Design for Mood: *Twenty Activity-Based Opportunities to Design for Mood Regulation*

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This paper introduces a theory-based approach to design for mood regulation. The main proposition is that design can best influence mood by enabling and stimulating people to engage in a broad range of mood-regulating activities. The first part of the manuscript reviews state-of-the art mood-focused design research initiatives, grouped into four basic intentions, exploring how technology can measure, express, adapt to, or influence mood. The second part provides a functional explanation of the mood phenomenon, addressing how mood can be described, the function of mood, manifestations of mood, and how mood differs from emotion. The third and final part of the manuscript introduces an overview of novel mood-regulation strategies, and explores how these strategies can inspire design interventions. Twenty activity-based opportunities to design for mood regulation are grouped into three main focal categories: seeking relief, restoring balance, and building resilience.

Keywords **–** Design for Mood, Design for Well-Being, Mood Regulation.

Relevance to design practice – This paper provides a new perspective on the impact of design on mood. It includes an overview of current mood-focused design research, a basic theory of mood and mood regulation, and a novel approach to design for mood regulation.

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Introduction

Some days we are cheerful; others, we are grumpy. Likewise, we can be calm, nervous, relaxed, excited, glum, or perhaps irritable: Although our awareness of such affective dispositions may not be continuous, we are always in some kind of "mood". Moods pass —they can last for hours, or sometimes even days, but they are constantly changing and converging into other moods. At the same time, moods are pervasive. They represent the nonreflective feeling state that forms the core of our affective being (Russell, 2003), and they are a direct indicator of our general subjective well-being (Diener, Fujita & Sandvik, 1994). When in a good mood, people evaluate life in general as more satisfying and fulfilling, and are more inclined to remember positive life events than when they are in a bad mood (Schwarz & Strack, 1999; Forgas & Bower, 1987). Moreover, mood also influences our motivation, behaviour, and evaluation of everyday interactions (Kelley & Hoffman, 1997). It has been shown that when in a good mood, people are kinder to others (and to themselves), more generous and willing to lend a helping hand, more inclined to accentuate the positive aspects of ambiguous situations, more open to new activities and ideas, and more creative than when they are in a bad mood (Isen & Levin, 1972; Clark & Isen, 1982).

Design for Mood Regulation

The phenomenon of mood has been a long-standing source of design inspiration. Numerous designers, artists and architects have explored whether design can deliberately influence mood states, and if so, how this might be possible. History provides us with a vast number of designs and design interventions intended to function as a means for *mood regulation*. One example is the infamous "*pink prison experiment*", which concluded that prison inmates' tempers were soothed when placed in pink-walled cells (Schauss, 1979). This finding became so widely accepted that, for decades, prison cells in Canada and the USA were painted a bright pink colour. It even inspired Colorado State University and the University of Iowa to paint their visiting teams' changing rooms pink, believing that the soothing effects would create an advantage for the home-team.[1]

As a historical event, the pink cell example is notable, but painting a room is a simple and unrefined design intervention when compared to the potential inherent in state-of-the-art mood-influencing technology. Since the seventies, impressive advances have been made, especially after mood became a key topic of inquiry in the domain of interaction design (see Picard, 2000). Over the years, explorations have continued to evolve, becoming increasingly sophisticated. Recent developments in wearable technology, robotics and ambient technology, for example, have enabled the development of advanced, articulated mood-influencing designs. Figure 1 shows three examples that demonstrate some of the possibilities that are currently under investigation: social robotics and intelligent interaction (*Paro*; see Wada, Shibata, Saito, &

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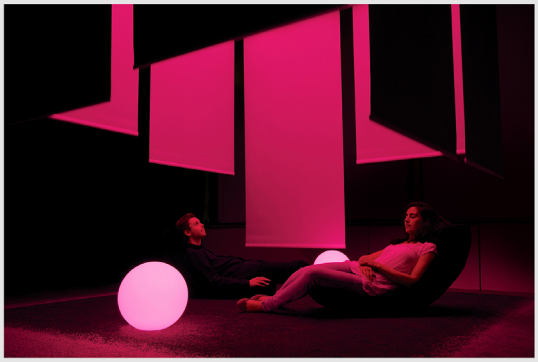
Paro, a social robot

This interactive robot, which was modelled after a baby harp seal, has a calming effect and evokes a positive mood in patients of hospitals and nursing homes.

Image by Focal Meditech BV.



The Adaptive Relaxation Space

In this interactive space, the light intensity and colour and spatial configuration dynamically adapt to stimulate a guided and gradual mood transition.

Image by Philips Communications.

Mood Wings

The wings of this wearable device beat at different rates depending on the wearers' mood states, thereby supporting personal mood awareness.

Image from MacLean et al., 2013.

Figure 1. Three examples of mood-influencing technology.

Tanie, 2004), adaptive environments and dynamic ambiance (the *Adaptive Relaxation Space*; see Van de Garde, 2014), and affective wearables incorporating real-time, personalized mood feedback (*Mood Wings*; see MacLean, Roseway, & Czerwinski, 2013).

Motives to Design for Mood Regulation

In the present work, mood is defined as a mild, diffuse, pervasive feeling state that is experienced as pleasant or unpleasant, and which has a broad influence on perceptions, motivation, and behaviour.[2] There are three reasons (at least) why it is meaningful to explore how design interventions can influence mood. Firstly, mood has a direct influence on people's subjective well-being (see Diener et al., 1994). User mood may therefore be a key variable for initiatives investigating how design can foster long-term user well-being (e.g., Desmet & Pohlmeyer, 2013). As a logical consequence, research that explores the possibilities to design with the purpose to influence mood continues to emerge in the domain of (preventive) health care (e.g., Veenhoven, 2008; Javelot et al., 2014; Valenza, Gentili, Lanatà, & Scilingo, 2013). Moreover, researchers have started to explore the effects of various interiors on mood, such as in hospitals (Dijkstra, Pieterse, & Pruyn, 2008; Salonen et al., 2013), classrooms (Lundquist, Kjellberg, & Holmberg, 2002; Woolner, 2010), living rooms (Yildirim, Lutfi Hidayetoglu, & Capanoglu, 2011), and offices (Kwallek, Woodson, Lewis, & Sales, 1997; Küller, Ballal, Laike, Mikellides, & Tonello, 2006).

Secondly, mood influences consumer behaviour. Research has demonstrated that consumer mood influences buying behaviour, product preference, and purchase decisions (Fedorikhin & Cole, 2004; Maier, 2012; Spies, Hesse, & Loesch, 1997). When evaluating new products, people do so more favourably when in a good mood than when in a bad mood (Gorn, Goldberg, & Basu, 1993). The same bias occurs in post-purchase evaluations (Miniard, Bhatla, & Sirdeshmukh, 1992), and even applies when people evaluate products that they have owned for a longer period of time: in a good mood, people rate the performance of their cars and television sets as better than when they are in a neutral or bad mood (Isen, Shalker, Clark, & Karp, 1978). These mood effects have particularly caught the attention of researchers in the domain of retail design. Several studies have investigated how retail design can be optimized to put consumers *in the buying mood* (e.g., Quartier, Christiaans, & van Cleempoel, 2009; Arnold & Reynolds, 2009).

Thirdly, mood influences user behaviour. For example, Wensveen (2005) found that a person's mood state influences the way he or she wants to operate an alarm clock. It has been shown that, when using new products, individuals in a bad mood tend to explore fewer interaction possibilities than those who are in a good mood (Venkatesh & Speier, 1999). Likewise, mood influences the kind of information that people process when interacting with technology (Zhang & Jansen, 2009), and it affects which products people (prefer to) use: A good mood increases one's willingness and motivation to adopt and use new technologies (Djamasbi & Strong, 2008, 2010). In response to these findings, researchers have started to explore if and how interaction design can be improved with the use of mood-influencing interactions (Spillers, 2010; for examples, see Rao, 2008; Sánchez, Kirschning, Palacio, & Ostróvskaya, 2005).

