Differential motion parallax as a monocular depth cue?

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Computing the distance of an object from motion parallax involves the comparison of the displacement or velocity of the observer’s eye with the hereby induced displacement or velocity of the object on the retina. Motion parallax computation therefore requires knowledge about the relative speed between the observer and the object. In many situations this information is not available to the observer -- either because the observer or the object moves with an unknown velocity. Theoretically, one could still determine distance by moving with two different speeds and employing only knowledge about the difference between them. We refer to this mechanism as “differential motion parallax” and we assume that many birds use this mechanism to monocularly measure distance in the lateral visual field. Here, we examine whether humans are capable of using differential motion parallax. Observers had to indicate whether a central, horizontal array of small squares was before or behind a plane represented by two flanking horizontal arrays. We measured depth discrimination thresholds for the monocularly viewed patterns with and without adding a constant, but from trial to trial unpredictably varying motion component to the stimulus. Since motion parallax was the only cue, subjects had to make lateral translational movements with their upper body in order to solve the task. If the stimulus did not move, subjects demonstrated a high accuracy (in average 0.2 % of the viewing distance). Adding a constant speed of the same magnitude to both the central pattern and the flanking arrays did only slightly impair this performance. However, when adding constant, randomly chosen speeds independently to both patterns, the threshold increased dramatically, suggesting that the human visual system is not able not take advantage of differential motion parallax.

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