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Modelling auditory attention: Insights from the Theory of Visual Attention (TVA)

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We report initial progress towards creating an auditory analogue of a mathematical model of visual attention: the 'Theory of Visual Attention' (TVA; Bundesen, 1990). TVA is one of the best established models of visual attention. It assumes that visual stimuli are initially processed in parallel, and that there is a 'race' for selection and representation in visual short term memory (VSTM). In the basic TVA task, participants view a brief display of letters and are asked to report either all of the letters (whole report) or a subset of the letters (e.g., the red letters; partial report). Fitting the model to the data produces the following parameters: the minimum amount of information required for target identification ($t0$); the rate at which information is encoded, assuming an exponential function (v); the relative attentional weight to targets versus distractors (α); and the capacity of VSTM (K). TVA has been used to model normal visual attention, as well as identifying how the different parameters are affected by changes across the lifespan (McAvinue et al., 2012) and by attentional deficits such as neglect (Duncan et al., 1999). An auditory analogue would allow these same parameters to be measured for auditory attention; providing insights into impaired auditory attention in old adults and neuropsychological patients, and allowing direct comparisons with visual attention.

In the visual task, the stimuli are simultaneous, stationary (unchanging over time), and separated in space. In the first instance we are testing whether TVA can model identification of auditory stimuli with the same characteristics. The task is to identify dichotic, concurrently-presented synthesised vowels with different f0s. Early data indicate that the rate of information acquisition is more rapid for auditory stimuli, and may be better modelled using a log-logistic function than an exponential function. A more challenging difference is that in the partial report task, there is more target-distractor confusion for auditory than visual stimuli. This failure of object-formation (prior to attentional object-selection) is not yet effectively modelled by TVA.

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