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Reinforcement by reward enhances discrimination of odor stimuli

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An odor mixture in comparison to a pure odor might be processed differently, even if the participants are not able to perceptually discriminate them. It is established that participants can learn to discriminate likewise smelling odors in an aversive learning paradigm. Our hypothesis is that perceptual and neuronal discrimination can possibly also be enhanced by using a reinforcing feedback paradigm. In our experiment, all volunteers performed significantly better than chance level in an odor discrimination task, but only a subgroup that was identified using the signal detection theory, showed a significant improvement throughout the task. Comparing neuronal processing of a pure, pleasant lemon odor to a mixture consisting of a lemon odor and caproic acid, we observed increased activation of the left insula and ventral striatum/putamen in the pure odor compared to the odor mixture condition. The subgroup of good performers improved in differentiating the odors with reinforcement and showed a related activation of dorsal anterior cingulate cortex, midcingulate cortex, operculum and primary somatosensory cortex compared to the other group of participants. In conclusion, the mentioned areas are involved in odor discrimination learning, and processing of odors seems to depend on even subtle changes of odor quality.

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