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The global and transitional probability of task-irrelevant dimensions impact behavior

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Organisms pick up on stimulus statistics along multiple perceptual dimensions. These statistics can be accumulated quickly, sensitively, and passively, and can even influence behavior in unrelated tasks. In the auditory domain, there is a great deal of evidence that listeners build up statistically-driven expectations of what they will hear. Despite such strong empirical demonstrations of 'statistical listening'there is no consensus on how these statistics influence perception, attention, and behavior. With most studies'focus on passive accumulation of sound statistics, the influence of task is a crucial aspect of this puzzle that has been less considered. Here, we use two paradigms that tap into quite different perceptual processing of the same stimuli: 1) suprathreshold duration judgments of tones; 2) detection of near-threshold tones in noise. In each task, the statistic of interest – the global probability of a tone's frequency – is task-irrelevant. This proffers an opportunity to examine how statistical learning proceeds in an active task when dimensions of regularity are task-irrelevant, and would apparently direct behavior non-optimally. Focusing on global probabilities of tone frequencies and transitional probabilities between tone frequencies, we find that listeners weigh expectations based on the global probability of a tone frequency in performing the tasks. Duration judgments are faster for more-probable-frequency tones than for less-probable-frequency tones. Moreover, detection of tones nearer to a more-probable frequency is superior. We find that the influence of expectation builds quickly, and switches rapidly with changes in probability. Even a seemingly 'neutral'equiprobable distribution can influence behavior in the context of a switch to statistics that bias probability prior to or after experiencing the 'neutral'statistics. Listeners also are influenced by transitional probabilities whereby one tone frequency tends to predict another frequency, even when frequency is task-irrelevant. In these cases, a sensory match in tone frequencies provides no additional benefit above and beyond statistical learning and the joint influence of global probability and transitional probability is not additive. Overall, our results demonstrate that statistical learning of global and transitional probabilities proceeds across dimensions of sound even when listeners are engaged in a task for which the dimension offers no information relevant to the task. Examination of statistical learning of task-irrelevant dimensions offers a productive approach to determining how statistical learning and prediction evolve across active behavior, and provides a strong foundation for dissociating competing theoretical accounts of expectation.

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