



## Adding odor: Less distress and enhanced attention for 6-month-olds



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### ABSTRACT

The effect of odor on cognitive and emotional processes has been studied in adults and children, but less so in infants. In this study twenty-seven six-month-olds were presented with a video while in either an odor (pine or baby-powder) or a no odor control condition. The video was a 92-s audiovisual presentation of a woman expressing happiness and sadness, with the order of emotion counterbalanced. Infant attention (looking time) and emotional expression (smiling, crying, mouthing) were coded. Infants looked longer in the presence of odor and expressed less crying and mouthing but more smiling behavior. Presence of odor markedly reduced infant emotional distress and increased attention, suggesting that the olfactory sensory system provides cues to infants that support mood regulation and maintain attention. These results have implications for optimizing infant environments for emotional health and cognitive development.

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## 1. Introduction

There is an old rhyme – “little drops of water, little grains of sand, make the mighty ocean and the pleasant land” (Carney, 1845). Analogously, “little” features of an infant’s surround might “make” a more pleasant “land” or environment for an infant and thereby influence perceptual and cognitive development, possibly producing “mighty” or at least noticeable systemic benefits. Physical health, as well as important cognitive processes in adults and children, has been shown to be supported by sensory surrounds that enhance positive emotion (Ashby, Isen, & Turken, 1999; Danner, Snowdon, & Friesen, 2001; Fredrickson & Levenson, 1998). We predict that similar effects also occur during infancy, when longer term cumulative effects are probable. Even a simple process such as “looking” or attention span may be affected by positive visual, auditory and, in the present case, olfactory information in the surround.

### 1.1. The importance of olfaction

This study focuses on olfaction for several reasons. First, it is the only sensory system directly connected to the ventral tegmental area (VTA), a dopamine producing area of the brain (Ashby et al., 1999), which is thought to be linked to mood

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regulation. Additionally, the importance of the olfactory system is suggested by evidence that more of the human genome is devoted to olfaction than other sensory systems (Buck & Axel, 1991) as well as by the early development of the olfactory system (Schaal, Marlier, & Soussignan, 2000). Olfaction therefore has more potential to influence early affective connections and cognitive sequelae than other sensory systems. Researchers have focused less on olfaction, however, and have attended less to its potential in cognitive developmental processes.

### 1.2. Emotion regulation

By six months of age infants can regulate their distress, and the manner in which they do so in response to audio–visual information from the environment is well understood. Six-month-olds readily discriminate negative from positive emotional expressions and can respond with emotional displays indicating distress (Walker-Andrews, 1997). When the emotional expression of sadness is on their mothers' face, infants demonstrate this ability even earlier, showing sadness and self-soothing when their mothers are sad (Tronick & Gianino, 1986). Although infants look away to the side or down when their mothers are angry or sad, they will continue to attend to a happy mother even when her expression is not contingent upon the infant reaction (Haviland & Lelwica, 1987). By purposefully controlling their attention, infants can regulate their own distress in this rudimentary way (see also Stearns, 1993). Parents may give support to this regulatory process, motivating attention and social interaction, by providing interested, happy faces and voices to infants, even in situations where the infant is distressed (Malatesta & Haviland, 1982). These processes are relatively well delineated but the focus has been exclusively on the roles of auditory and visual sensory systems in mood and attention regulation. The olfactory system, with its connection to the VTA, is at least as likely, if not more, to provide mood regulation early in life. The current study seeks to clarify the role of olfaction in emotion regulation as it affects attention.

### 1.3. Olfaction in infants

Newborns can attend to and localize odors (Bingham, Churchill, & Ashikaga, 2007; Doucet, Soussignan, Sagot, & Schaal, 2007). They are capable of detecting a variety of biological and artificial odors (Goubet et al., 2002) including their own mother's breast milk and amniotic fluid (Bingham et al., 2007; Doucet et al., 2007; Varendi, Christensson, Porter, & Winberg, 1998) and quickly avoid anise and other unpleasant odors (Schaal et al., 2000; Soussignan, Schaal, Marlier, & Jiang, 1997). Infants not only localize the source of odors, but also will orient preferentially to familiar ones (Marlier & Schaal, 2005; Schaal, Marlier, & Soussignan, 1998).

### 1.4. Olfaction and mood regulation

Part of the significance of these early skills is related to the unique connection of the olfactory system to the VTA area, which is a main producer of dopamine and is presumed to be an important part of mood regulation, particularly positive mood regulation (Ashby et al., 1999). This relationship between olfaction and mood regulation has been demonstrated in infants during various medical procedures. Varendi et al. (1998) recorded crying in neonates during a 90-min observation period immediately after birth, while they were exposed to either their own amniotic fluid, their mother's breast odor (obtained prior to giving birth) or to a no-odor control. Babies presented with their own amniotic fluid cried less than babies in either of the other conditions.

In another study, different groups of infants undergoing a routine (painful) heelstick to draw blood were exposed to an odor (vanillin, commonly rated as pleasant by adults) to which they had been familiarized, the same odor to which they had not been familiarized, or no odor. The blood draw was prescribed by the physician as part of the infants' routine care. Infants in the first group were familiarized with vanillin overnight. A short while later, a scarf scented with vanillin was held next to the infant's nose while the blood draw was performed. Infants in the other groups were not familiarized, but a vanillin-scented or unscented scarf was held next to their noses during the blood draw. Babies presented with the familiar odor cried less during the less painful procedure (venipuncture) and recovered (return to baseline levels of crying and grimacing) more quickly after the more painful procedure (Goubet, Rattaz, Pierrat, Bullinger, & Lequien, 2003). The authors concluded that familiar odors can reduce distress when a neonate is stressed and in pain.

Similar effects have also been reported for unfamiliar odors. Kawakami and colleagues exposed neonates to the artificial odors of lavender or milk or to no odor during the routine heelstick procedure (Kawakami et al., 1997). Infants in the odor groups demonstrated less salivary cortisol in response to the heelstick than did infants in the no odor control condition. The authors concluded that odor influenced cortisol response during stress.

### 1.5. Support against stress

Following the Goubet et al. (2003) and Kawakami et al. (1997) studies showing the calming effects of odor in a stressful environment, we predict that exposure to a pleasant odor before and during a stressful event (e.g. watching sad female face and voice) also will be calming, leading to increased attention. In the case of infants the pleasant odor should result in fewer negative emotional reactions, i.e. fewer cry faces or self-comforting mouth movements (Haviland & Lelwica, 1987).

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