Error Statistics Reflect Movement Coding and Prior Movement History



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Introduction

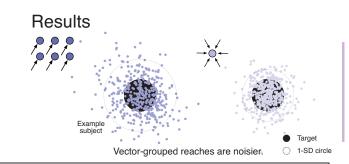
Two possible codes for planned movements:

- · As a vector (direction and extent, Refs. 1,2)
- As a desired endpoint (x/y-coordinates, Refs. 3,4)

Q1: Are both codes used in human movement planning?

Q2: Can they be distinguished experimentally?

Q3: How do they differ in terms of movement accuracy?



Vector-grouped reaches pooled by vector:

12 subjects (all ellipse areas normalized)

Vector-grouped reaches have larger variance along the reach direction.

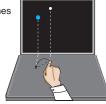
Vector-grouped reaches pooled by target:



But variance looks circular (and larger, not shown here) when vector-grouped reaches are pooled by target.

Methods

 Point-to-point reaches on a tabletop:



· 6 Targets:





 Each target has 6 associated start positions (only 2 sets shown):



pooled by target:



Endpoint-grouped reaches

Endpoint-grouped reaches have circular variance as well when pooled by target.

Endpoint-grouped reaches



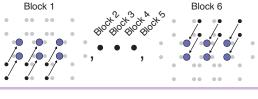
Surprisingly, endpoint-grouped reaches also have circular variance when pooled by reach direction.

 2 blocks (run in random order): Grouped by vector



With 6 sub-blocks:

- · Sub-blocks in random order
- Each sub-block has 12 repetitions of its 6 reaches (random order)



Grouped by endpoint

With 6 sub-blocks:





Conclusions

- A1: Yes, both vector and endpoint codes used in human movement planning.
- A2: Yes, they be distinguished experimentally by blocked practice that makes the better-practiced system dominant.
- A3: Yes, they differ in terms of movement accuracy; the endpoint code results in lower, isotropic variance.

References: (1) Krakauer et al., J Neurosci 20, 2000. (2) Vindras & Viviani, Exp Brain Res 147, 2002. (3) van den Dobbelsteen et al, Exp Brain Res 138, 2001. (4) Thaler & Todd, Neurosci 159, 2009.

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