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Understanding the Mood Phenomenon

Surprisingly little attention has been paid to mood theory in the field of mood-influencing design research. The majority of reported design explorations are based on implicit or intuitive understandings of the mood phenomenon.[3] This is problematic because intuitive assumptions about the causes of mood have been shown to be unreliable. In fact, the last thirty years mood researchers have unmasked numerous misconceptions about the influence of environmental stimuli on mood. For example, it has been shown that, contrary to popular belief, the colour red is not physically stimulating or arousing, and the colour blue is not calming or relaxing (Bakker, van der Voordt, de Boon, & Vink, 2013; O'Conner, 2011). Likewise, environmental psychologists have shown that the effect of room colour on mood is neither consistent nor predictable (Akers et al., 2012; Küller et al., 2006; Kwallek, 2005; Kwallek et al., 1997).[4] This applies to other environmental stimuli too, such as light conditions (McCloughan, Aspinall, & Webb, 1999), fragrance (Herz 2002, 2009; Knasko, 1992; Retiveau, 2004), and music (Bruner, 1990; Alpert & Alpert, 1990; Ferguson & Sheldon, 2013). These studies have consistently found that environmental stimuli do not have the presupposed effects on mood when tested in real-life settings (for a discussion, see e.g., Bakker et al., 2013).

These findings indicate that, unlike emotion, mood only has loose connections to discrete events, and the influence of stimuli on mood cannot be understood in isolation from the context in which the mood is experienced (Kahneman, Diener, & Schwarz, 1999).[5] A sunny day, for example, does not guarantee a cheerful mood because our mood state depends on many other things. Likewise, a blue office may be soothing on one day, but irritating the next (Küller et al., 2006). For design research, it is therefore crucial to recognize that mood and emotion are different affective phenomena: Even though the words *emotion* and *mood* are often used interchangeably (both in everyday conversation, and in design research), they have different functions and causes (see e.g., Davidson, 1994; Frijda, 1994), which means that designing for mood involves different opportunities and challenges than designing for emotion. In this paper I propose two reasons why a theory of mood can be a valuable resource: It can help when resolving some of the conceptual ambiguity in the domain of experience design, and it enables us to identify new opportunities to influence mood through design.

Aim and Structure of the Manuscript

The main objective of this manuscript is to introduce a theory-based approach to design for mood regulation. This approach is detailed in a set of twenty design opportunities grouped into three main focal categories: seeking relief, restoring balance, and building resilience. The manuscript consists of three separate but related parts. The twenty design opportunities are presented and discussed in the third part of the paper. To provide a theoretical basis, the second part reports a functional explanation of the mood phenomenon that addresses four basic questions: How can mood be described, what is the function of mood, what are the manifestations of mood, and how does mood differ from emotion? The first part serves as a general introduction by providing an overview of the diversity to be found in current mood-related design research initiatives. This overview shows four basic topics that are currently receiving attention: measuring, expressing, adapting to, and influencing mood, respectively. Together, the present work aims to propel design a step closer toward the development of solid research and methods in the domain of design for mood regulation.

Overview of Mood-Focused Design Research

Mood has been explored in a variety of design disciplines, including product design, fashion, architecture, graphic design, service design, and interactive technology. The domain is broad, and its focus ranges from raising users' mood awareness, to enabling mood expressions, to developing mood-influencing tools. Without claiming to be all-comprehensive, the following section aims to provide a general overview of the variety of mood research in the domain of (interaction) design (see Appendix 1 for the review procedure). The overview is structured in four basic areas of exploration: (1) measuring mood in real-time, (2) expressing mood, (3) adapting to mood, and (4) influencing mood[6]. These areas are not mutually exclusive, and many of the initiatives discussed fit in combinations of two or more.

Technology that Measures User Mood

Mood can be measured using a wide variety of devices and systems. The domain of real-time mood measurement is extremely dynamic, and given the scope of this paper it is not possible to provide a complete overview of current initiatives. Instead, this review attempts to encompass the diversity to be found among such initiatives (for comprehensive reviews, see e.g., Calvo & D'Mello, 2010; Ryan, 2014; Lin, 2011). Mood-measurement technology can be categorized into four broad categories[7]: mood assessment via (A) wearable sensors, (B) natural-contact sensors, (C) non-contact sensors, and (D) self-expression.

(A) Mood Assessment with Wearable Sensors

Mood can be measured with the use of wearable devices that measure physiological signals such as heart rate, skin conductance and temperature, and respiratory rate. These devices, sometimes called "affective wearables" (Picard & Healey, 1997), come in a wide variety of forms, including (finger or ear) rings, wristwatches, arm bands, and gloves. An early example is the glove-like device *Galvactivator*, which measures arousal through skin conductivity (Picard & Scheirer, 2001). A more recent evolution in this technology is the development of "sensorized garments", which are regular clothes like jackets, t-shirts and underwear with integrated sensors (see Seoane et al., 2013, 2014, for research exploration; see Nuubo, 2011, for a commercial product). In recent years, the Quantified Self movement has prompted the emergence of a range of wearable, gadget-like

devices to satisfy the needs of a growing audience. Although most Quantified Self devices currently measure activity and physical fitness (using accelerometers and altimeters), newer versions are being introduced that also aim to measure mood. An example is the W/M wristband, purported to measure the four basic mood states: passive, excitable, pessimistic, and anxious (Phyode, n.d.).

(B) Mood Assessment with Natural-Contact Sensors

Slightly more sophisticated than affective wearables are the so-called *natural-contact sensors*, which are integrated into surfaces that users come into contact with during typical user-product interaction. Instead of requiring the user to wear sensors, the product wears the sensors in on its body or surface (Lin, 2011). The non-intrusive nature of these technologies is an advantage that leads to more natural human-product interaction. Several researchers have experimented with 'emotional mice' that use sensors to measure physiological signals, and thereby infer the affective state of computer users from the data they gather (cf. Ji, 2007; Lin, 2011; Sun, Paredes, & Canny, 2014). Another application of sensor technology is the *Smart Wheel*, a car steering wheel that measures affect while driving (Cai & Ling, 2007; Lin, Leng, Yang, & Cai, 2007). In these examples, the sensors measure physiological signals such as heart rate, skin conductance and temperature, and respiratory rate. An alternative approach is to infer mood from user behaviours. An example is a chair that captures body posture and movement data to determine user mood (D'Mello & Graesser, 2009; see also Mota & Picard, 2003). Hernandez and colleagues (2014) developed a keyboard capable of detecting states of user stress and relaxation, Alonso and colleagues (2008) developed a pen that can detect nervousness from hand gestures, while Sun and colleagues (2014) studied how mouse movements can be used to measure stress. This kind of technology has also been recently integrated into mobile communications devices. LiKamWa and colleagues (2013), for example, introduced *MoodScope*: a smartphone application that infers user mood from usage behaviour.

