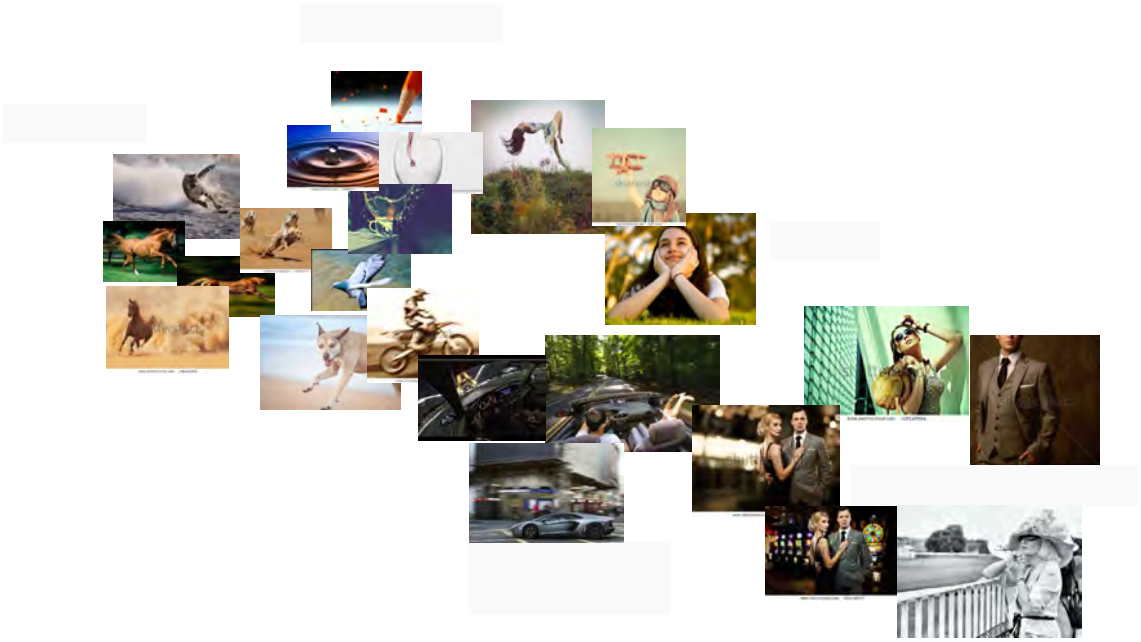


Figure B.5: The mood board for the BMW commercial by designer 'E'.

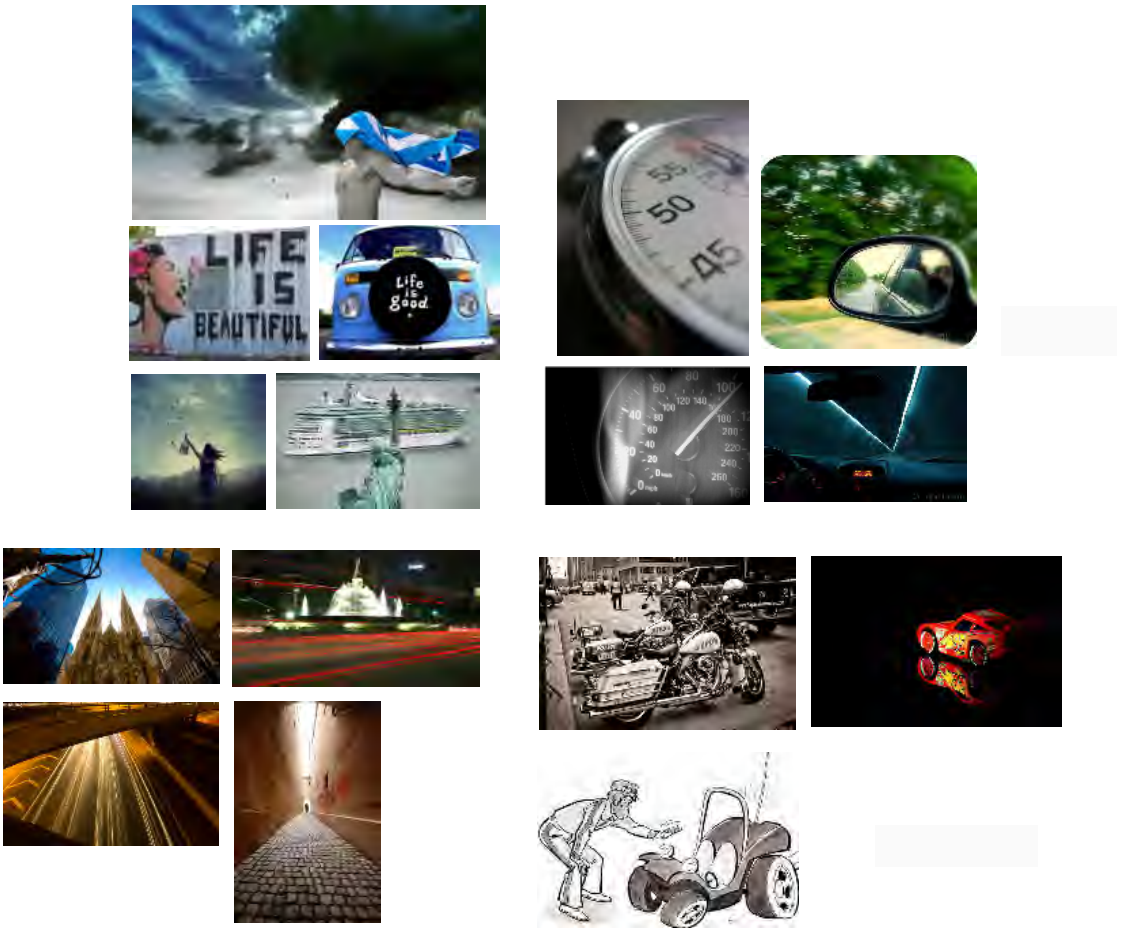


Figure B.6: The mood board for the BMW commercial by designer 'F'.

