Precise measurements of perceptual attention filters for features

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The recent conceptualization of feature-based attention in terms of attention filters (Drew et al, 2010) is here elaborated into a general purpose centroid-estimation paradigm for studying feature-based attention. An attention filter is a brain process, initiated by a participant in the context of a task requiring feature-based attention, that operates broadly across space to modulate the relative effectiveness with which different features in the retinal input influence performance. Here we describes an empirical method for quantitatively measuring attention filters. The method uses a ``statistical summary representation" (SSR) task in which the participant strives to mouse-click the centroid of a briefly flashed cloud composed of items of different types (e.g., dots of different luminances or sizes), weighting some types of items more strongly than others. In different attention conditions, the target weights for different item-types in the centroid task are varied. The actual weights exerted on the participant's responses by different item-types in any given attention condition are derived by simple linear regression. Because, on each trial, the centroid paradigm obtains information about the relative effectiveness of all the features in the display, both target and distractor features, and because the participant's response is a continuous variable in each of two dimensions (versus a simple binary choice as in most previous paradigms), it is remarkably powerful. The number of trials required to estimate an attention filter is an order of magnitude fewer than the number required to investigate much simpler concepts in typical psychophysical attention paradigms. Additionally we describe (1) algebraic derivations for three useful statistics to describe attention filters: efficiency, fidelity, and data driveness, (2) confidence bounds on these statistics, and (3) some important procedural improvements: singleton trials, constant dispersion. Matlab code for all these computations is available. Illustrative examples will be shown as time permits.