(C) Mood Assessment with Non-Contact Sensors

Mood can also be measured using devices that do not require physical contact between the human body and a sensor. These systems are primarily visual- or audio-based, interpreting signals such as facial and voice expression, body posture, pupil diameter, and eyelid closure patterns (for a more extensive review, see Bailenson et al., 2008; Zeng, Pantic, Roisman, & Huang, 2009). Interestingly, several studies have indicated that trained observers can ascertain mood from the body postures of subjects video-recorded in a natural setting (cf. Thrasher, van der Zwaag, Bianchi-Berthouze, & Westerink, 2011). Recently, researchers have begun to develop algorithms that can replace such expert observation. There has been noteworthy progress in this area, resulting in the introduction of several automated face analysis (AFA) systems that code facial expressions (for a recent discussion on AFA, see Cohn et al., 2014). Examples are the *computer expression recognition toolbox* (Littlewort et al., 2011) and the *FaceReader* (see Terzis, 2011). However, any opportunity for mood measurement is limited, because unlike emotions (such as fear, anger, or disgust), moods do not own their own unique facial expression (Ekman, 1994). Moreover, most systems require posed facial expressions in a neutral setting, and are not reliable when used in natural settings.

(D) Mood Assessment through Self-Expression

The fourth category represents technology that enables people to express their momentary mood state. Wensveen and colleagues (2002) developed an alarm clock that allows users to convey how they feel about their wake-up time. Another example is the text messaging service *eMoto* developed by Fagerberg and colleagues (2003, 2004). Shaking or swinging this device enables users to adjust the visual appearance of their text message to convey their affective state. One example of a commercial application is the *MoodPad* developed for hotel guests by Philips (2008). With this so-called ambient controller, guests can personalise lighting, temperature, curtain and soundtrack settings according to their mood. What sets this controller apart from regular remote controls is that users can also select a pre-configured mood (such as 'romantic') rather than adjusting the room settings individually. Apart from these devices, a host of online applications that enable users to manually track their mood, such as *Moody-Me*, *MyMoodTracker*, *MoodChart*, and many more, are now widely available.

Technology that Expresses User Mood

Interactive technology can be used to create all kinds of expressive mood manifestations. Perhaps the most direct way is via mood-expressive clothing, which can enable an intimate form of self-expression (for an overview, see Uğur, 2013). Stead and colleagues (2004), for example, developed an *emotional wardrobe*, including garments that express the affective state of the user, and Stylios and Yang (2013) presented a collection of clothes that change colour to correspond with user mood, which they coined *MoodWear*.

Beyond transmission, some researchers have explored additional purposes for technology-assisted mood expression. One approach is to support personal mood management. An example developed by MacLean and colleagues (2013, Figure 1) is *Mood Wings*, a robotic butterfly attached to a wristband. The wings beat at different rates depending on wearers' mood state, which encourages personal mood awareness. Besides monitoring transitory mood, technology can also be used to provide more long-term mood awareness. An example is *AffectAura*, a system that allows users to reflect on their mood states over long periods of time (McDuff, Karlson, Kapoor, Roseway, & Czerwinski, 2012). The system measures mood continuously, and an interface communicates these mood developments, which encourages users to reflect on their long-term mood memory. Likewise, many of the available mood tracking apps (like Moody-Me and MoodChart, see above) visually render mood data to buoy users' efforts to manage their personal mood.

A second potential purpose for technology-assisted mood expression is to support effective social interaction. El Kaliouby and colleagues (2006a) describe the development of social-emotional prosthetics, devices that aim to enhance users' social-emotional intelligence skills. Primarily developed for people with autism, these systems help users to interpret the mood states of people they interact with (see El Kaliouby, Teeters, & Picard, 2006b, for an overview). Sánchez and colleagues (2005) developed a mood-oriented instant messaging interface that provides a visual mood representation. This interface enables users to convey their long-term mood by supplying emoticons that are suited to persistent states. Fessl and colleagues (2012) developed *MoodMap*, an app that enables users to track their own mood and the moods of their team members during virtual meetings. Their study indicated that the resulting mood-awareness enhances interpersonal communication. A final example is *MobiMood*, a mobile social application that enables friends to share their moods with each other (Church, Hoggan, & Oliver, 2010). Their study indicated that mood sharing and mood awareness appear to be effective springboards for conversations and increased communication among users.

Technology that Adapts to User Mood

When mood is measured in real-time, the resulting data can be used to responsively adapt digital interfaces and environments to match a user's mood. An example is a smartphone music player that tailors the playlist to suit users' moods by analysing their facial expressions (U.S. Patent No. 8094891B2, 2012). In the domain of interactive architecture, "affective architecture" explores how the built environment can be programmed to respond to inhabitants' moods by changing shape, colour, temperature, humidity and other features (Bonnemaison & Yates, 2011; Gross & Green, 2012; Negroponte, 1975; Oosterhuis, 2005). Several authors have explored how the environment can respond to human mood through implicit feedback from an occupant, for example by taking data from the human body. Carneiro et al. (2013) explored how workspaces that are aware of their user's mood state can be developed, and how such spaces could continuously and dynamically adapt environmental conditions to reflect these moods. The aim of these authors is to create more harmonious working environments, with effects on interpersonal relationships, productivity, quality of work and health. Along similar lines, the Philips *MoodPad* (Philips, 2008; see above) enables hotel guests to optimise the fit between room ambience and mood, while Mennicken and colleagues (2014) developed the *EmotoCouch*, a couch prototype that was conceived to explore how furniture can express moods through colour and light. Davis and colleagues (2013) developed the *Textile Mirror*, a wall panel that aims to reflect occupants' affective states by mapping mood to textile panels that shift in real-time (occupants track their moods via a mobile application).

Technology that Influences User Mood

From environments that adapt to user mood, it is a small step to further explore how ambient interiors can influence user mood. Kuijster and colleagues (2012) explored how a combination of functional and atmospheric lighting can improve the moods of elderly people. Baños and colleagues (2006, 2012) demonstrated that virtual environments could be used to induce positive moods with the aim of enhancing elderly well-being. The *Textile Mirror* described above (Davis, Roseway, Carroll, & Czerwinski, 2013) was developed to enable users to modify their mood state by transforming the feel of the fabric. A more inclusive design is *GRIP*, a smart ambient space designed to actively influence the mood of office workers (Van de Garde, 2014; see Figure 1). This environment reacts to human presence by configuring a personal space of varying size, soundscape and brightness, and stimulating paced breathing and meditation, which helps employees who are in a bad mood to recover and regulate their mood.

The potential to influence mood by means of ambient environments has not only been explored in architecture, but also in the domain of mobility design. Ho & Spence (2013), for example, studied how responsive interior car design can influence the mood of car drivers. Likewise, interactive products can adjust their interaction style to influence mood. The "intelligent pen" developed by Alonso and colleagues (2008) and described above influences user mood by shifting its weight distribution. In health care, a new category of product development is currently underway that focuses on patient mood management. These social robots, or "care robots", actively aim to improve patient mood.[8] One of the most prominent products in this domain is *Paro*, a therapeutic robot modelled after a baby harp seal (NIAIST; National Institute of Advanced Industrial Science and Technology, n.d.; see Figure 1). *Paro* was designed to have a calming effect, and nurture a positive mood in hospital and nursing home patients, similar to animal-assisted therapy (Wada et al., 2004; Wada & Shibata, 2007). A variety of similar therapeutic social robots are available, and more are being introduced every year. Examples are the interactive bear by Fujitsu Robotics (Robotsnu, n.d.) and the robotic cat *JustoCat* (Robyn Robotics, n.d.).

