**Does light touch enhances manual control?**

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## INTRODUCTION

Human postural sway is reduced when individuals lightly touch a surface below a threshold that provides mechanical support [1, 2]. Lightly touching a surface provides augmented proprioceptive information that appears to be beneficial for postural control [3].

Although, lightly touching a surface reduces sway during quiet stance, there is little evidence this minimization is actually functional (i.e. stabilizes posture in a manner that allows improved control of a goal-directed task). Investigating the functionality of light touch is significant since people rarely stand for the sake of standing. Rather, in daily life, people control posture in a manner that facilitates the performance of other goal directed tasks. In the current study, we investigated if the stabilization provided by lightly touching a surface is functional. Participants performed a manual precision task with their dominant hand while lightly touching a surface with their non-dominant index finger. We hypothesized that if light touch is indeed functional, posture should be stabilized in a manner that facilitates the performance of a manual task.

## METHODS

Eighteen young college-aged participants stood comfortably on a force platform. 3D kinematics of the upper body and center of pressure (CoP) data were collected as participants performed a standing manual fitting task. Participants were instructed to pick up and then fit a block through either a small or large opening (the transport phase of the task). The block was then held in the opening for 20s (the holding phase of the task). All trials were performed while either touching (below 1.1N) or not touching a surface (Figure 1).

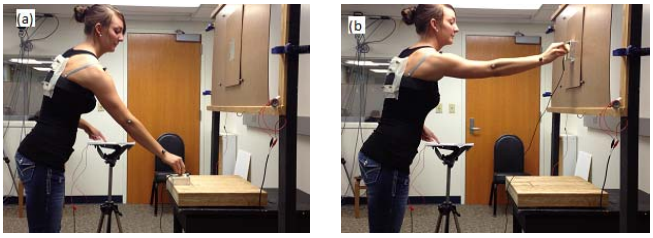


Figure 1: The block was (a) picked up and (b) fit into an opening. Once the block was within the opening, the participant was instructed to hold it in place for 20s.

The standard deviation (SD) of CoP and trunk position in the medial-lateral (ML) and anterior-posterior (AP) directions were assessed over the transport and holding phase of the task. The wrist straightness ratio was assessed over the transport phase of the task to examine the smoothness of the reach trajectory.

## RESULTS AND DISCUSSION

No touch by opening size interactions were observed in either the transport or holding phase of the task ($p>0.05$). However, there was a main effect of touch. CoP and trunk displacement SD in both the AP and ML directions were lower in both phases of the task when participants lightly touched the surface ($p<0.05$). We also observed a main effect of opening size. The CoP SD (Figure 2) and trunk position SD in the ML direction were smaller during both the transport and holding phase when fitting through the small opening. The wrist straightness ratio (Figure 3) was also lower when lightly touching the surface, suggesting a smoother reach trajectory ($p<0.05$).

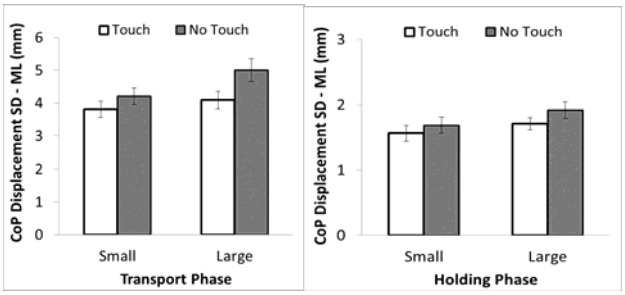


Figure 2: COP SD (ML direction) was lower during the transport and holding phase when fitting through the small opening ($p<0.05$).

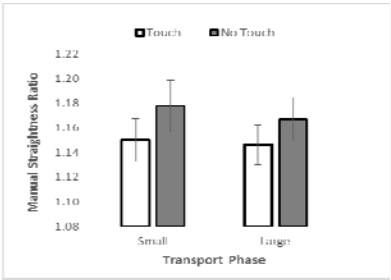


Figure 3: The straightness ratio was lower when lightly touching a surface suggesting a smoother reach trajectory ($p<0.05$).

The smoother reach trajectory and decreased trunk and arm fluctuations suggest that lightly touching a surface may indeed aid the performance of a manual task. It is however interesting to note that there was no touch by size interaction, indicating that light touch stabilization is not scaled to the task constraints. Typically, when performing a manual task, posture is controlled in a manner that facilitates performance of the task. For example, when performing a precision manual task, posture is stabilized to improve hand precision. However, when performing a non-precision demanding task, posture is not tightly constrained. Allowing sway likely improves postural flexibility [4]. Thus, the healthy postural system either allows or constrains sway based on the demands of a concurrent task [5]. Given the task-dependent nature of posture, a touch by size interaction was expected if light touch is indeed functional. In essence, overly constraining postural sway when postural sway could be beneficial may ultimately impair performance or threaten upright stance. There are many potential reasons the touch effect was not scaled to task constraints. First, it is possible that the stabilization effect emerges because light touch at the finger triggers the postural muscles in a feedforward manner [6]. If the light touch effect emerges prior to manual feedback, the touch effect may not be task dependent.

Second, one rational typically given why postural sway may, in some circumstances, be beneficial, is because it is exploratory [5]. Although constraining sway when it is not warranted could impede these exploratory processes, it is possible that the exploratory information can be generated at the finger when lightly touching a surface [7]. If the exploratory information lost by constraining sway is compensated by the finger contact, there is no cost to constraining sway.

Finally, it may be that light touch is simply an epiphenomenon of some other process and not necessarily functional. Studies with clearer performance measures may be able to better address the functionality of light touch.

## CONCLUSIONS

Our findings indicated that lightly touching a surface improves performance of a concurrent manual goal-directed task.

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