INTRODUCTION...

Attentional priority refers to the selection of relevant information among that offered to the human brain at a given moment. The spatiotemporal proximity between different kinds of sensory signals (e.g., visual, olfactory...) enhances processing efficiency. These cross-modal interactions may be based on partly common processing sub-systems between sensory modalities.

One of these theoretically common sub-systems may be concerned by the evaluation of the biological salience (or significance) of events that cause a modification of the current state of the environment (Michael et al., 2001). For instance, stimuli that may signal a potential threat (e.g., the view of a snake or the odor of gas) may attract attention, and several studies identified the amygdala as being the potential neural basis of such a sub-system (Morris et al., 1999; 2001).

If there is some cross-modal amygdala-based sub-systems that are responsible for the establishment of the biological salience of sensory events, then the direct stimulation of the amygdala (as a relay of olfactory signals) with olfactory stimuli should influence processing in other sensory modalities also. The aim of this study was to provide some seminal evidence on cross-modal interactions between vision and olfaction and, indirectly, on the existence of a cross-modal sub-system.

METHODS & RESULTS...

Subjects: 47 women (mean age 22±1.3 years).

Visual tasks: two tasks of visual attentional capture by luminance
Ambient odors: (a) no-odor (n=19); (b) Allyl Isothiocyanate (AIC; n=16); (c) Phenyl Ethyl Alcohol (PEA; n=16).

Psychophysics: Individual evaluation of the intensity, hedonic valence and perceived irritation of the ambient odor (see table)

Experiment 1 investigated the basic influence of ambient odors on visual distraction, whilst Experiment 2 investigated this influence on the time course of visual distraction. Previous studies showed that the presence of a distractor, such as a luminance change, penalizes chronometric performance, but it has no effect if it follows the target for about 200msec.

Subjects were asked to indicate the gap-location (up or down) of a small central target and to ignore all other potential events. In some trials, a lateral big circle underwent a sudden increment in luminance just 50msec (Experiment 1; see figure) or 50msec, 100msec or 200msec (Experiment 2) after the target presentation.

Results of Experiment 1: in the no-odor session, response times (RT) were slower in the presence of a luminance change (p<0.008), revealing a distraction effect. Similar results were observed in the AIC session (p<0.001), but the distraction was well bigger than in the no-odor session (p<0.022). Finally, the presence of PEA slowed RT in the baseline compared to the no-odor session (p<0.037), and abolished distraction.

The Results of Experiment 2 (see table) show that, in the no-odor session, the capture fades with increasing target-to-distractor temporal interval. In the AIC session, the distractor still captures attention even when presented 200msec after the target. Furthermore, the capture effects are quite larger than in the no-odor session. No capture was evidenced in the PEA session.

DISCUSSION...

The results show that the presence of ambient odors modulates both the amplitude and the duration of visual capture by luminance distractors.

Specifically, the trigeminal AIC causes bigger and long-lasting capture effects, whilst the PEA abolishes visual attentional capture and slows the basic speed of response.

These findings suggest that visual attention and olfaction may share some neural bases. We believe that the amygdala is one of these structures since it receives direct afferent signals from the olfactory system and it has been shown to participate in visual attention and perception (Morrison et al., 1999; 2001).

Based on the present and on previous findings, we propose that the system of attentional capture works on the establishment of the perceptual salience of the afferent signals (Theeuwes, 1991) as well as their biological significance (LeDoux, 2000). Our results can be explained if we consider that the amygdala-based mechanism of biological salience is common to different sensory modalities. Mixed-up together within the cross-modal master salience map, a rather neutral visual stimulus would be represented as highly significant due to the presence of a negatively or positively tagged odor. As a result, visual attentional capture would be modulated by the presence of ambient odors...