



Odor emoticon: An olfactory application that conveys emotions [☆]



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ABSTRACT

Olfaction is an associative and emotional sense. The brain processes odors together with internal states, and odor-related memories contain strong emotional contents. This study focuses on people's emotional interpretations of odors, and proposes an olfactory application that uses odors as emoticons to convey emotions. This application offers an olfactory route for emotion communication, which can enhance communication experiences. Nine odor emoticons were designed, and validated through experiments. The effects of odor emoticons were also examined. A prototype system—Olfaction—that emits odor emoticons was developed and applied in two contexts: online text chatting and voicemail receiving. Results suggested that odor emoticons induced more chatting, were easy to use, and helped participants perceive and convey emotions.

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1. Introduction

Olfaction is an important route for human–computer interaction applications related to emotions. Olfactory applications use odors to influence people's emotions. These applications ease the anxiety of patients (Lehrner et al., 2000), and have been used in various contexts such as shopping, watching videos, and solving problems (Adolph and Pause, 2012; Herz et al., 2004; Murray et al., 2013b). However, the emotions that could be induced were limited; only pleasantness and disgust were widely induced in previous studies. Besides inducing emotions, odors have been used to represent information. That is, participants associated multiple meanings with odors, and perceived an emotional link when choosing odors to tag pictures (Brewster et al., 2006). This provides new perspectives on combining odors with emotions. Emotions could be arguably conveyed and communicated through odors rather than just being induced by odors.

This study uses odors to convey emotions and proposes an olfactory application named “odor emoticon.” Odor emoticons employ odors as emoticons to represent emotions. Participants send and receive odor emoticons to express and perceive emotions. Because emotion perception and expression is an important

factor in communication, odor emoticons might enhance participants' communication experiences. Twelve odors corresponding to 12 emotions were first selected from questionnaire results, and nine were validated for use as odor emoticons through further testing. A prototype that emitted odor emoticons was then developed. Further experiments in two contexts revealed that participants had a positive reaction to odor emoticons, and odor emoticons helped participants perceive and convey emotions.

There are three main contributions offered by this study. First, it proposes odor emoticons as an olfactory method to convey emotions during communication. Previous studies used odors to influence participants' emotions and explored participants' personal experiences of odors (Obrist et al., 2014). This study, however, explores the use of odors as a new communication route. Second, this study offers a method for designing odor emoticons. This method incorporates textual questionnaires and olfactory experiments, examining both the meaning related to odors and odor features. Third, this study applies odor emoticons in separate contexts of chatting and receiving voicemail, and examines the quality of participants' experiences on odor emoticons.

2. Background

Olfaction affects our perception of the world. An odorant stimulates a number of olfactory receptor cells that form an

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activation pattern on the olfactory epithelium, activating the olfactory bulb and the primary olfactory cortex, and giving rise to the perception of the odorant (Auffarth, 2013; Yeshurun and Sobel, 2010). The human–computer interaction domain has been paying attention to olfaction for over a decade. Researchers studied the effects of odors (Bensafi et al., 2002), and developed techniques to imitate odors in distant communication and to convey odors precisely (Harel et al., 2003; Sugimoto et al., 2010; Yanagida et al., 2003). Olfaction applications build on the results of these studies.

2.1. Odors that influence emotions

One category of applications uses odors to influence people's emotions and affect their performance. Olfaction and emotion share common brain pathways (Soudry et al., 2011): the brain processes odors together with other sensory modalities, memory, and internal states (Wilson, 2008). During processing, people recognize odor qualities and subsequently alter their physiological responses and emotions (Olofsson et al., 2012). Although emotions induced by odors are potent and hard to regulate (Adolph and Pause, 2012), the categories of these emotions are affected by culture and are quite personalized and limited (Ferdenzi et al., 2011). The emotions most commonly induced by odors are pleasantness and disgust. Bensafi et al. (2002), for example, used 12 different food odors and found that these odors evoked pleasantness and disgust. Furthermore, Croy et al. (2011) reported that only half of their participants could propose olfactory elicitors for anger, surprise, and sadness. During an attempt to develop a scale of odor-induced emotions, Chrea et al. (2009) found that, despite their prevalence in everyday life, guilt, shame, anger, and sadness did not seem to be included as emotional descriptors. In addition to pleasantness and disgust, de Groot et al. (2014, 2012) proposed that fear could be induced by the odor of sweat produced by fearful individuals.

