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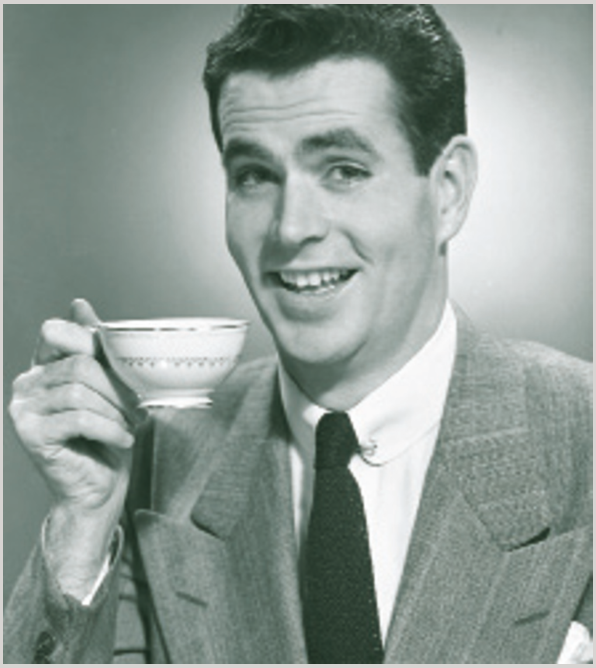
SENSORY SYSTEMS

Great (taste) expectations



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Expectation of a sensory stimulus can increase the speed and accuracy of the response to that stimulus; however, the neural mechanisms underlying this phenomenon remain unclear. Now, Fontanini and colleagues show that in behaving rats, cue-induced expectation of a tastant modulates activity in the gustatory cortex (GC) and leads to faster neural coding of the subsequent taste stimulus.

The authors' study involved a complex behavioural task. They trained rats to wait for ~40 s and then, within 3 s after hearing an auditory tone (the cue), to press a lever and self-administer a tastant (the stimulus) directly into their mouths via an intra-oral cannula. For each trial, one of four tastants was randomly delivered following lever-pressing but the tone remained the same. Thus, the behavioural task was designed to study the effects of general expectation of a taste experience, rather than the expectation associated with specific tastants. As a control, animals were exposed, at random, to the delivery of a tastant at an unexpected point in the pre-tone period.

The authors assessed neural activity associated with expected and unexpected tastants through the use of multiple movable bundles of electrodes. These were placed into the GC and basolateral amygdala (BLA) and allowed single-unit responses as well as the firing patterns of neural ensembles to be monitored.

Fontanini and colleagues first examined GC activity following tastant delivery and found that in the first 125 ms, neural ensemble activity patterns in rats that had received an expected tastant allowed faster, more-accurate stimulus discrimination than did the GC activity in rats that had received an unexpected tastant. Further analysis revealed that this cue-linked improvement in taste-stimulus coding was partly due to a narrowing of response tuning and a decrease in response variability over the initial post-tastant period.

Interestingly, trials involving expected tastants were characterized by an anticipatory increase in the spike firing rate in GC neurons in the period between cue onset and tastant delivery — a pattern that was absent in control trials involving unexpected tastants. Moreover, correlation analyses and a principal component analysis showed that the dynamics of GC activity in the first 125 ms following a cue were similar to those seen over a similar time period after an unexpected tastant. Thus, these observations suggest that anticipation of the taste experience leads to priming of cortical activity to allow faster neural coding.

Fontanini and colleagues hypothesized that if cue-induced pre-tastant activity was linked to anticipation of the stimulus, it would involve a top-down mechanism. Of note, the BLA forms part of the anticipatory network and sends projections to the GC. The authors found that, on average, BLA neurons responded more quickly to the auditory tone than GC neurons (33 ms versus 49 ms). Moreover, the BLA firing rate and GC local field potentials showed a small, but notable, increase in cross correlation following the tone, indicating that the two processes may be linked. Finally, pharmacological inhibition of the BLA blocked cue-triggered responses in the GC. Thus, tone-induced anticipatory activity seems to result from top-down input from the BLA in this paradigm.

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Together, these data show that cue-triggered expectation of a taste experience involves a top-down input from the BLA and leads to priming of the GC, which allows a more rapid coding of the subsequent taste stimulus. This mechanism may serve as a model for how cue-induced expectation alters cortical activity to allow enhanced processing of other sensory stimuli.

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ORIGINAL RESEARCH PAPER Samuelsen, C. L., Gardner, M. P. H. & Fontanini, A. Effects of cue-triggered expectation on cortical processing of taste. *Neuron* **74**, 410–422 (2012)