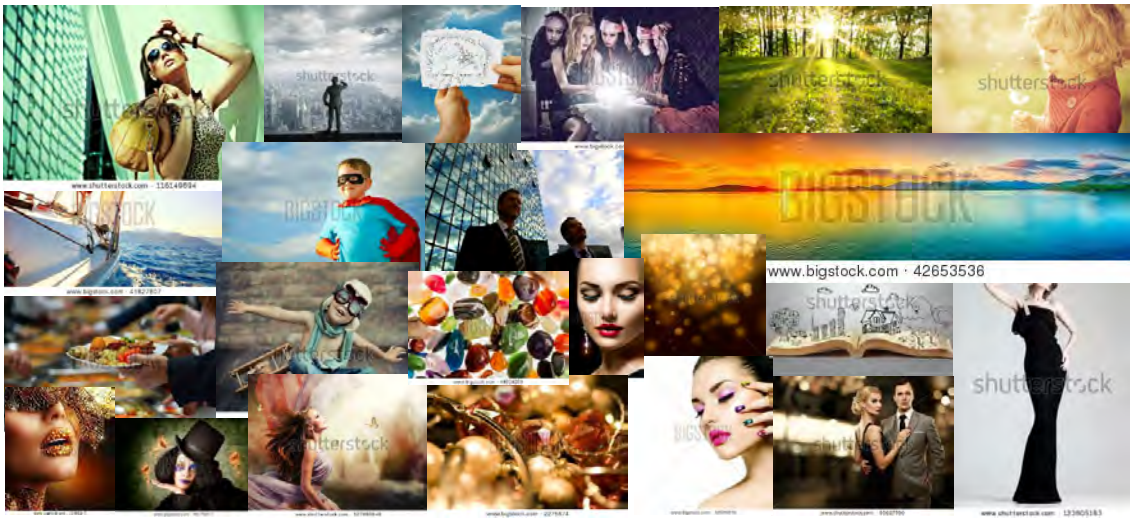


Figure B.7: The mood board for the BMW commercial by designer 'G'.

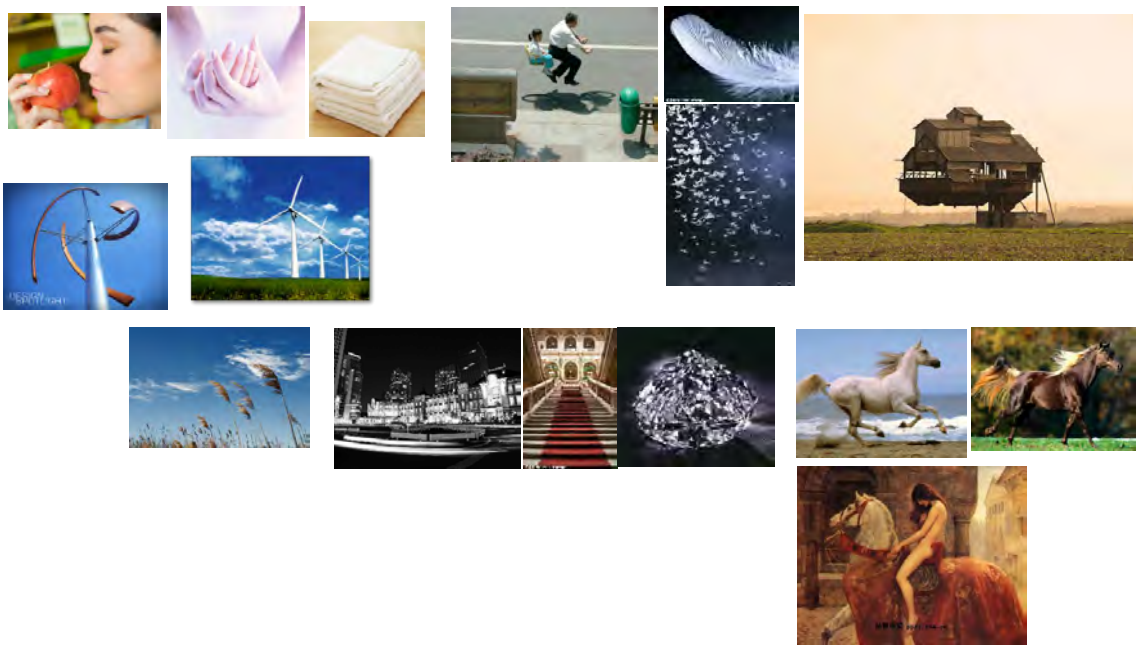


Figure B.8: The mood board for the BMW commercial by designer 'H'.

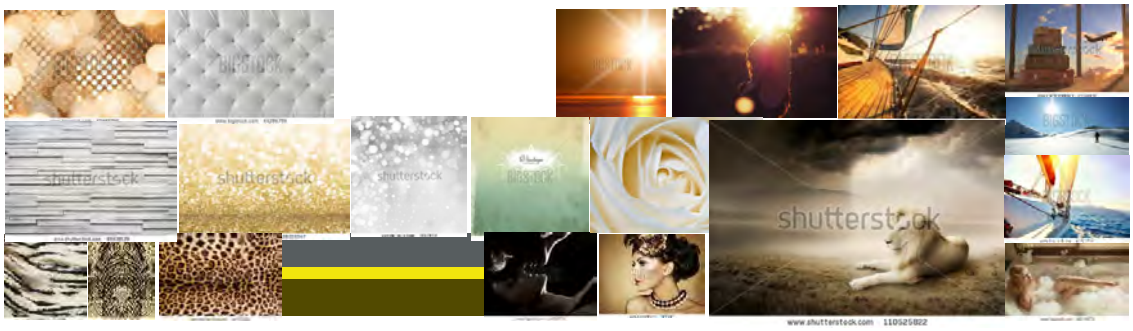


Figure B.9: The mood board for the BMW commercial by designer 'I'.