Summary and Discussion

The domain of mood-focussed design research is both diverse and robust. Researchers are inspired by potential design applications that include therapy (e.g., affective prosthetics), self-development (mood tracking apps), communication, work efficiency, entertainment, artistic expression, comfort and general well-being. Many initiatives utilize some form of mood measurement, either via sensors that measure (psycho-) physiological signals or behavioural expressions (e.g., hand movement with mouse or pen, body movement with chair), or through some kind of self-reporting. Most of the devices measure basic dimensions of mood (like pleasure and arousal) rather than discrete mood states (like grumpiness and cheerfulness). Likewise, most measure the basic dimension of physiological arousal. In some cases, the dimension of arousal is augmented with a second dimension, which can be hedonic tone, dominance, or engagement. When self-report is used, it is recorded using a single bi-polar scale (bad mood–good mood), and in some cases it is possible to select one or more discrete mood labels from a predefined set. Once mood has been measured, the next step is to translate the data into some kind of designed expression. In most

cases, this designed expression is ambiguous, or left open for interpretation by the user. Decisions about how these expressions might represent mood states are mostly based on aesthetic considerations. The most oft-used expression is coloured light (e.g., mood-ware; *EmoCouch*), although some other examples exist, like responsive surface texture (e.g., *Textile Mirror*) or object behaviour (e.g., *Mood Wings*). These design-mediated mood expressions can enable self-expression, support social interactions, and support mood-management. A second category of initiatives includes mood-focussed technology that does not rely on mood measurement, like *Paro* or the *Adaptive Relaxation Space* shown in Figure 1. Usage can be initiated by the user (i.e., the user wants to regulate his or her mood) or by some other party (i.e., the user may not be aware that mood-influencing technology has been introduced).

Most of the reviewed work that explored the mood-influencing possibilities of design does not report underlying hypotheses surrounding the kind of design features or qualities that might affect mood in a particular way. This limited theoretical substantiation has several unwanted consequences. Firstly, by building on intuitive assumptions about the causes of mood, only a limited repertoire of strategies to influence mood has been explored. Secondly, not all of the explored strategies may be effective because many of the underlying intuitive assumptions have been shown to be unreliable (see introduction for an overview). Thirdly, the lack of precision has created conceptual confusion by enabling design researchers to overlook important differences between causes and manifestations of emotions and moods. Because these three consequences hinder the progression of the field, the next two parts of the manuscript introduce a basic mood theory and a set of theory-based design opportunities.

Understanding Mood

Mood is a diffuse and general feeling state that provides the affective colouring for all day-to-day events (Morris, 1989). Unlike emotions, moods are not directed toward specific targets, but instead have a broad influence on one's perceptions, judgments, and behaviour (Kelley & Hoffman, 1997; Martin & Clore, 2013). This means that one's mood is not directed at anyone or anything in particular, but rather at the surroundings in general, or, in the words of Frijda (1994), at "the world as a whole" (p. 60). In other words, moods represent positive and negative frames of mind that subtly influence our responses to all the events we encounter: when 'in a mood', a person sees the world – and everything in it – as dim and grey, while when cheerful, the same person sees the world through rose-coloured glasses. Where emotions are usually elicited by an explicit cause (e.g., some event), moods have diffuse or combined causes. Consequently, we are usually unable to specify the cause of a particular mood (Ekman, 1994). Although limited in time, moods tend to have a relatively long-term character. One can be sad or cheerful for several hours, or even for several days (Beedie, Terry & Lane, 2005).

The second part of the paper provides a functional explanation of the mood phenomenon. To this end, four basic questions are addressed: how can mood be described? what is the function of mood? what are the manifestations of mood? and how does mood differ from emotion? The approach of this analysis was pragmatic: reviewing theory available in psychology and philosophy, and collecting those insights that enable a functional analysis of human mood in the context of design interventions. The analysis was mostly based on the functional view on mood developed by Morris (1992, 1998, 1999, 2000), complemented with insights from the work on the nature of the mood phenomenon (e.g., Lazarus, 1991; Parkinson, Totterdell, Briner, & Reynolds, 1996), the strategies that people employ to influence their own moods (e.g., Gross, 2007; Larsen, 2000), and techniques to regulate mood (e.g., Martin, 1990; Schneider, Gur, Gur, & Muenz, 1994).

Describing Moods

So far, we have not explicitly described moods. Naturally, the mood repertoire is far more nuanced than the basic *good-bad* distinction would have us believe: an individual can experience a range of moods that are perceived as good (e.g., cheerful, relaxed, elated) or bad (e.g., gloomy, grumpy, nervous). A common approach to capturing the breadth of this variety is to use basic dimensions that identify mood categories. In this tradition, Watson and Tellegen (1985) proposed a two-factor model of mood that employs both of the dimensions that consistently emerge in studies on the affective structure of moods, across languages and cultures (Watson & Clark, 1994; Watson, Clark & Tellegen, 1988): valence (pleasure–displeasure; representing the good/bad distinction) and arousal (high energy–low energy). Together, they combine to form four basic mood categories, as depicted in Figure 2. These four categories have been shown to account for roughly one-half to three-quarters of the common variance in mood terms (Watson, 1988): energized–unpleasant, energised–pleasant, calm–unpleasant, and calm–pleasant.

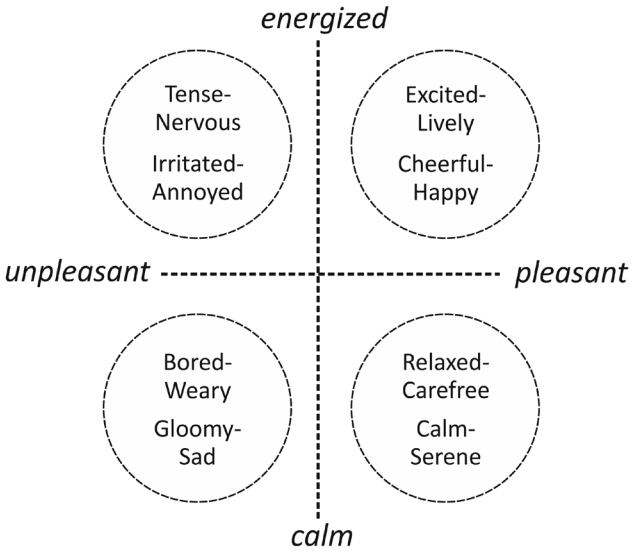

Figure 2. Eight basic mood types (Desmet et al., 2012) i**n four mood categories** (Watson and Tellegen, 1985)**.**

Each category represents a variety of distinguishable mood types (Watson & Tellegen, 1985). Calm-unpleasant, for example, represents mood types such as feeling bored, dejected, depressed, weary, fatigued, gloomy, inert, miserable, and sad (Lorr & McNair, 1988; Lorr, McNair & Fisher, 1982; Russell 1980; Watson & Clarck, 1994). Desmet, Vastenburg, van Bel, & Romero, (2012) assembled a set of eight basic mood types, two for each category (see Figure 2). This set, representing the main mood differentiations found in the typologies of nine mood theorists, aims to balance fine-grained distinctions with a more comprehensive overview: it is concise, yet adds nuance to the four basic categories.[9] While it does not capture every nuance, this set of eight mood states does embody the general variety of human moods.

Mood Functionality

The explanation of mood set forth here is based on the proposition that moods are functional. They are *evolved psychological mechanisms* that accomplish particular objectives to protect and increase our well-being (as proposed in evolutionary psychology; see Buss, 1995).[10] The essence of this view is that mood is best considered a monitoring system that enables us to maintain a healthy balance between the availability of our personal resources and the perceived demands of everyday life. More specifically, moods serve as a cue that signals the degree to which these resources are sufficient to meet the current level of demands (Morris, 1992). A positive mood signals a *surplus of resources* that inspires us to actively seek out new challenges (e.g., help a friend, start a project, try a new recipe). A negative mood signals a *shortage of resources* that prompts us to withdraw from ongoing challenges (e.g., stay at home, cancel a weekend trip, avoid demanding colleagues). This means that the mood system helps us to maintain homeostatic balance between our perceived resources and environmental demands (which require resource investments), promoting conservation when resources are low and expenditure when they are high. This balance is visualised in Figure 3.

