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Input vs. Output Level Coupling Demonstrates Asymmetrical Attentional Biases

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Input vs. output level coupling demonstrates asymmetrical attentional biases

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Introduction & Method

• Reaching across the body with one hand (referred to as a contralateral reach) incurs substantial costs on various measures of performance compared to ipsilateral (i.e. same side) reaches (Carey, Hargreaves & Goodale, 1996).

• Consequently, reaching with *both* hands to either the left or right side of space forces one hand to reach into it's own space *at the same time* as the other reaches across the body.

• Several studies have shown that, during midline bimanual reaching, the hands show a degree of temporal coupling (i.e. they take off and land at the same time) *even if the movements to be made by each hand are of different amplitudes* (Kelso, Southard & Goodman, 1979; Marteniuk, Mackenzie & Bada, 1984). This coupling is facilitated by a combination of speeding up the hand with the harder task (the longer reach), and slowing down the hand with the easier task (the shorter reach).

•The current study examined the performance of each limb as it reached across the body (the hard task), while yoked to it's ipsilateral reaching counterpart (the easy task).

• These reaches (in the context of a bimanual movement) were compared to identical, unimanual reaches, with the aim of examining which hand is yoked to which during bimanual coordination.

• Changes in 'early' measures, such as reaction time may give insight into the leading hand specified at an input level, while changes in 'later' measures such as peak velocity may indicate the lead hand during movement output. A measure such as total movement time (reaction time + duration) would represent both early and later coupling.

• Right handed participants (n=18) made reaches on a horizontal LED board, under the following conditions:

-Bimanual - Reaching with both hands concurrently to 2 targets (approx 10cm apart) located to the left or right of the body midline (3 target pairs per hemispace; 60 trials).

-Unimanual - Reaching to single targets located in ipsilateral and contralateral space (3 targets per hand per hemispace; 60 trials).

Results

Median scores for reaction time, peak velocity and total reach time under each condition were examined, due to the performance costs often shown in these measures when reaching with one hand into it's contralateral space.

• **Reaction time**

-As no differences were observed in reaction time across the hemispace for either hand in unimanual trials (the aforementioned performance costs), this measure was excluded from further analyses.

• **Peak velocity**

Paired sample t-tests examining the difference between bimanual and unimanual reaches for:

• Left hand, left space: **113.1mm/s difference**; t(17) = 2.59, p<0.05.

• Left hand, right space: **3.3mm/s difference**; t(17) = 0.10, NS.

• Right hand, Left space: **12.9mm/s difference**; t(17) = 0.34, NS.

• Right hand, right space: **82.1mm/s difference**; t(17) = 2.01, NS.

• **Total reach time**.

Paired sample t-tests examining the difference between bimanual and unimanual reaches for:

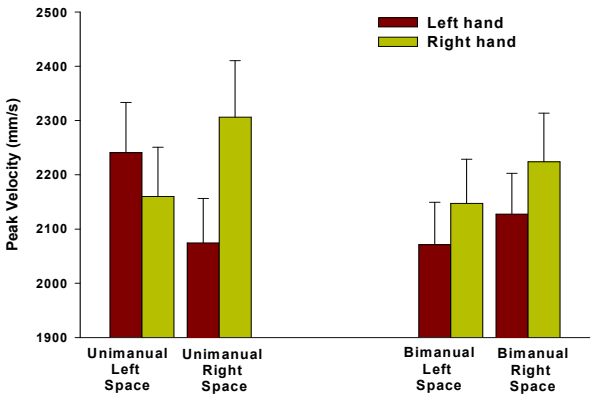
• Left hand, left space: **10.1ms difference**; t(17) = 1.58, NS.

• Left hand, right space: **6.7ms difference**; t(17) = 1.25, NS.

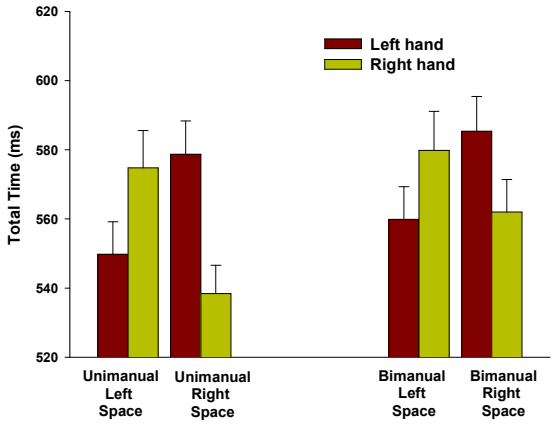
• Right hand, Left space: **5.1ms difference**; t(17) = 0.77, NS.

• Right hand, right space: **23.6ms difference**; t(17) = 3.66, p<0.01.

Peak Velocity



Total Movement Time



Conclusions

The aim of this study was to compare performance measures on bimanual reaches across the hemispace with unimanual reaches across the hemispace, in order to determine which hand was yoked to which.

• Neither hand's contralateral performance was improved by yoking it to an ipsilateral movement of the other hand.

• A lowering of left hand *ipsilateral* peak velocity under bimanual conditions was observed –

-This could suggest that the right hand defines the output characteristics of the overall reach i.e. the left hand is yoked to the right hand.

• Conversely, the right hand showed a bimanual cost in total movement time in it's own space –

-This seems to suggest that the right hand is yoked to the left hand *in terms of input and output measures combined.*

• As the movements in the bimanual condition were of identical amplitudes, which offered little scope for either hand benefiting from it's counterpart, further research is underway comparing reaches of different amplitudes across the hemispace.

References

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