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In many domains, cues are only partially valid, probabilistic predictors of outcomes. In medical diagnosis, for example, symptoms are usually only probabilistically valid indicators of various diseases. Different cues can have different validities for different outcomes, e.g., fever is a relatively good indicator of flu, whereas sore elbow is a relatively poor indicator of flu. Previous research by many experimenters has shown that people can learn about the relative validity of various cues, and people can utilize the cues to an extent corresponding with the relative validity. The correspondence is ordinal, however, not linear or optimal. In particular, people's utilization of a partially valid cue is inversely related to the validity of other available cues. This "overshadowing" of a less valid cue by a more valid cue, also known as "cue competition," has been documented in a number of species and in a number of different experimental paradigms in humans. Previous research has also shown that more *salient* cues can overshadow less salient cues of equal validity. It has also been shown that people can utilize probabilistic information from non-linear combinations or *configurations* of cues, but utilization of such configural information is less than utilization of equally valid component cues (e.g., Edgell, Castellan, Roe, Barnes, Ng, Bright, & Ford, 1996).

A number of theorists have tried to address these findings, but none has provided a detailed model that has also closely fit experimental data. Several connectionist models of associative learning, in particular, have failed to fit these phenomena (Edgell et al., 1996). In fact, it has been proven that a certain class of connectionist models cannot exhibit overshadowing or cue-competition after asymptotic training (Busemeyer, Myung, & McDaniel, 1993).

We conducted new experiments, with human participants, replicating and extending previous research on overshadowing. Our first set of experiments examined the effect of other-cue validity on cue utilization. We measured utilization of a binary-valued cue that had a fixed validity, under a number of conditions. Our experiments used carefully counter-balanced cues, consistent across conditions, unlike some previous research. In one condition the cue occurred by itself, without competing cues. In another condition, a second cue occurred but had zero validity. In a third condition, the second cue had equal validity, and in a fourth condition the second cue had greater validity. Our data showed the classic overshadowing effect of the second dimension, that is, utilization of the fixed-validity dimension declined as the validity of the other dimension increased.

In other experiments, we investigated the effect of differential salience on utilization, when a second cue either is or is not present. We found that when a cue is presented by itself, there is a small effect of salience on its utilization, but when the same cue is presented with a second cue of zero validity, the salience has a large effect on utilization. These new results put additional constraints on any model of utilization.

We successfully fit the data with an extended version of the exemplar-based connectionist model, ALCOVE (Kruschke, 1992). Three aspects of the model are important for fitting the data: First, the model rapidly shifts limited-capacity attention across cues, in response to error. This reallocation of attention causes more valid or more salient dimensions to pull attention away from less valid dimensions. Second, the model uses an exemplar-based internal representation, which permits the model to learn about configural information, but less effectively than component cue information. Third, the model anneals (i.e., decreases) its associative learning rates and attention shift rates, which is computationally appropriate for probabilistic environments. All three properties of the model are direct formalizations of three corresponding psychological principles: Learners rapidly shift limited-capacity attention in response to error, learners can encode exemplars or combinations of cues, and learners stop or decelerate learning when they are in probabilistic environments with frequent, uncontrollable errors.

References

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