Figure 3 illustrates that we are constantly experiencing some kind of mood, and that the valence and intensity of our moods is determined by the dynamic disparity between resources and demands. In a good mood, attaining most goals seems possible and challenges seem surmountable, while a bad mood seems to take the wind out of our sails.

Mood thus operates as a cue in a self-regulatory system that controls goal-directed behaviour. The underlying idea is that readiness to engage in a potentially taxing, goal-directed activity is generally advantageous for our well-being. Investing our personal resources by seeking out challenges will enable us to flourish through the (incremental) attainment of those goals. Positive moods thus stimulate us to invest our resources (Figure 3, right). However, our resources are limited, and we need to ensure that we do not face more demands than we can cope with. Negative moods prompt us to withdraw from challenging situations in order to conserve and replenish our resources (Figure 3, left). We have various kinds of resources, the most fundamental being physical energy (Thayer, Newman, & McClain, 1994). Other kinds of resources are social, intellectual, material and financial. Similar to our physical energy, these resources are not fixed, but influenced by internal and environmental factors (Morris, 1992).

Manifestations of Mood

The balance in Figure 3 indicates that mood is not predicted by resource level in itself, but by the disparity between the resources available and the perceived demands (Morris, 1992). In order to maintain a homeostatic balance, the mood system influences how one feels, thinks, and behaves. The self-correcting system acts to regain control once the defended threshold value that is passed. Overall, negative moods discourage active involvement in the pursuit of environmental goals (i.e., low willingness to engage), nudging us to sit and think, be alone, and take naps. Conversely, positive moods encourage investment in enthusiastic, outwardly directed action (i.e., high willingness to engage), spurring us to engage in social, strenuous and leisure activities (Cunningham,

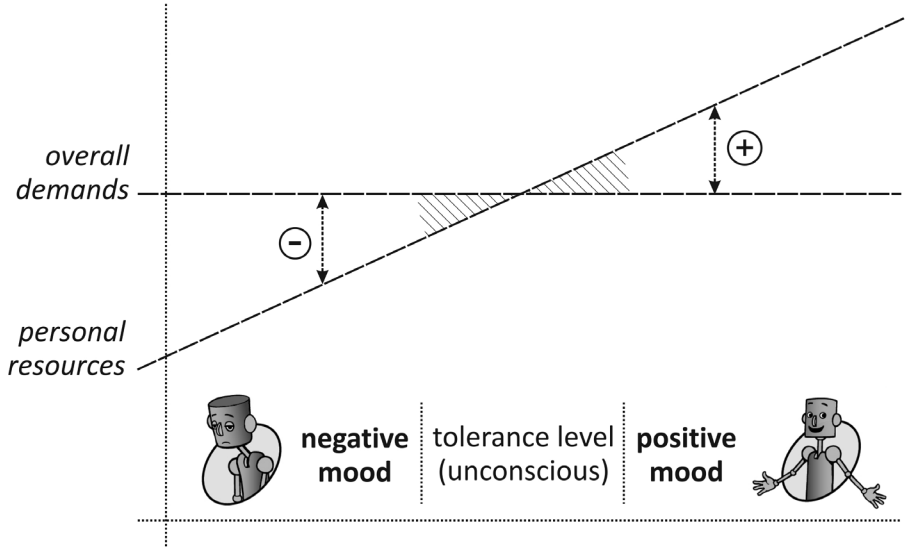

Figure 3. Mood homeostasis (robot cartoons excerpted from Desmet et al., 2012).

1988). Numerous effects of mood on thought and behaviour have been shown (for reviews, see Hunsinger, Isbell, & Clore, 2012; Martin & Clore, 2013). For example, in a good mood, people are more outgoing, friendly and outward-focussed, scanning the environment to identify opportunities (Morris, 1992). They have stronger motivation and sense of control, and, related to this, they take more risks and have higher expectations for success. They are generally more optimistic in their evaluations and judgements. Isen et al. (1978) also found that in a good mood, people rate the performance of their cars and television sets higher than when they are in a neutral or bad mood. Finally, in a good mood, people are more creative, better at problem solving, and make faster decisions (Parkinson et al., 1996).

Moods versus Emotions

The words 'mood' and 'emotion' are regularly used interchangeably, both in everyday language and in (design) research. They do, however, refer to different, specific experiential phenomena. Even though they both represent affective systems, they differ in terms of eliciting conditions and experiential and behavioural manifestations. In design and emotion research, it can therefore be advantageous to distinguish between them. Table 1 summarizes their similarities and differences.

Mood and emotion are both monitoring systems that serve related (but different) functions in protecting and increasing our well-being. They have evolved in order to signal when *things are wrong for us* (negative feeling) or when *things are right for us* (positive feeling) (Schwarz & Clore, 2003). The key difference is that mood has an internal focus (monitoring the internal state), whereas emotion has an external focus (monitoring the environment) (Morris, 1989). Emotions are evoked through events are construed as threats (negative emotion) or opportunities (positive emotion). Because these events require our immediate attention, the emotion interrupts ongoing thought and behaviour with emotion-specific *action tendencies* (e.g., to withdraw, attack, approach, examine, etc.) that aim to neutralize the threat or capitalize on the opportunity (Frijda, 1996). Compare this with moods, which influence rather than interrupt our ongoing thought and behaviour (Davidson, 1994): A good mood increases, and a bad mood decreases our general *willingness to engage* in all of our ongoing undertakings. As an example, take the activity of chairing a project team meeting. Compared to a chair who is in a good mood, one who is in a bad mood might be less patient towards the team members, less proactive in suggesting new plans, or not as keen on accepting follow-up tasks. In sum, negative emotions empower us to neutralize immediate threats, and positive emotions empower us to act upon immediate opportunities. Conversely, negative moods stimulate us to preserve personal resources by avoiding demanding situations, and positive moods stimulate us to invest personal resources by exploring and seeking out new opportunities.

Design for Mood Regulation

Mood theory provides us with a simple, yet crucial insight for design: mood is not a response to external stimuli. Whereas emotions are direct responses to external events, mood is a diffuse experience of the balance between one's overall personal resources and one's life challenges. This insight predicts that design interventions (like changing room colour or ambiance) do not have a direct impact on mood, which explains why studies that investigate the impact of environmental manipulations on mood generally fail to find the predicted effects (see introduction). This does not mean, however, that design cannot influence mood. The mood regulation literature tells us that people influence their mood with all kinds of intentional activities, and I propose that design can have an indirect influence on mood by deliberately supporting these mood-regulating activities. To this end, the third part of this paper introduces twenty regular mood-regulation strategies, and proposes how these strategies can be used to inspire mood-regulation design.

Mood Regulation

People often attempt to influence their mood: When they are in a bad mood, they try to get themselves out of it, and when they are in a good mood, they try to prolong it (Thayer, Newman, &

Table 1. Emotion versus mood.