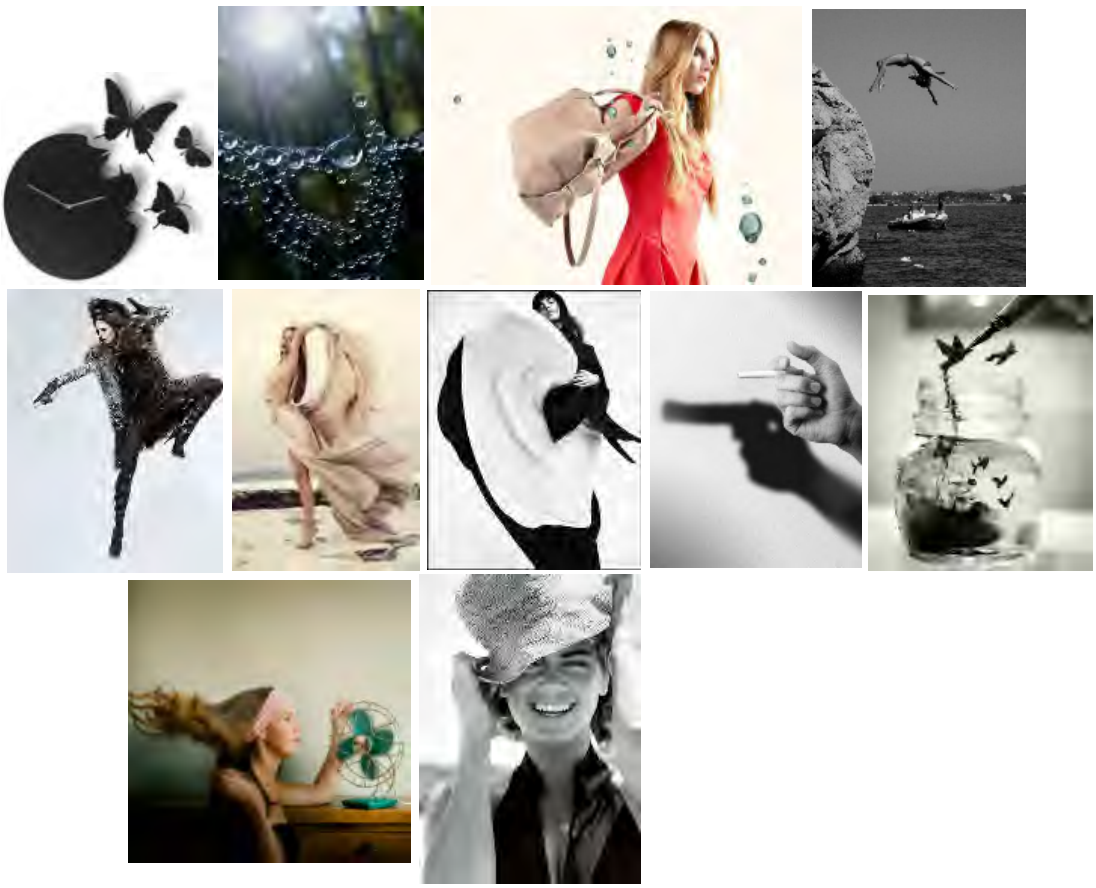


Figure B.10: The mood board for the BMW commercial by designer 'J'.

Figure B.11: The mood board for the BMW commercial by designer 'K'.

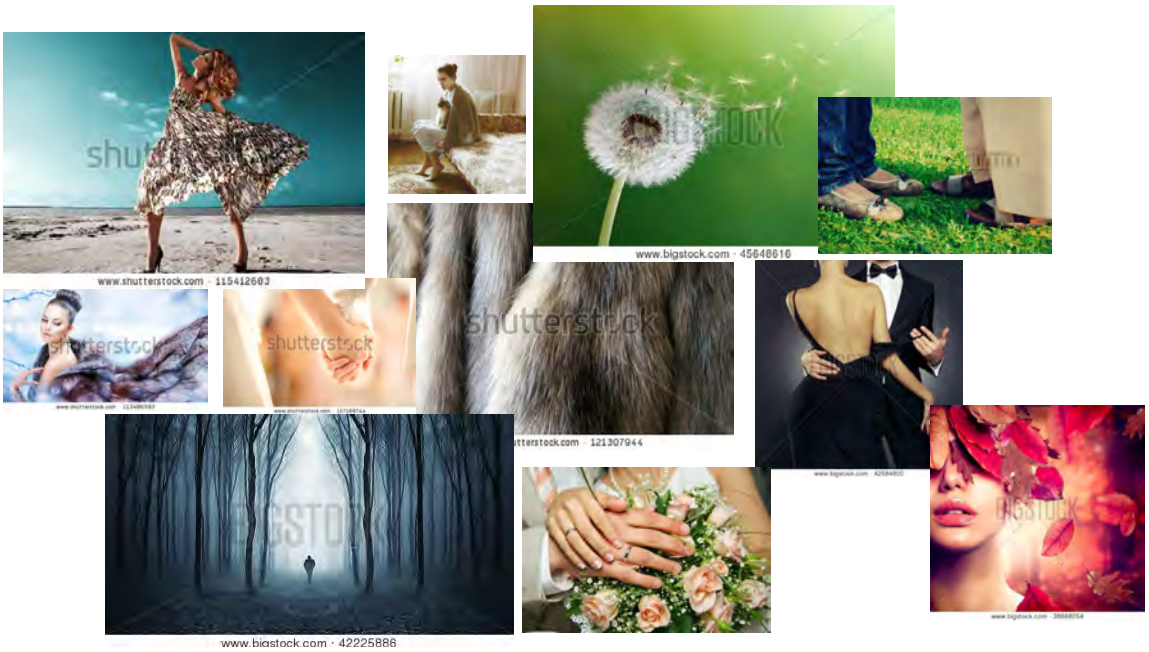


Figure B.12: The mood board for the BMW commercial by designer 'L'.

