Olfaction, Emotion and Associative Learning: Effects on Motivated Behavior

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Two experiments were conducted to investigate emotional associative learning to odors and subsequent behavioral effects. In Experiment 1, participants experienced a frustration mood induction in the presence of an unfamiliar ambient odor and later worked on puzzle tests in a room scented with either the same-odor, a different-odor, or no-odor. Participants in the same-odor condition spent significantly less time working on the tests than participants in the other conditions; however, test accuracy did not vary. To clarify the findings, Experiment 2 included a test-only control and an emotionally neutral same-odor conditions. Results were compatible with the conclusion that decreased time spent by participants in the negative-same-odor condition was due to emotions elicited by associative learning to the ambient odor, although alternative interpretations remain possible. These data extend our previous results with children and suggest that odors readily become associated to emotions and can thereby influence behavior.

KEY WORDS: odors; emotion; associative learning; behavior; motivation.

Associative learning, the process by which one event or item comes to be linked to another through experience, is critically involved in human cognition and behavior (Wasserman & Miller, 1997). It has also been proposed that associative learning principles explain human perceptual responses to odors (Engen, 1988, 1991; Herz, 2001). Specifically, it is proposed that odor hedonic perception (e.g., liking/pleasantness) is derived from a learned association with the emotional context in which that odorant was first encountered. That is, one would dislike the smell of rose if it were first encountered in an unpleasant setting (e.g., a funeral).

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Developmental and cross-cultural literature provide strong evidence that associative learning with emotion as the mediating variable governs odor hedonic perception. Mennella and colleagues found that infants of mothers who consumed distinctive smelling volatiles (e.g., garlic, alcohol, cigarette smoke) during pregnancy or lactation showed preferences for these smells compared to infants who had not been exposed to these scents (Mennella, 1995; Mennella & Beauchamp, 1991, 1993). Notably feeding, in addition to providing nutrition, is an opportunity for close physical contact and emotional bonding. Association through affectionate cuddling also induces preferences for specific (yet arbitrary) scents, such as cherry oil or mother’s perfume (Balogh & Porter, 1986; Davis & Porter, 1991; Lott, Sullivan, & McPherson, 1989; Schleidt, Hold, & Attili, 1981). Moreover, among adults no empirical data have shown cross-cultural consensus in odor evaluation for either common “everyday” odors (Ayabe-Kanamura et al., 1998; Schleidt et al., 1981) or even ‘offensive’ scents. Indeed, in a recent study undertaken by the US military to create a “stink bomb” it was impossible to find an odor (including US army issue latrine scent) that was unanimously considered repulsive across various ethnic groups (Dilks, Dalton, & Beauchamp, 1999). Direct evidence supporting the emotional associative learning hypothesis for odor perception was recently offered by Robin, Alaoui-Ismaili, Dittmar, and Vernet-Mauri (1998) and Herz, Beland, and Hellerstein (2004). Robin and colleagues found that the smell of eugenol (“clove” odor used in dental cement) was evaluated negatively and elicited autonomic fear responses among patients who were afraid of dental procedures, but not unafraid patients (Robin et al., 1998). In our study we showed that hedonic evaluation of a novel odor directionally changed (positively and negatively) as a function of the emotional experience that had been paired with it (Herz et al., 2004).

Prior research has shown that odors that are liked or disliked have a congruent impact on mood and cognition. Pleasant fragrances used in a “real life setting” were shown to improve mood and even alleviated some of the symptoms associated with menopause (Schiffman, Sattely-Miller, Suggs, & Graham, 1995; Schiffman, Suggs, & Sattely-Miller, 1995). In other studies, participants exposed to the ambient smells of chocolate or baby powder reported being in a better mood than people in a no-odor condition (Knasko, 1995), and participants exposed to dimethyl disulphide (rotten eggs) reported being in a less pleasant mood than participants exposed to lavender (Knasko, 1992). Several studies have also shown that pleasant and unpleasant odors elicit physiological changes (heart-rate, GSR, eye-blink) that are consistent with positive and negative emotional states (Alaoui-Ismaili, Robin, Rada, Dittmar, & Vernet-Maury, 1997; Ehrlichman, Kuhl, Zhu, & Warrenburg, 1997; Miltner, Matjak, Braun, Diekmann, & Brody, 1994). Note that in these laboratory studies the physiological and subjective mood changes observed to odors only occurred in individuals who experienced the odors as “pleasant” or “unpleasant,” respectively.