Emotion	*Mood*
Affective phenomenon that: • Has a short duration (seconds, minutes) • Has a rapid onset and is episodic • Has a strong intensity • Interrupts thought and behaviour • Is specific and targeted • Has a single identifiable cause	Affective phenomenon that: • Has a long duration (hours, days) • Has a gradual onset and is continuous • Has a weak intensity • Influences thought and behaviour • Is global and diffuse • Does not have a single identifiable cause
External focus: Signals states of the world	Internal focus: Signals states of the self
Monitors perceived threats and opportunities: - Negative emotions signal threats - Positive emotions signal opportunities	Monitors available personal resources: - Negative moods signal resource shortage - Positive moods signal resource excess
Points of reference are personal goals, needs, motives, norms, and values	Points of reference are the demands posed by the environment
Stimulates a focussed adaptive response to the immediate threat or opportunity	Increases or decreases one's general willingness to engage (seek out or avoid demanding situations)

McClain, 1994). In these attempts, they make use of a wide range of *mood-regulation strategies* (Morris & Reilly, 1987), actions that can be both behavioural (e.g., sporting activity) or mental (e.g., thinking about pleasant memories). Note that mood management is so integrated into our daily activities and habits that we often regulate our moods without being aware of doing so (Parkinson et al., 1996). Someone who is in a bad mood may, for example, call a friend, take a walk or look at family pictures, without forming the conscious intention to relieve their negative state. The diversity of mood-regulation strategies is vast, ranging between drinking alcohol, listening to music, meditating, repressing the mood and seeking help. To provide an overview, Table 2 groups a broad range of activities into 20 basic mood regulation strategies. The activities and strategies have been drawn from the work on mood regulation by Koole (2009), Morris (2000), Morris and Reilly (1987), Gross (1998, 2011, 2013), and Thayer et al., (1994). First, a long list of 83 activities (third column in Table 2) was assembled from these publications. Next, the author and an experience design researcher clustered these activities into 20 main strategies, and sorted these into three categories[11], each of which represents a specific mood-regulation focus: (A) finding relief, (B) restoring balance, and (C) building resilience.

Mood-regulation strategies with a relief-focus (category A) aim to alleviate the unpleasant feeling associated with a bad mood. The primary purpose of these strategies is to feel better, regardless of what caused the bad mood. They include physical activities like taking a shower or going shopping, and mental activities like thinking about pleasurable memories or trying to trivialize the bad feeling. Strategies with a balance-focus (category B) aim to correct the imbalance between one's available resources and the demands that require spending these resources. Instead of merely alleviating the bad feeling, these strategies aim to *resolve* the bad mood by reducing the underlying causes. These are actions that either increase one's personal resources (e.g., going to bed early, and asking for help) or reduce the environmental demands (e.g., reducing workload, and lowering expectations). The third category (category C) includes mood-regulation strategies that employ the bad mood as a means for personal development. Rather than trying to reduce the causes of the mood or the associated negativity, these strategies aim to transform the bad mood into something constructive. These actions are more reflective and holistic than those in the first two categories, with a focus on mood resilience and long-term well-being (see Koole, 2009 for a discussion).

Note that mood-regulating activities can function on different levels, depending on the underlying motivation. Talking to a friend, for example, can be a pleasant distraction from a bad mood (relief-focus), but it can also initiate social support (balance-focus). The conversation can have a reflective nature, helping the person to learn from his or her bad mood (resilience-focus). Moreover, some activities that people typically

Table 2. Twenty activity-based mood regulation strategies in three categories.

Focus	*Strategy*	*Example Activities*
Seek RELIEF	Seek distraction	Stay busy; concentrate on other things (like work or chores); daydream to forget troubled feelings; watch television; help others.
	Self-reward	Engage in hobby or any other pleasurable activity (e.g., go shopping, have sex, listen to music, socialize, or eat candy).
	Vent	Let off steam; express the feeling; tell people about the feeling; write about the feeling.
	Repress	Supress the feeling; inhibit the expression; active forgetting; use tranquillizers, alcohol, or drugs; act happy.
	Think positively	Think about happy things; look on the bright side; focus attention on successes in other areas of life; think about an anticipated pleasurable future event.
	Trivialize	Play down the bad feeling ("it is not as bad as it seems"); downward social comparison ("there is always someone else who is worse off"); use humour.
	Seek relaxation	Use relaxation techniques; use stress management activities; stretch; breath control exercises.
	Seek refreshment	Take shower; splash water on face; go outside and get some fresh air.
Restore BALANCE	Reduce demands	Reduce workload; walk away from, abandon, cancel or postpone activities, situations, or responsibilities; lower aspiration levels.
	Avoid new demands	Make resolutions to avoid future demands; avoid demanding situations, responsibilities or activities; turn down requests.
	Withdraw	Try to be alone; not talk to people; avoid eye contact; put out phone; avoid stimulation; close curtains; stay home.
	Eliminate energy drainers	Eliminate stimuli that cost energy, such as noises, bad smells, bright lights, and playing radios.
	Rest	Take a break; close eyes; nap; go to bed early.
	Energise	Exercise; eat something; drink coffee or caffeinated beverage.
	Seek social support	Ask for help; look for advice or guidance; pray for help.
Build RESILIENCE	Rationalize	Put feelings in perspective; treat mood in the abstract, as a piece of information; try to understand the feeling;
	Analyse	Analyse situation to determine mood causes; keep a diary to track mood; use biofeedback systems.
	Transform Creatively	Expressive writing about the mood; using the mood as the basis for creative expression.
	Embrace	Allow the bad feeling; accept or appreciate the mood.
	Detach	Distinguish between the self and the mood; meditate; engage in mindfulness; engage in spiritual or religious activity.

engage in to improve their mood operate on more than one level simultaneously. An example is yoga: Engaging in yoga exercises can help individuals to relax and alleviate bad feelings, restore their resource-demand balance, stimulate mood awareness and build mood resilience (Hartfiel, Havenhand, Khalsa, Clarke, & Krayer, 2011).

Design that Supports Mood Regulation

None of the 20 mood-regulating strategies necessarily rely on or require designed interventions. A person can, for example, vent her mood by shouting out loud during a walk on the beach. She can find a moment of self-reward by taking a stroll in the afternoon sun, reduce demands by cancelling a meeting, and increase her resources by taking a nap. At the same time, we use all kinds of products and services during their mood-regulating activities: the phone used to call a friend for help, the cup used to drink an energizing coffee, the digital calendar used to schedule a meeting, the pillow used to cry on, and even the iron, used to keep ourselves busy to distract us from our heart pains. It seems specious to label these products as mood-regulating, as their contribution to mood-regulation is peripheral. We can, however, also imagine products that have the deliberate intention to enable, support, and inspire people to engage in mood-regulating activities. In light of this potential, I propose that each of the 20 strategies can be a source of design inspiration. Figure 4 shows two examples.[12] The *Grumble Bubble* was designed to enable and stimulate venting (Strategy 3 in Table 2). The device is to be placed on the shore of the river flowing through a city centre. People can whisper, speak, or shout their burdens and complaints into a bright yellow trumpet. These burdens are then transformed into little bubbles that are washed away by the river's tide. The device invites people to seek some relief by venting their feelings. The Happiness Tree, which is placed in office environments, was designed to enable and stimulate office workers to engage in a brief moment of relaxation seeking (Strategy 7 in Table 2). The tree has two handles that are attached to ropes. By pulling the ropes, the user is guided into a yoga stretch pose and, at the end of the pose, rewarded with a warm yellow light and the sound of a bird chirping.

We can easily imagine how the strategies of venting and seeking relaxation can generate many more designs, depending on user group and context of use. An office lamp, for example, can help users calm their breathing by subtly mimicking a relaxed breathing rhythm (relaxation). Moreover, designs can be based on all other mood-regulation strategies. Examples could be a secret little drawer in the workspace desk that hides some candy (self-reward), a support button on the computer that, when pushed, momentarily displays images on screen of people that can be relied on (social support).

