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Hand Dominance Influences Spatiotemporal Finger **Coordination in Precision Grip, not Finger Individuation**



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Introduction

Handedness—the preference for one hand over the other—has long been associated with motor performance, yet its specific impact on fine motor control remains unresolved¹. While minimal differences have been reported in finger individuation (the ability to isolate one finger away from other fingers)², dominance effect emerges in tasks requiring thumb-finger opposition³. This distinction suggests that superior fine motor control in the dominant hand may depend on a task that requires multi-finger coordination. However, this distinction was only demonstrated in individuation during an opposition task, without examining coordination. Our study fills this gap by investigating both aspects of dexterity. To examine the relationship between finger flexibility and coordination in hand dominance, we assessed finger individuation and precision grip to test whether handedness selectively affects distinct aspects of dexterity.

We hypothesize that:

- 1. Finger individuation is unaffected by handedness.
- 2. Precision grip performance, driven by spatiotemporal coordination across fingers, distinguishes the dominant hand's superior dexterity.
- 3. Individuation ability enchances coordination of fingers during the precision grip tasks.

Methods

Participants: Healthy young adults (N=18, 20.4 ± 2.04 years, 17 right-handed, 13 female) participanted in a study assessing finger individuation and precision grip tasks using both hands. Handedness was assessed using the Edinburgh Handedness Inventory⁴. Participants performed tasks in a virtual environment using a novel 3D isometric fingertip force measurement device⁵⁻⁶.



Finger individuation exhibited no dominance effects.



A higher index indicates better individuation,

reflecting minimal unintended finger activation.



There is no significant effect (p = 0.5267) of hand dominance effect on finger individuation ability.

Precision grip reveals selective dominance effects.

Grip angle did not reveal consistent dominance effects across identical experiments.



John Hopkins University



Pinch type

Grip angle did not show a significant dominance effect, unlike findings at Johns Hopkins, despite similar experimental protocol and participant characteristics across sites.

Precision grip reveals dominant-hand superiority in finger timing and coordination.





The dominant hand shows better touch desynchronization except in thumb-ring pinch, where a higher interval may suggest ring finger inefficiency.



The precision grip task revealed higher across-finger coordination in the dominant hand, whereas the individuation task did not. This suggests that increased spatiotemporal demands may drive these dominance effects.

correlation of thumb-finger movement paths





Individuation ability selectively enhances finger coordination in precision grip.

The between-hand difference (dominant — non-dominant) was computed to assess handedness-related asymmetry. All correlations below use this difference. Takeaways:

- In the individuation task

- No significant correlation was found between individuation ability of the dominant hand and between-hand finger coordination difference (p > 0.05), suggesting that finger flexibility does not directly influence coordination.
- In the precision grip task
- No relationship was found between individuation ability of the dominant hand and coordination among active finger pairs (p = 0.597).
- Better individuation ability of the dominant hand was associated with greater between-hand difference in coordination across active-passive and passive-passive finger pairs (p < 0.05), suggesting that individuation ability enhances coordination by acting on task-irrelevant fingers in the precision grip tasks.



Conclusion

- Finger flexibility (Individuation Index) exhibited no dominance effects, consistent with prior findings.
- We also found no dominance differences in coordination across passive or active-passive fingers in the finger individuation task.
- Precision grip demonstrated dominant-hand superiority in spatiotemporal finger coordination (touch desynchronization, trajectory synchronization, temporal correlations), but not grip angle.
- In the precision grip task, better individuation ability of the dominant hand was associated with the coordination difference between the two hands across active and passive fingers.
- Our findings suggest finger flexibility and coordination contribute to hand dexterity differently.

References

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