C

MOOD BOARDS FOR THE HERO ARCHETYPE

In this appendix, we show the mood boards for the Jeep commercial (SistemasNormalesHD, 2013), which represents the anima archetype (see Figure C.1 to C.12). These mood boards were created by twelve professional designers who had at least two-year professional experiences as a designer. These mood boards were used in the study reported in Chapter 7.

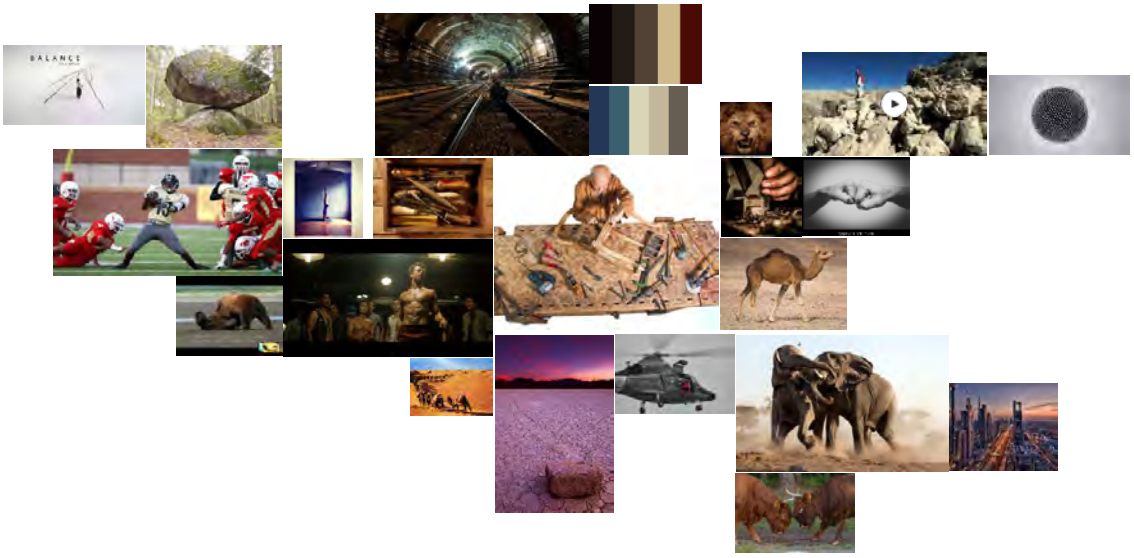


Figure C.1: The mood board for the Jeep commercial by designer 'A'.

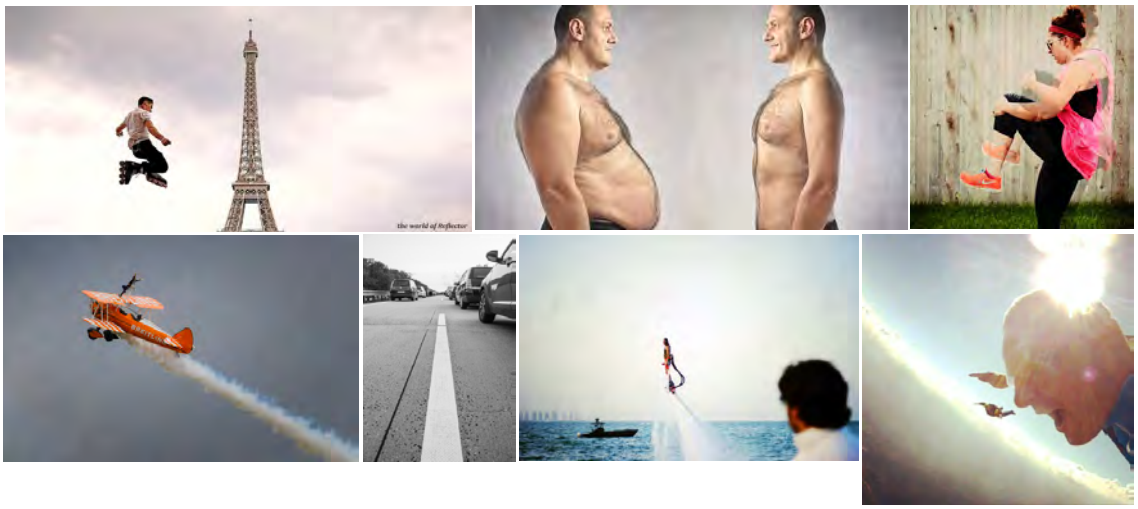


Figure C.2: The mood board for the Jeep commercial by designer 'B'.