Besides their utility as inspiration for design, this collection of 20 regulation strategies can also be useful when categorising existing mood-regulation designs. Take, for example, the three products in Figure 1. *Paro*, the seal robot, is an example of a product that influences mood by providing a positive distraction (Strategy 1 in Table 2). The *Adaptive Relaxation Space* enables a moment of withdrawal (Strategy 11 in Table 2), and the *Mood Wings* enable people to rationalize their mood (Strategy 16 in Table 2). These examples illustrate that designs can differ in their focus: whereas the *Paro* robot offers some relief from a bad mood by alleviating a negative feeling (i.e., relief-focus), the *Adaptive Relaxation Space* helps people to restore their resource-challenge balance (i.e., balance-focus), and the *Mood Wings* enable users to increase their mood awareness (i.e., resilience-focus).

Nudging Toward Mood-Regulating Activities

It has been shown that the activities that can improve mood are the very same activities that are less likely to occur during bad moods (Morris & Reilly, 1987). It may be that the person in a bad mood

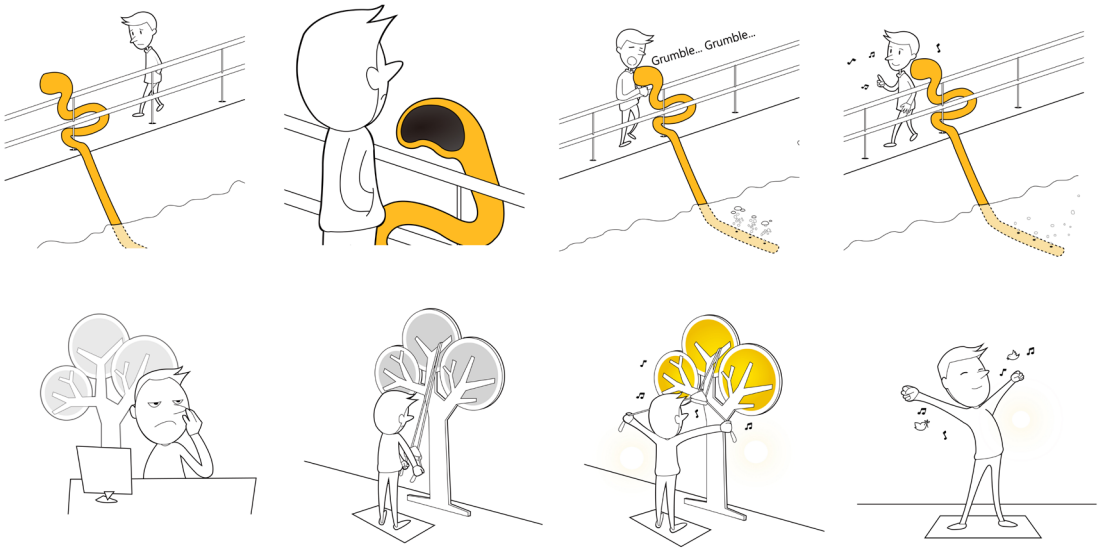

Figure 4. Two designs for mood regulation. (Top: *Grumble Bubble*, by Joep Deiman and Steffen de Jonge; Bottom: *Happiness Tree*, by Anne Jansen, Floris van der Marel, Lisa van Mastbergen, Po-Ying Chao, and Ties van Veelen)

does not feel like initiating such activities, because the reward seems less attainable or attractive than usual, or simply because the bad mood makes one too tired to put out the effort (Clark & Isen, 1982). Morris and Reilly (1987) propose that a supportive social network can contribute favourably to homeostatic balance, because friends or family may *force* us to engage in mood-regulating activities that we wouldn't do if left to our own devices. Perhaps products can serve a similar function: More than merely enabling mood-regulating activities, design can inspire and stimulate people to engage in these activities. For example, people may only come up with the idea to vent their frustrations, or even become aware that they have frustrations to vent, after encountering the Grumble Bubble. Likewise, the *Happiness Tree* does not only enable office workers momentary relief, having it in the office reminds office dwellers of the importance of short bouts of rest, and inspires the general incorporation of stress-relieving activities into daily work routines.

Not all 20 strategies are equally popular: People often favour strategies with a relief-focus over those with a balance- or resilience-focus (Thayer et al., 1994). It has been proposed that these strategies are more popular because they have an immediate effect on mood (Morris & Reilly, 1987). Unfortunately, they are also less effective than the other strategies, because even though they provide immediate mood relief, this relief is only temporary, as it does not address the cause of the bad mood (Parkinson et al., 1996). The strategies with a balance-focus provide a more structural mood improvement, and the strategies with a resilience-focus can enable people to enduringly increase overall mood balance (see Figure 3). It would be interesting to explore how design can elicit a balanced approach to improving moods by offering a layered form of mood regulation that includes all three foci. The *Adaptation Relaxation Space* in Figure 1 could be interpreted as an example of such a layered approach. People may be motivated to use the space because the enjoyable, colourful and dynamic ambiance offers a certain degree of positive distraction (strategy 1). At the same time, however, engaging with the space allows users to avoid new demands (strategy 10) a context for rest (strategy 13), and perhaps even a setting to practice mindfulness or meditation (strategy 20). A promising direction for additional design research is to explore how design interventions can offer such layered approaches to mood regulation, enabling both short term mood relief and longer-term mood repair and resilience.

General Discussion

The impact of designed interventions on mood is not as strong as is sometimes assumed because one's mood is not a direct response to an external stimulus. Instead, it is an expression of the overall balance between an individual's personal resources and the challenges that require these resources. Nonetheless, mood can be regulated by engaging in particular activities, and these activities suggest a multitude of design opportunities: design can enable, support, and inspire people to engage in the activities that have a positive impact on mood. In this paper, I have proposed a collection of 20 mood regulation activities, each a potential source of design inspiration. The collection may broaden the repertoire of mood-influencing design variables and support design researchers in developing a more explicit rationale for mood-focussed design intentions.

Increasing our understanding of how design can influence mood is relevant and timely, as the domain of mood-managing technology is rapidly expanding. Although many of the recent initiatives in mood-influencing technology are exploratory in nature, we are currently witnessing an accelerating translation from these academic explorations into commercially available products, services, and systems. The *Para* robot in Figure 1 is an example of a product that is now available to care institutions and individuals who are willing to make the investment. Numerous examples of commercial devices are currently available to followers of the Quantified Self movement that has been gathering momentum since 2007. The number of wearable devices sold is expected to grow to 485 million in 2018, and when this figure includes software apps, projected sales reach into the billions (ABI-Research, 2014).

Besides its business potential, mood-focussed design is also relevant as a means to contribute to human health and happiness. Mood is not only a key determinant of positive well-being (Morris, 1999), but also of ill-being. Indeed, a durable disturbance of mood (implicating both deficient positive and excessive negative mood) is found to be one the main underlying features of major clinical depression (see Gordijn et al., 1994; Lewinsohn & Amenson, 1978; Peeters, Berkhof, Delespaul, Rottenberg, & Nicolson, 2006; Rottenberg, 2005). Depression, and other mood "disorders", represent a group of diagnoses where a disturbance in the person's mood is the main underlying feature (American Psychiatric Association, 2013). The World Health Organization (2012) has reported that globally, more than 350 million people of all ages suffer from mood disorders, making mood-influenced ill-being the leading cause of disability worldwide, and a major contributor to the global burden of disease. Given the direct relationship between mood and both well- and ill-being, products, environments, and services that support appropriate moods should be considered a necessity rather than a luxury.

