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The presence of deviant tones modulates temporal predictions in visual-to-auditory predictions

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Abstract

Forward predictions are not only crucial to predict somatosensory consequences of movements, but may also guide cross-modal sensory mapping (Ramnani, 2006). When a visual stimulus temporally predicts an auditory tone onset ('when' information), the amplitude of the N1-P2 complex is reduced compared to a temporally unpredictable tone (e.g., Ford et al., 2007; Sowman, Kuusik, & Johnson, 2012). However, cue quality and/or tone identity ('what' information) may further modulate visual-to-auditory predictions. When the quality of a visual cue varies, its strength to predict a subsequent tone onset influences cross-modal sensory mapping. In addition, infrequently occurring deviant tones (altered in frequency) induce uncertainty about tone identity that may further impact visual-to-auditory predictions (cf. Schwartze, Farrugia, & Kotz, 2013, for sensory predictions). A visual-to-auditory cross-modal prediction paradigm was used in the current experiment. Participants passively viewed visual cues that temporally predicted a subsequent tone onset or not. We manipulated (1) the predictive strength of a visual cue (five different cue colors vs. one [grey] color), (2) the probability of an auditory tone to occur (80% standard, 20% deviant tones), and (3) temporal predictability (predictable vs. unpredictable tone onset). Predictable blocks either preceded unpredictable blocks or vice versa (between subjects-design). This allowed investigating whether frequent standard tones are affected by uncertainty of tone identity ('what' information) as a function of temporal predictability ('when' information). The results on lateral electrodes revealed that the N1-P2 complex to standard tones was modulated by temporal predictability. The N100 amplitude was enhanced (predictable>unpredictable) when predictable blocks preceded unpredictable blocks, while the N100 amplitude was reduced (predictable<unpredictable) for unpredictable blocks preceding predictable blocks. These effects did not vary as a function of cue quality. The P200 response was attenuated (predictable<unpredictable) for colored and grey cues, but only when unpredictable blocks were presented first. This finding is comparable to previous results, in which tone identity was always fully predictable. This suggests that the P200 component is not susceptible to uncertainty of tone identity. In contrast, N100 findings differ between the two studies. Whereas the N100 showed a main effect of temporal predictability (predictable<unpredictable) when tone

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identity was 100% certain, the N100 amplitude was altered by temporal predictability ('when' information) depending on block order in the current study. This can be explained by a global order effect, in which initial blocks receive more attention than succeeding blocks. However, only predictable blocks were modulated by block order. Thus, a more reasonable explanation for the present results is that the saliency of deviant tones attracts attention, which, in turn, affects temporal predictability. Future research needs to further address whether cross-modal sensory mapping is indeed susceptible to attention.

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Keywords: Temporal prediction; Cross-modal; N1-P2 complex

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