## Inbodied Interaction Design Example: Smell

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The sense of smell has long played a minor role in HCI [1]. However, its somewhat limited use could be transformed through an inbodied interaction approach that leverages the physiology of smell—specifically, the possibilities to combine the *cogitate*, *sleep*, and *eat* areas of the in5 model (see article on tuning in this section) to yield benefits, from health to performance.

***Inbodied insights into odor and memory.*** Unlike most other cranial nerves, the olfactory nerve is wired directly into the cortex, indicating its relative importance for survival-related functions (for example, assessing if food is safe to eat). Smell stimulates several other key areas of the forebrain, including the insular cortex, an area that supports interoception (the sense of the internal state of the body) and our sense of self, and areas related to visual vividness and emotional processing. Memories that have been paired with odor cues during waking hours and reinforced via odor exposure during slow-wave sleep were shown to consolidate memories [2], indicating a form of passive reinforcement that can boost human performance.

Through an inbodied interaction approach, we can design interactions through layering different perspectives on experience, connecting existing HCI knowledge with new behavioral and neurological insights. Consider the case of odor-cued memories. We know these have emotional dimensions through stimulation of the amygdala; these experiences affect our sense of (inbodied) self through activation of the insular cortex. Weaving these insights together can change the way we use odor in HCI, combining both passive and active interactions that can subtly influence user behavior or support deliberate user action. The experience changes whether the perceived odor is something that is stumbled across or deliberately sought out for interaction. If the odor is delivered as something we can eat through technologies such as 3D food printing [3], it allows for nutrition tailored to support memory function [4].

***Designing an inbodied smell album.*** One potential use case for smell could be a smell memory bank that captures, stores, and reproduces smells paired with specific memories. This could include existing strongly connected pairs (such as the smell of grandma's perfume) [1] as well as supporting the encoding of new smell memory pairs (such as the new school uniform smell on your child's first day) reinforced through passive exposure during sleep [2]. Learning could also be supported through this process, for example, when studying for exams. Users could encode newly learned information with scents that can be reinforced in the user's brain during sleep [5]. It may also be important to consider what types of information best suit smell-memory cues. The visual vividness of odor memories supports the recall of images, maps, or diagrams, while the emotional aspect can be utilized for the recall of reactions or critiques. For either reminiscing or learning, the integration of inbodied perspectives of odor in sleep and cogitation extends human-memory performance, supporting not only the recall of old memories but also the deliberate encoding and recall of new information too.

## Endnotes

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## Insights

- Understanding the neuroanatomy of smell offers new design opportunities, particularly in relation to memory.
- Memory-odor pairs are usually based on old memories; however, we propose a novel learning mechanism for encoding new memory-odor pairs.