Additional research is required to explore how the 20 opportunities can be utilized in design activities. Even though all 20 activities in Table 2 might offer design inspiration, not all of them are free of risk of harm. For example, some of the things people do to improve their mood may be momentarily effective, but cause greater (mood) problems in the long run (Thayer, 2001); two obvious examples are drinking alcohol and using drugs (strategy 4), which have been shown to be potentially harmful (e.g., Parkinson, 1996). Likewise, the other strategies should be used with care. Waking away from responsibilities (strategy 9), for example, may be effective on the short term, but if carried out irresponsibly, purposeful relinquishment of responsibility can generate harmful effects, not only for the individual but also for others (imagine flight controllers deciding to close their eyes for a couple of minutes to reenergize). Design explorations should take such considerations into account when creating ideas that are not only effective but also responsible, realistic and appropriate. Related to this, additional ethical issues in design

for mood also require further attention. For example, design that wilfully influences mood should find the right balance between determination and freedom (see Dorrestijn & Verbeek, 2013).

At least two additional opportunities for future research can be identified. The first is to study how a negative impact of design on mood can be prevented. There is an exception to the rule that external stimuli do not directly influence mood. This concerns *energy drainers*, such as noise, inappropriate lighting, or other causes of discomfort. These external conditions have a direct impact on mood because they attack and drain our personal resources (see Bluyssen, Aries, & van Dommelen, 2011). Obviously, environments should be designed with the intention of minimising such energy drainers (see strategy 12). It is not clear, however, if the opposite also applies: future research can explore whether and how environments might be designed to improve mood by offering *energy replenishment*.

The second is to explore the motivations that people have for regulating their moods. Mood regulation does not always aim to change mood, but may instead aim to maintain a mood (Parkinson et al., 1996). Depending on the circumstances, we may try to keep ourselves in a good, neutral, or bad mood (Tice & Bratslavsky, 2000). Although the most common motive for mood regulation is to get out of bad moods, good moods may even occasionally be intentionally transformed into bad ones (e.g., Parrott, 1993). In situations in which good moods are deemed inappropriate or disadvantageous (e.g., as a result of social norms, such as during funerals) people may deliberately try to put themselves in what could otherwise be construed as a bad mood (see Morris & Reilly, 1987). Likewise, in certain situations, a neutral mood might be preferred over a positive mood, for example when people have to interact with a stranger (Erber, Wegner, & Therriault, 1996). These alternative motives for mood regulation can offer new directions for design research. Eventually, increasing our understanding of how design can support mood-regulating activities, both in the short term by offering relief, and in the long-term by supporting mood repair and mood resilience, can contribute to the body of knowledge on positive design (see Desmet & Pohlmeyer, 2013), supporting designers in their attempts to design for human flourishing.

Acknowledgements

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Endnotes

1. The popular notion regarding the soothing effect of pink persists even today. A recent example is a Swiss prison that, in 2013, painted 30 prison cells pink. In an interview, a police spokesman stated, “It really seems to work. They quieten down and go to sleep much more quickly in a pink room” (Spottiswoode, 2013).
2. This definition is based on the work of Clark and Isen (1982), and has been formulated to align with the functional view of the mood phenomenon as developed by Morris (1992, 1998, 1999, 2000) and Parkinson and colleagues (1996).
3. Many researchers use descriptive theory (e.g., core affect, or the circumplex model of affect) to describe the mood phenomenon, but only a few make use of theory that explains the causes and effects of mood, or the conditions that influence mood.
4. With respect to the pink prison example: recent research has invalidated the results of the original pink-prison study, exposing the presumed soothing effect of pink cells as an urban myth (for a discussion see O’Connor, 2011).
5. O’Connor (2011) proposed that the findings of such studies are limited, because they aim to isolate the effect of a single type of stimulus (like colour) from what is actually a complex and subjective phenomenon.
6. This categorization compares to the one of Spillers (2010), who proposed three categories: Products that offer detection, indication, and inducement of moods.
7. The distinction between wearable and natural-contact sensors was introduced by Lin (2011).
8. Numerous studies have explored how the mood of humanoid robots and virtual agents can be expressed dynamically by facial expression, gestures, and body postures. Some initiatives have focused on how mood can be expressed with facial expressions, whereas others have focused on (or included) bodily expression (for an overview, see Xu et al., 2014). Examples of the former are explorations performed using the robot head *Kismet* (Breazeal, 2002), the humanoid robot head ROMAN (Hirth et al., 2011), and the desktop robot *iCat* (Bartneck et al., 2004). Examples of the latter are explorations performed using the NAO robot developed by Alderbaran Robotics (Haring, et al., 2011), the KOBIAN robot (Zecca et al., 2009), and the Honda humanoid robot (see Salem et al., 2012).
9. Mood typologies have been included that were reported by Watson & Clark (1994), Lorr & McNair (1988), Lorr, McNair & Fisher (1982), Russell (1980), and Matthews, Jones & Chamberlain (1990). Note that even though negative moods show more differentiation than positive moods, it was decided to include an equal number of positive and negative moods to allow for a balanced instrument (for a discussion on balance in affect scales, see Desmet, 2002).
10. Vincent Nowlis and Helen Nowlis (1956) were among the first to introduce the functional view of the mood phenomenon, and this view was later developed by William Morris (1989, 1992, 1999, 2000). More recently, the functional perspective of mood is represented in the domain of positive psychology (cf. Cummins, 2010).
11. These three categories are loosely based on the three functions of emotion regulation proposed by Koole (2009).

12. Both designs were created by students of the Faculty of Design Engineering of Delft University of Technology.

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Appendix 1: *Sources for review of mood-focused design research*

The overview in Part 1 of this paper was created by reviewing papers published the last ten years in nineteen journals and proceedings of twenty conferences (see below). From these sources, papers were reviewed with the word mood or emotion in the title and/or abstract. In addition, relevant references in these papers were collected and reviewed. Because the words *emotion* and *mood* are often used interchangeably, sometimes authors report focusing on moods while actually focusing on emotions, and vice versa. For this reason, the review comprises those initiatives that fit with the mood definition provided in the introduction, independent of what words the cited authors have used. Manuscripts that contributed to the topic of mood in relation to design or technology were selected, which resulted in an overview of more than 150 relevant manuscripts.

Design Research Conferences

ACM Conference on Human Factors in Computing Systems; ACM International Joint Conference on Pervasive and Ubiquitous Computing; CHI; Conference on Designing Interactive Systems; DPPI; Design Research Society Conference; IASDR; IEEE Computer Society Conference on Computer Vision and Pattern Recognition; IEEE International Conference on Automatic Face & Gesture Recognition; IEEE International Symposium on Robot and Human Interactive Communication; International Conference on Autonomous Agents and Multi-Agent Systems; International Conference on Design & Emotion; International Conference on Entertainment and Media in the Ubiquitous Era; International Conference on Mobile and Ubiquitous Multimedia; International Conference on Mobile systems, Applications, and Services; International Conference on Pervasive Technologies Related to Assistive Environments; International Conference on Tangible, Embedded and Embodied Interaction; International Workshop on Wearable and Implantable Body Sensor Network; Latin American Conference on Human-Computer Interaction; Nordic Conference on Human-Computer Interaction; SAE World Congress; SIGCHI Conference on Human Factors in Computing Systems.

Design Research Journals

Advances in Science and Technology; Affective computing and intelligent interaction; Applied Artificial Intelligence; Applied Ergonomics; Design Issues; Design Studies; IEEE Transactions on Pattern Analysis and Machine Intelligence; IEEE Transactions on Robotics; Intelligent Buildings International; Interacting with Computers; Interactions; International Journal of Design; International Journal of Human-Computer Studies; International Journal on Social Robotics; Journal of Design Research; Personal and Ubiquitous Computing; Personal Technologies; Sensors; The Design Journal.