The Role of Cerebellar Impact on Adaptive Skilled Behavior

החוג למדעי הקוגניציה
האוניברסיטה העברית בירושלים
قسم العلوم الاستعرافية
الجامعة العبرية في اورشليم القدس
COGNITIVE SCIENCES
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INTRODUCTION

The cerebellum coordinates timing and adaptation in motor control.

This study examines how disrupting cerebellar output with high-frequency stimulation (HFS) affects fine motor behavior in monkeys.

RESEARCH QUESTION: What is the role of cerebellar impact on adaptive dexterous behavior?

METHODS

One monkey was trained to open puzzle boxes requiring fine motor control.

Movements of 11 joints (e.g., wrist, fingertip) were recorded using DeepLabCut, a markerless tracking tool.

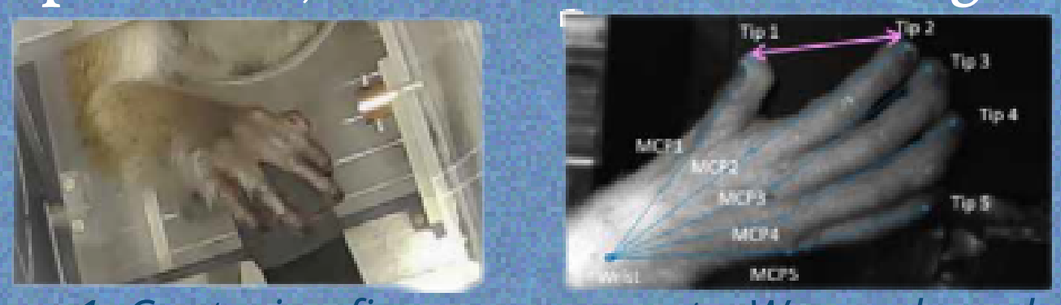

Figure 1: Capturing finger movements. We used markerless tracking algorithm (DeepLabCut) to track movement of individual fingers during task performances.

High-frequency stimulation (HFS) was applied to temporarily block cerebellar output. Each session included both control and HFS conditions.

Joint positions were smoothed, converted to velocity, and analyzed using PCA to compare movement complexity and coordination across conditions.

RESULTS

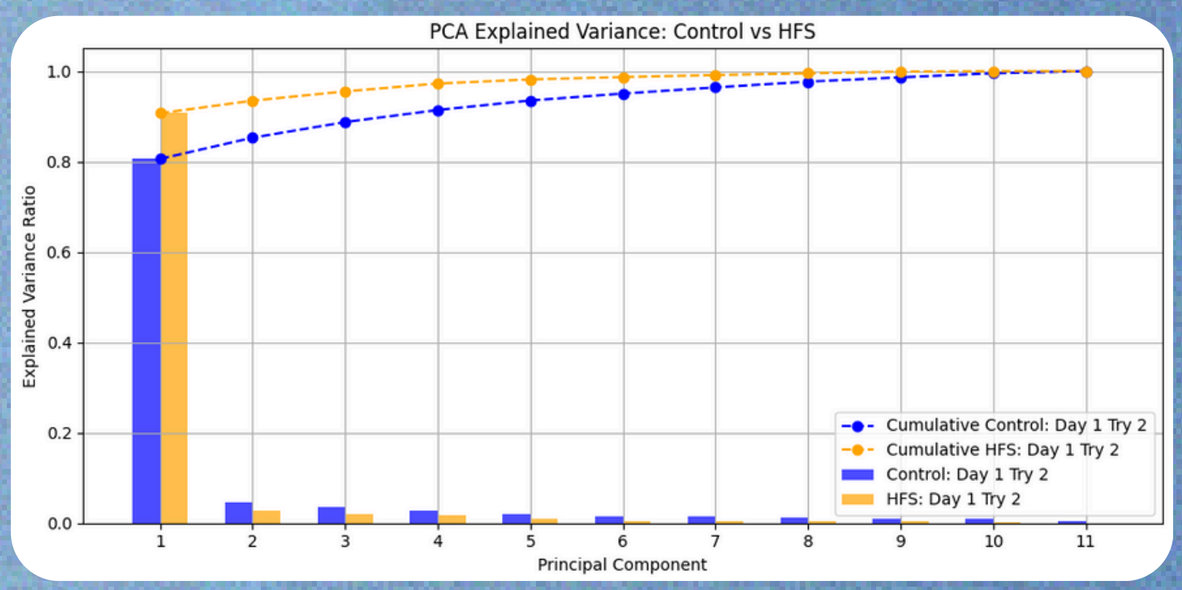

Figure 2: Variance explained by each principal component (PC) in the control and HFS conditions.

The first principal components explain less variance in control than in HFS, suggesting cerebellar output supports adaptive, dexterous behavior, while its suppression simplifies movement.

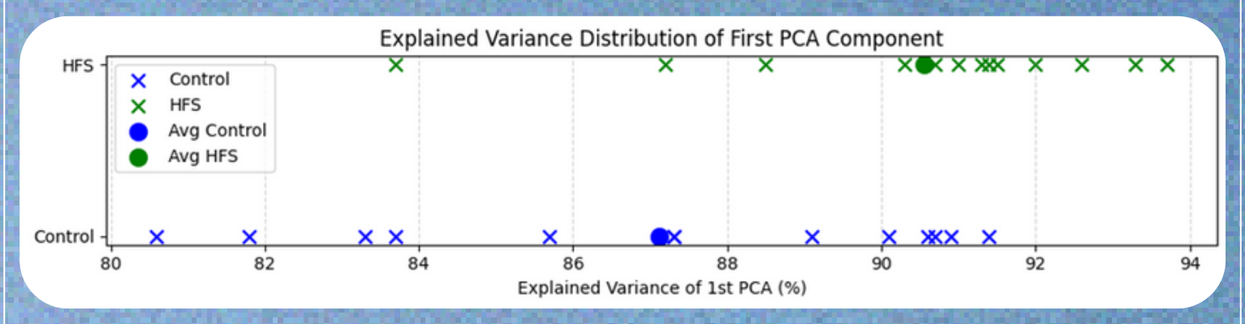

Figure 3: Distribution of the variance explained by the first principal component (PC1) across individual trials in the control (blue) and HFS (green) conditions, with average values shown as bold markers.

HFS shows consistently higher PC1 values than control, supporting the hypothesis that cerebellar suppression reduces motor complexity and impairs dexterous behavior.

CONCLUSION

Blocking cerebellar output with HFS led to simpler, more uniform joint movements.

This suggests the cerebellum helps coordinate precise, flexible finger control in complex tasks.

Future work should examine how cerebellar signals affect learning new motor strategies over time.

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