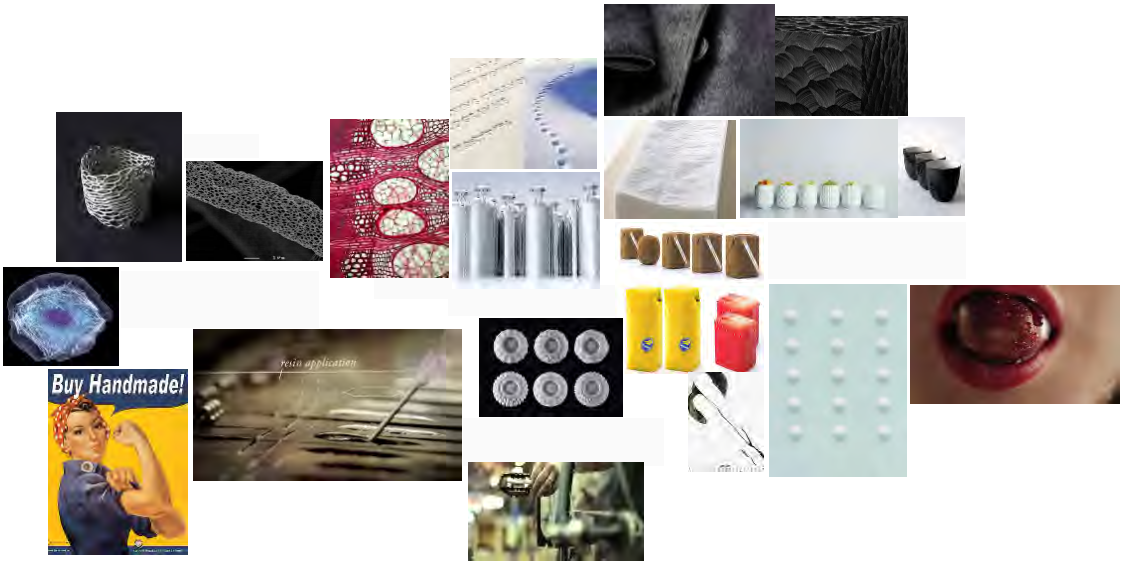


Figure C.3: The mood board for the Jeep commercial by designer 'C'.

Figure C.4: The mood board for the Jeep commercial by designer 'D'.

Figure C.5: The mood board for the Jeep commercial by designer 'E'.

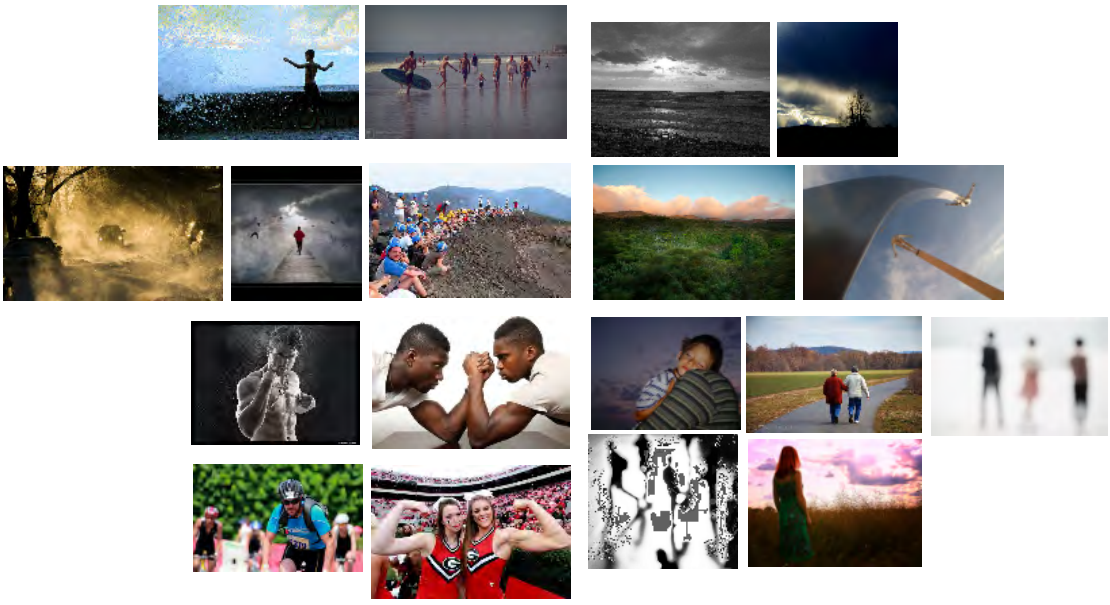


Figure C.6: The mood board for the Jeep commercial by designer 'F'.

Figure C.7: The mood board for the Jeep commercial by designer 'G'.

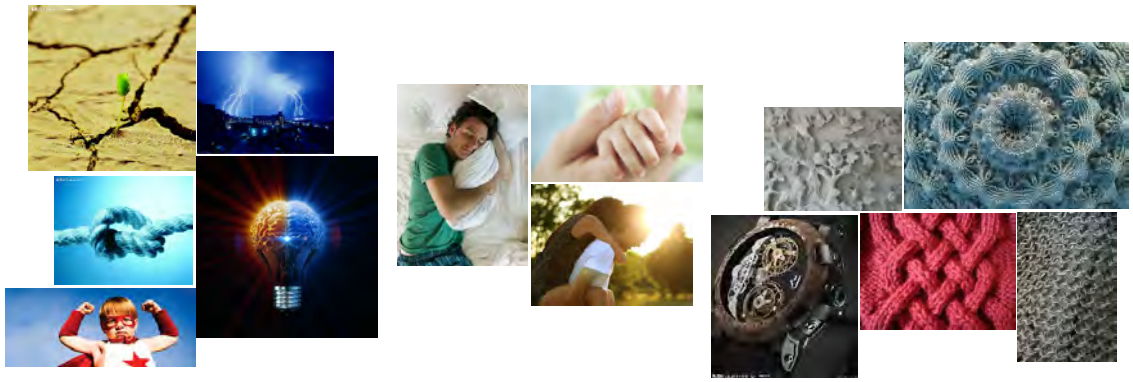


Figure C.8: The mood board for the Jeep commercial by designer 'H'.