Olfactory applications mainly use pleasant odors to make people happy and help them complete tasks (Herz, 2009; Wilson, 2008). For example, Lehrner et al. (2000) showed that specific odors such as that emitted by an orange reduced anxiety in female patients, while Basevitch et al. (2011) found that lavender diverted participants' attention during exercise. In another study, subliminal pleasant odors increased the preference for faces (Li et al., 2007). Herz (1997) manipulated ambient odors and participants' internal states during a word-memorizing task, and discovered that an ambient odor that had been associated with heightened emotion enhanced participants' performance. However, Ademoye and Ghinea (2013) showed that when information was displayed in a multimedia presentation, odors did not have significant effect.

2.2. Odors that convey information

The other category of odor application makes use of the ubiquity of olfactory sensation in daily activities (Obrist et al., 2014), and adds odors in human–computer interactions to enrich those experiences—odors can augment the reality of digital worlds. Pair et al. (2006), for example, added odors and tactile stimuli in a virtual-reality exposure treatment. Ghinea and Murray have done extensive work trying to apply odors in multimedia appropriately (Ademoye and Ghinea, 2009; Ghinea and Ademoye, 2012b; Murray et al., 2014a). They studied participants' feelings when encountering odors that were either relevant or irrelevant to a given context, and analyzed the effects of odor-emitting timing on participants' experiences. Participants reported a higher level of enjoyment when odors were associated with the video clips. Their perceptions of odors were also affected by video and by the absence of audio (Ghinea and Ademoye, 2012b; Murray et al., 2014b).

Apart from the direct representation of objects, odors have also

been applied in domains that did not involve olfaction. Brewster et al. (2006) instructed participants to use odors to tag and categorize pictures in picture-management software. The criteria when choosing odors included the context of odors, the emotional link between odors and the content of pictures, and simple dimensions such as “nice” and “bad.” Other odor applications have included representations of atomic energy levels (Richard et al., 2006), notifications of messages (Bodnar et al., 2004), and representations of the ups and downs of the NASDAQ stock market (Kaye, 2001). These studies are significant because they suggest that people associate various meanings with odors and use odors to express these meanings. These meanings cover a broader range involving level of importance, ups and downs, nice and bad, and even feelings and emotions.

2.3. Odors that convey emotions

Emotions are important in everyday life and daily activities, while olfactory applications have been restricted by the limited category of emotions that could be induced. Moreover, studies that used odors to convey information reported that participants took emotional associations into account when choosing odors to tag pictures (Brewster et al., 2006), and the additional olfactory route enhanced participants' experiences (Ghinea et al., 2014). Odors could thus represent emotions and help convey emotions other than inducing them. The Shannon–Weaver model also provides a foundation for this proposal. Emsenhuber (2011) proposed that odors can be regarded as codes that contain information: the receiver decodes the odors and receives the information. The receiver and the emitter could then, theoretically, achieve olfactory communication through having similar code principles. Indeed, it may be easier for people to understand the emotional meaning of an odor than to evoke an odor's corresponding emotions. Therefore, the number of emotions that odors could convey might be more than those that could be induced. This offers a new sensory route to communicating emotions and building informative experiences.

3. Odor emoticons as an olfactory application

In this paper, it is argued that emotional interpretations of odors can act as a “code principle” in the conveyance of emotions. For example, the odor of a rose is widely recognized as a symbol of love, even though it may induce feelings of pleasantness or disgust according to participants' personal experiences. Another example is that of visual emoticons: a person understands the intended emotional meanings when receiving a “sad” or “embarrassed” emoticon, even while they may experience a feeling of happiness. This study proposes the concept of an “odor emoticon”, which refers to a group of odors that represent emotions. Odor emoticons provide a new route for conveying emotions and have the potential to enrich communication experiences.

This article contains two parts. The first part examines participants' interpretations of odors, and describes the design of odor emoticons. Twelve emotions were derived from the study of Hertenstein et al. (2006): six basic ones (happiness, disgust, anger, fear, sadness, and surprise), three pro-social ones (love, gratitude, and sympathy), and three self-focused ones (embarrassment, pride, and envy).

The methods used in exploring the connections between odors and emotions involved both researchers and participants (Brewster et al., 2006; Ferdenzi et al., 2011). Establishing which odors could represent emotions required extensive exploration. Therefore, two study phases were conducted. In Phase 1, potential representative odors for each emotion were collected through questionnaires. In

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