Bimanual Coupling in Left and Right Space: Which Hand Is Yoked to Which?

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Introduction

- Reaching across the body into contralateral space with one hand incurs a substantial cost on various measures of performance, compared to ipsilateral reaches of a similar amplitude (Carey, Hargreaves, & Goodale, 1996).
- When reaching with both hands, unimanual asymmetries disappear.
  - The hands take off and land concurrently (Kelso, Southard, & Goodman, 1979).
- To test if this ‘yoking’ is driven by the left or the right hand, participants performed reaches of different amplitudes.
- These reaches were made to the left or right side of space.
  - Further increasing the unimanual (baseline) asymmetries that get wiped out by the yoking.
- The hand which is less affected by the other’s presence is likely to be driving the coupling.
- The strongest conclusions could be drawn from a relative improvement of a contralateral reaching hand, by the presence of an ipsilateral reaching counterpart.

Method

- Right handed participants (n=18) performed fast bimanual or unimanual reaches toward targets presented on a horizontal LED board.
- The arrangement of the targets allowed for the reaches to be grouped into 4 contextual conditions:

  - Unimanual
  - With shorter
  - With same
  - With longer

- To equate these conditions for the (unrelated) cost to performance of bimanual reaching, a constant was added to the unimanual values.
  - The mean unimanual score was subtracted from the mean with same score; the resulting value was added to the individual unimanual scores on all sides of space.
- Unimanual reaction time was increased by 22 ms & unimanual movement duration was increased by 17 ms.

- This adjusted unimanual reaching context was compared to the with shorter reaching context.
- To increase the chances of demonstrating a performance improvement, only contralateral reaches were analysed.
- The hand that improves the most is more adaptable than its counterpart, therefore not ‘in-charge’ of the yoking.

Results – reaching into contralateral space

Reaction time

- 15 ms right hand contralateral improvement when yoked with a shorter amplitude ipsilateral reach (p < .025).
- No significant contralateral improvement with the left hand.

Movement duration

- 23 ms left hand contralateral improvement when yoked with a shorter amplitude ipsilateral reach (p < .025).
- No significant contralateral improvement with the right hand.

Discussion

- Right hand appears to be yoked to the left hand for the reaction time measure.
  - Left hand in-charge for movement onset.
- Positively related to left hand reaction time advantages often seen in unimanual reaching studies.

- Left hand appears to be yoked to the right hand for movement duration measure (similar trend in peak velocity).
  - Right hand in-charge during movement output.
- Strategic to cope with the increased attentional demands of bimanual reaching.

- This directional yoking could be an expression of a rightward attentional bias during bimanual coordination (Peters, 1981).

References


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