Figure C.9: The mood board for the Jeep commercial by designer 'I'.

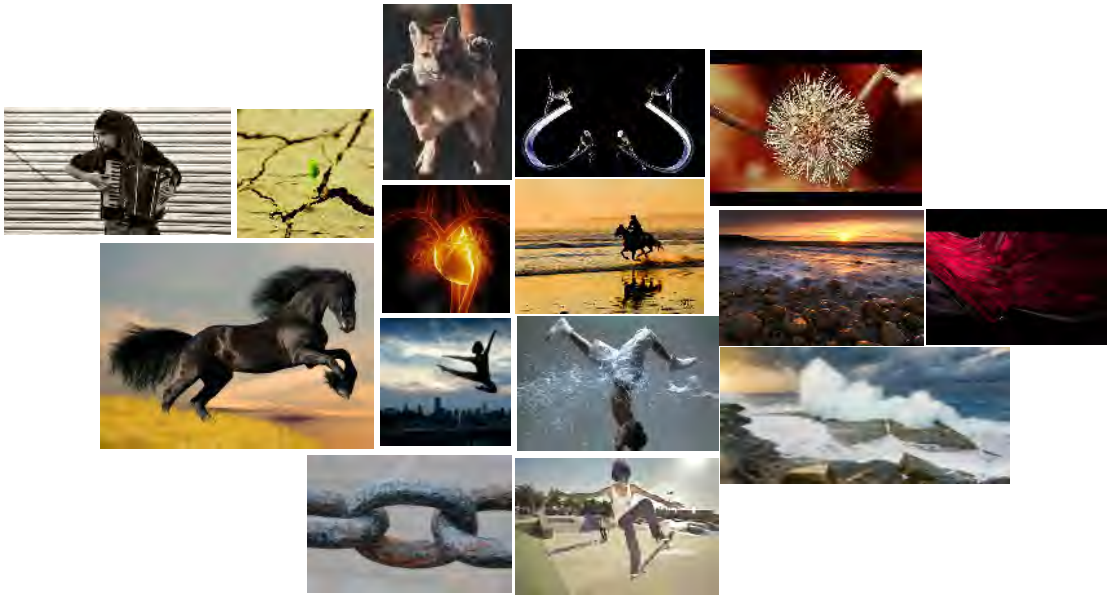


Figure C.10: The mood board for the Jeep commercial by designer 'J'.

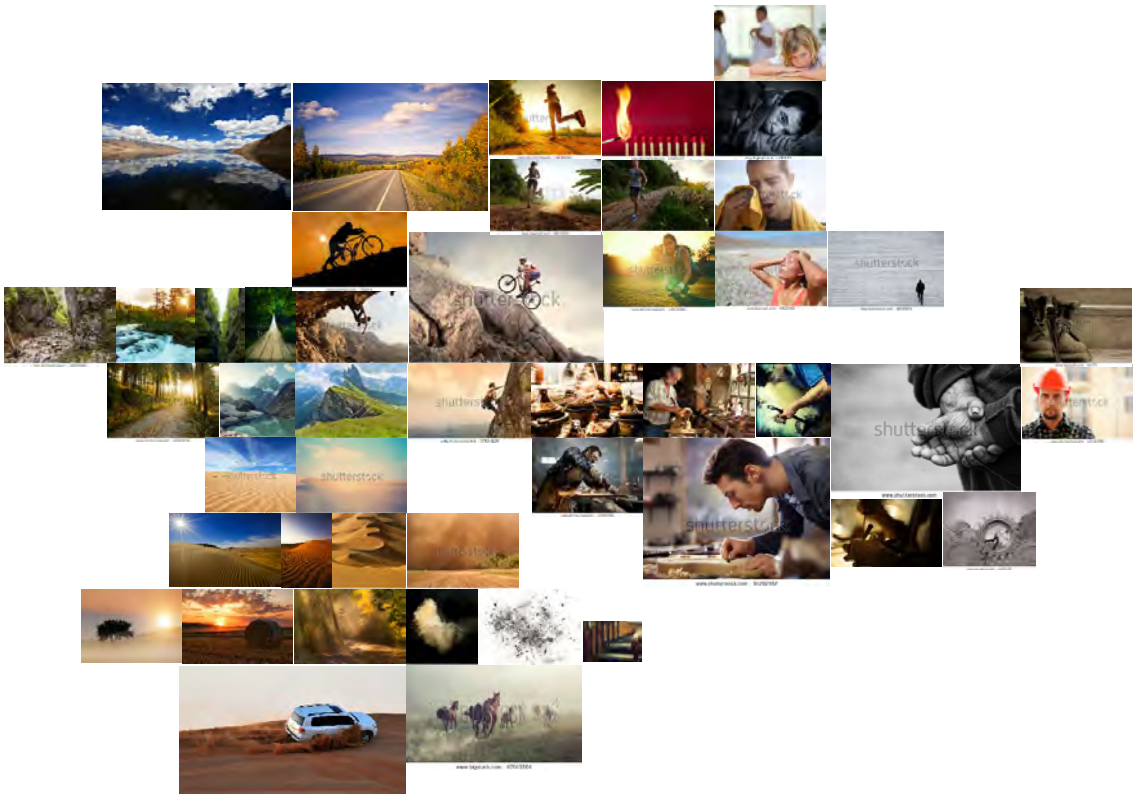


Figure C.11: The mood board for the Jeep commercial by designer 'K'.

