Contradictory Behavioral Biases Result from the Influence of Past Stimuli on Perception

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Abstract:

Biases such as the preference of a particular response for no obvious reason, are an integral part of psychophysics. Such biases have been reported in the common two-alternative forced choice (2AFC) experiments, where participants are instructed to compare two consecutively presented stimuli. However, the principles underlying these biases are largely unknown and previous studies have typically used ad-hoc explanations to account for them. Here we consider human performance in the 2AFC tone frequency discrimination task, utilizing two standard protocols. In both protocols, each trial contains a reference stimulus. In one (Reference-Lower protocol), the frequency of the reference stimulus is always lower than that of the comparison stimulus, whereas in the other (Reference protocol), the frequency of the reference stimulus is either lower or higher than that of the comparison stimulus. We find substantial interval biases. Namely, participants perform better when the reference is in a specific interval. Surprisingly, the biases in the two experiments are opposite: performance is better when the reference is in the first interval in the Reference protocol, but is better when the reference is second in the Reference-Lower protocol. This inconsistency refutes previous accounts of the interval bias, and is resolved when experiments statistics is considered. Viewing perception as incorporation of sensory input with prior knowledge accumulated during the experiment accounts for the seemingly contradictory biases both qualitatively and quantitatively. The success of this account implies that even simple discriminations reflect a combination of sensory limitations, memory limitations, and the ability to utilize stimuli statistics.

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