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The Effect of Vibrotactile Complexity on Spatial and Temporal Performance During a Wrist Movement Task

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PURPOSE: Compare task performance when individuals are provided vibrotactile (VT) sequences of increasing temporal complexity. **METHODS:** 30 right-hand dominant participants aged between 18-30 provided informed consent and were enrolled into 3 groups (C1, C2, C3). A 1-degree of freedom wrist flexion/extension matching task was performed with each group assigned to 1 of 3 VT sequence complexity options. VT information was supplied with a 2-tactor array on the right forearm, indicating the speed and direction of targeted movement patterns. Those in group C1 were provided with a simple VT pattern with 1 temporal component (500ms). C2 participants were provided a complex repeating pattern with 2 temporal components (750ms, 500ms). Participants in C3 were provided the most complex VT pattern with 3 repeating temporal components (1000ms, 500ms, 750ms). Participants were given 5, 20-second trials to reproduce their target pattern under VT guidance while wrist movement was captured with an electrogoniometer. Flexion/extension movements were combined to calculate overall temporal accuracy (ACC; absolute error) and precision (PREC; standard deviation), as well as overall wrist range of motion (ROM) and ROM variability (ROM-SD) across each trial. Repeated measures mixed-models (5x3) examined performance outcomes between patterns (C1, C2, C3) and across trials (1-5) with post-hoc Tukey HSDs. **RESULTS:** No significant interactions were observed. Within the spatial domain only ROM trial differences were observed, revealing trial 1 to be significantly different from all other trials (mean±SD; 1=69.1±22.9°; 2=83.1±20.6°; 3=83.4±20.6°; 4=83.1±20.5°; 5=82.0±19.6°; $p<.05$). In the temporal domain, each group was found to be significantly different from the other for ACC (C1=0.082±0.089s; C2=0.176±0.045s; C3=0.293±0.099s; $p<.05$); while C3 was different from other groups for PREC (C1=0.126±0.179s; C2=0.171±0.068s; C3=0.303±0.183S; $p<.05$). Additionally, trial effects were observed with trials 1 and 2 found to be different from trials 3-5 for ACC (1=0.229±0.144s; 2=0.196±0.136s; 3=0.167±0.097s; 4=0.159±0.103s; 5=0.169±0.094s; $p<.05$); while trial 1 was different from all other trials for PREC (1=0.309±0.280s; 2=0.194±0.152s; 3=0.162±0.107s; 4=0.156±0.089s; 5=0.181±0.104s; $p<.05$). **CONCLUSION:** Altering VT pattern complexity by increasing the number of temporal components for users to match negatively influences temporal performance. Without explicit spatial instruction no group differences were observed for performance in the spatial domain. Results also suggest participants quickly adopted a preferred movement pattern that then persisted for the remaining trials. **SIGNIFANCE/NOVELTY:** As VT tools become more popular among rehabilitation specialists to guide movement, it is important to better understanding how users are able to interpret and respond to such interventions.