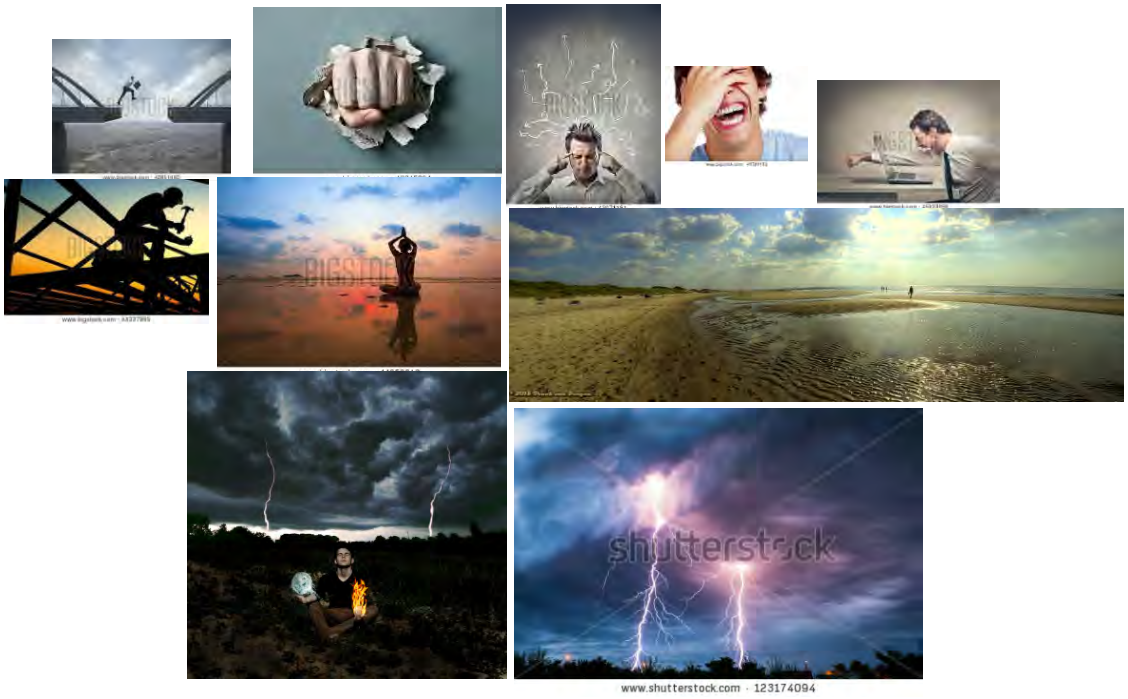


Figure C.12: The mood board for the Jeep commercial by designer 'L'.

MOOD BOARDS FOR NON-ARCHETYPAL COMMERCIALS D

In this appendix, we show the mood boards for two non-archetypal TV commercials. These mood boards were created by four professional designers who had at least two-year professional experiences as a designer. These mood boards were used in the study reported in Chapter 7. One of the non-archetypal TV commercials, *Honda Cog* (Thomme, 2012), utilized a chain of colliding parts taken from a disassembled automobile in order to demonstrate the motion qualities of the mechanical objects in an automobile (see Figure D.1, D.2,D.3, and D.4). The other commercial, *Honda Everyday* (Krug, 2006), used a series of daily routines behaviors, including driving a car, in order to emphasize the importance of owing a reliable car in modern people's lives (see Figure D.5, D.6,D.7, and D.8).

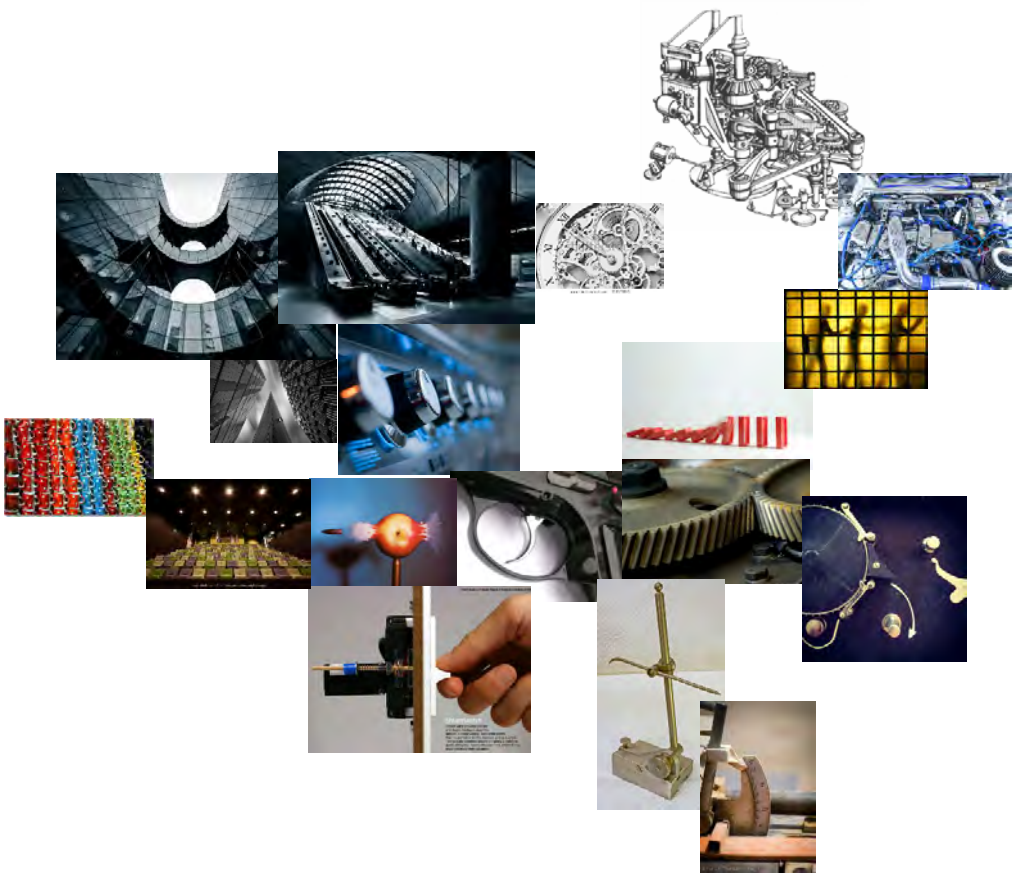


Figure D.1: The mood board for the mechanical object commercial by designer 'E'.

