CONTROL OF ISOMETRIC GRIP FORCE, VISUAL INFORMATION PROCESSES, AND FITTS' LAW

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ABSTRACT

Fitts' law models the relationship between the amplitude, precision, and speed of rapid movements. It has been widely used to quantify performance in pointing tasks, particularly for Human-computer interaction, but the same model can be applied to analogous tasks. If Fitts' law also applies to grip forces, model parameters would provide a meaningful approach to quantify grasp performance for rehabilitative medicine and prosthetics. We examined the applicability of Fitts' law to a grip force production task, with and without visual feedback (via a force meter), and with target forces presented both explicitly (arrows on the force meter) and implicitly (images of objects). When visual force feedback is available, speed and accuracy of grip force follows Fitts' law (average r2 = 0.82). Without vision (operating exclusively on tactile feedback), accuracy of grip force remains high, but force precision is lower, resulting in overall performance that is relatively insensitive to the target presented. Replacing explicit-but-abstract force targets with images of familiar objects that serve as implicit, well-understood targets enabled participants to generate consistent grip forces more reliably. Population means show that the underlying behavior is well-described by Fitts' law with either vision (r2 = 0.96) or implicit targets (r2 = 0.89), but not for explicit targets without vision (r2 = 0.54). Implicit targets allow for a straightforward and realistic see-object-squeeze-object test that uses Fitts' law to quantify the relative speed-precision relationship of any given grasper.