



Presentation Abstract

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Presentation Title: Making predictions in a complex world: Mechanisms of contingency degradation in fear conditioning

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Abstract: Attributing appropriate predictive power to different environmental cues is vital for the survival of any complex organism. In classical conditioning paradigms animals learn the association between an environmental predictive cue (conditioned stimulus or CS) and a biologically salient aversive outcome (unconditioned stimulus or US), and the strength of this association readily reflects the contingency between the CS and US during training. In particular, degrading this contingency by adding unsignaled aversive US presentations to CS-US pairings in an auditory fear conditioning protocol attenuates the level of conditioning to the CS (Rescorla, 1968). Thus, the predictive power of an environmental cue can be reduced if it does not reliably signal the occurrence of the biologically salient event.

To better understand how organisms attribute predictive power to environmental cues we varied the temporal order as well as the timing of paired and unpaired shocks using an auditory fear conditioning paradigm. Popular accounts of contingency degradation suggest that the context that the animals are trained in accrues predictive power and inhibits the auditory CS from gains in associative strength by reducing the reinforcing ability of the US during fear learning (i.e. that it occurs through contextual 'blocking' of the auditory fear conditioning). To test this, rats were given 12 unpaired USs and 3 CS-US pairings, with the 3 pairings occurring

in the same session either before, intermixed with or following the unpaired shocks. Irrespective of the temporal order, this degraded contingency resulted in weaker conditioning to the tone CS in all three groups for both short-term and long-term memory, when compared to controls where unpaired USs were omitted. However, when we gave the unpaired shocks after the pairings in a separate training session 24 hours later, they had no effect on levels of conditioning to the CS. These behavioral data support the idea that contingency degradation does not occur as a result of contextual blocking of auditory fear learning, as unpaired shocks given after animals had learned the auditory CS-US association still showed contingency degradation. Instead our results provide evidence that unpaired USs modulate the strength of auditory fear memories when presented before, during or after their formation in a time-dependent manner. These findings suggest that a novel neural mechanism accounts for the ability to attribute predictive power to competing stimuli in a complex environment. In ongoing experiments we are using optogenetic techniques to determine an anatomical locus and neural mechanism of contingency degradation.

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LEARNING AND MEMORY

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