Figure D.2: The mood board for the mechanical object commercial by designer 'K'.

Figure D.3: The mood board for the mechanical object commercial by designer 'C'.

Figure D.4: The mood board for the mechanical object commercial by designer 'I'.

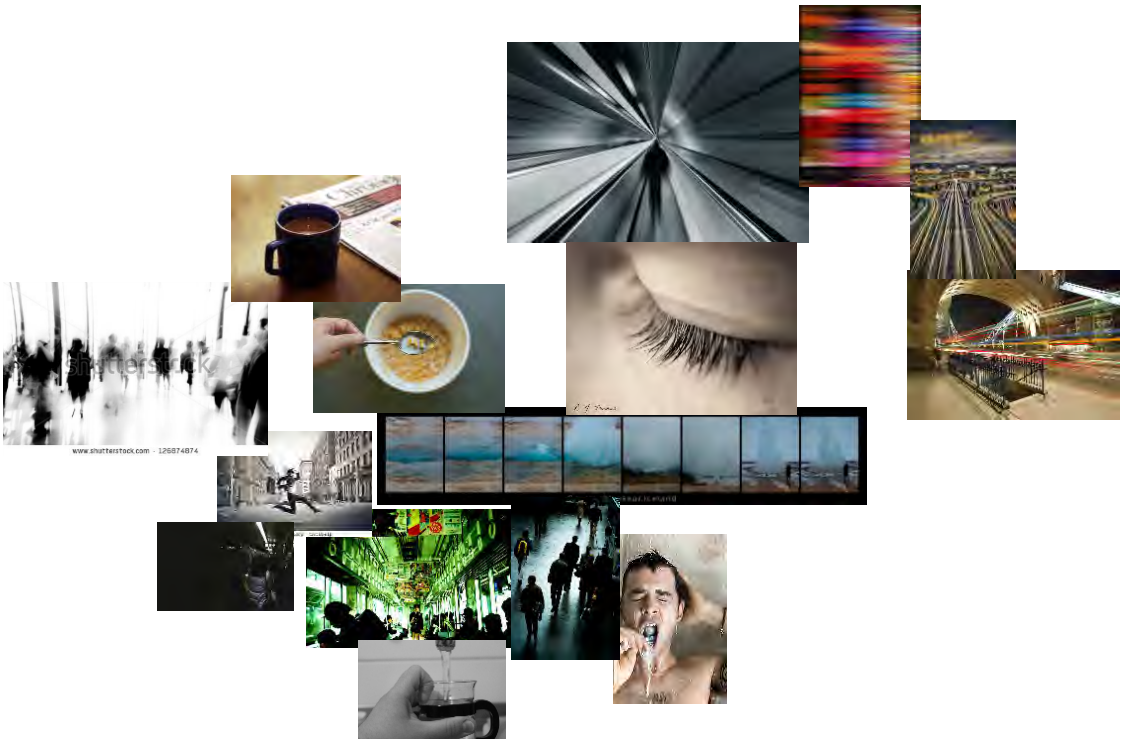


Figure D.5: The mood board for the daily routine commercial by designer 'E'.

Figure D.6: The mood board for the daily routine commercial by designer 'K'.

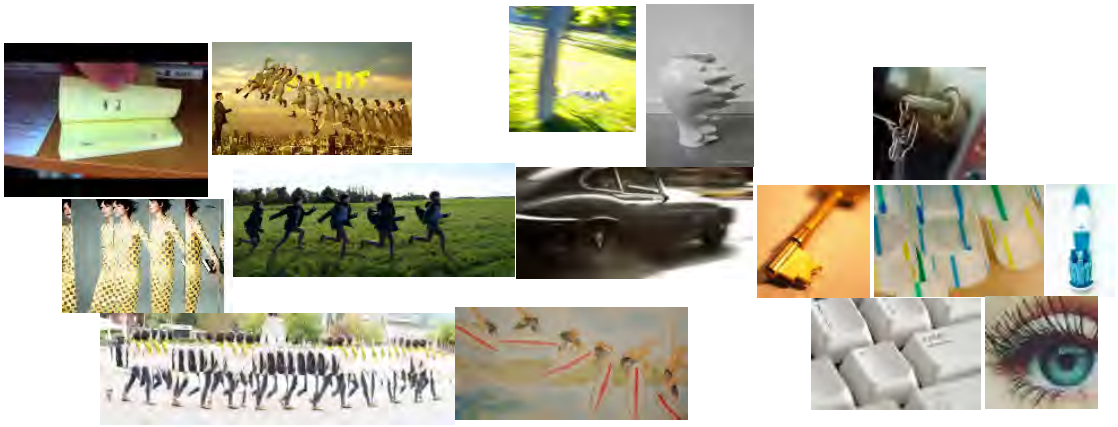


Figure D.7: The mood board for the daily routine commercial by designer 'C'.

Figure D.8: The mood board for the daily routine commercial by designer 'I'.

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CURRICULUM VITAE

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