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Visual sensitivity to acceleration: Effects of motion orientation, velocity, and size

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Traditional studies of acceleration perception have measured acceleration sensitivity in terms of the ratio of final to initial velocity or the proportion of change in velocity relative to the average velocity. From these studies, it is unclear as to how sensitivity to visual acceleration is affected by stimulus properties such as motion orientation, base velocity, and size. Here, we measured visual sensitivity to acceleration by parameterizing acceleration as it is defined: the change in velocity per unit time. Observers (n = 18) were asked to discriminate an accelerated stimulus from a constant velocity stimulus equated for mean velocity and size. Acceleration was adjusted according to the QUEST staircase procedure and thresholds, defined as the acceleration discriminated at the 82% correct-level, were obtained for positive and negative acceleration, horizontal and vertical motion, two base velocities, and two trajectory sizes. Consistent with previous findings, thresholds, if expressed according to proportion of velocity change relative to the base velocity were relatively constant across base velocities and sizes. Critically, we show that absolute acceleration thresholds varied in a manner analogous to Weber's law. We show also that thresholds were better for motions along the horizontal axis than the vertical axis, but only at the high base velocity and smaller size. Furthermore, acceleration sensitivity was not affected by the sign of acceleration or stimulus direction within the principle axes. These findings are discussed in the context of predictions of acceleration sensitivity from previous data for the perception of animate and inanimate motions.