Time Perception and Mental Imagery

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Introduction

Research on mental imagery shows a lack of consistency in the temporal equivalence between imagined and actual movements (Guillot & Collet, 2005). We know little about the timing mechanisms used in the mental simulation of actions, or the relationships between imagery timing and other forms of timing. The literature on interval timing also shows that our perception of time is often far from veridical, and on temporal reproduction tasks error patterns appear to conform to Vierordt's law where short durations are over-estimated and longer durations are under-estimated. However, accuracy on other timing tasks show patterns closer to Weber's law where variations in judgments grow linearly as the duration of the interval increases. The two studies presented here investigate relationships between imagery timing and estimation, production and reproduction timing.

Imagery Timing and Timing Estimates

Participants (n=22) were asked to verbally estimate how long it would take them to walk distances of 15m, 33m and 65m and to time themselves mentally walking these distances. To increase variations in responding task complexity was manipulated by asking them to estimate and imagine journeys along a straight corridor and a complex stairway, and with or without a 5kg load. Finally, measures of actual walk times were taken and timing errors for imagery and estimation were calculated.

Results and Discussion

The data did not conform to Weber's law in that the coefficients of variation varied across conditions. Participants under-estimated when they mentally imaged walking and this under-estimation increased significantly with distance ($F(2,42)=43.80$, $p<0.01$, ES=0.68) and load ($F(1,21)=5.30$, $p<0.05$, ES=0.20). In contrast they verbally over-estimated predicted walking times, with significant increases with distance ($F(2,42)=9.24$, $p<0.01$, ES=0.31), load ($F(1,21)=18.25$, $p<0.01$, ES=0.11) and path complexity ($F(1,21)=15.91$, $p<0.01$, ES=0.43).

The data also suggest that as distance and perceived effort increased the 'internal clock' speeded up relative to the external objective clock. When a person whose 'internal clock' is speeded up is asked to estimate the duration of an interval they over-estimate and report it as having lasted longer than it actually did. However, when asked to produce or reproduce the interval they under-estimate (Bindra & Wakesberg, 1956). Therefore, if imagery timing is similar to production or reproduction timing and uses the same timing mechanism as estimate timing, then the amount of over-estimating in the verbal estimates and under-estimating in imagery should be proportional. Further analysis showed this to be a consistent trend in the group means but only applied to a small number of trials for each individual.

Imagery, Production, Estimation and Reproduction

The aim of this study was to see if motor imagery timing conforms to Vierordt's law in a similar fashion to other interval timing tasks. Participants (n=20) were asked to mentally walk 6 distances in either a straight line (straight imagery) or a square (segmented imagery) and to undertake reproduction, production and estimation timing tasks on a computer. The tasks were matched so that the timing accuracy for durations of less than 3s and more than 6s could be compared.

Results and Discussion

ANOVA comparing error scores gave a significant main effect of task ($F(4,76)=4.06$, $p<0.01$, ES=0.18) and a post hoc Tukey HSD test showed the segmented imagery to be significantly different from the other tasks ($p<0.05$), with a small but consistent over-estimation in segmented imagery timing and a tendency for under-estimation on the other tasks. Overall accuracy levels were comparable for timing on straight imagery, reproduction, production and estimations. There was also a significant effect of duration ($F(1.66,31.49)=16.83$, $p<0.01$, ES=0.47) where judgments of the events with the three shorter durations were significantly more accurate ($p<0.05$) than the three longer durations. The interaction between task and duration was also significant ($F(20,380)=2.67$, $p<0.01$, ES=0.12) and a Tukey HSD test revealed that there were no significant differences between straight path imagery and the other tasks for short durations, but there were significant differences between the segmented imagery and the other tasks for the three longer durations. Straight imagery, reproduction, estimation and production all showed 'Vierordt like' effects, but the segmented imagery did not. This suggests that imagery and interval timing processes are similar in some instances but imagery timing accuracy changes according to the nature of the imagined event.

References

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