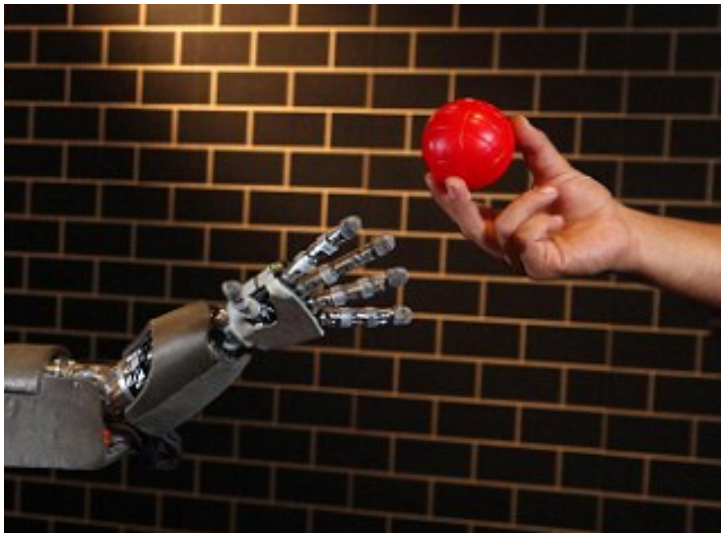
Planning, Coordination, and Control in Joint Action



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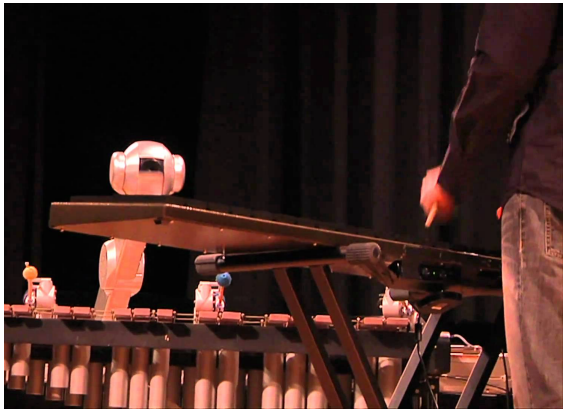
LUBRIMAX
20W-50



Shared Intentions

Social Physics

Coordination through informational coupling (direct perception-action links; e.g., Marsh et al. 2006)

Explains why people naturally fall into synchrony, e.g., rocking in synchrony even against chair eigenfrequency (Richardson et al. 2007)

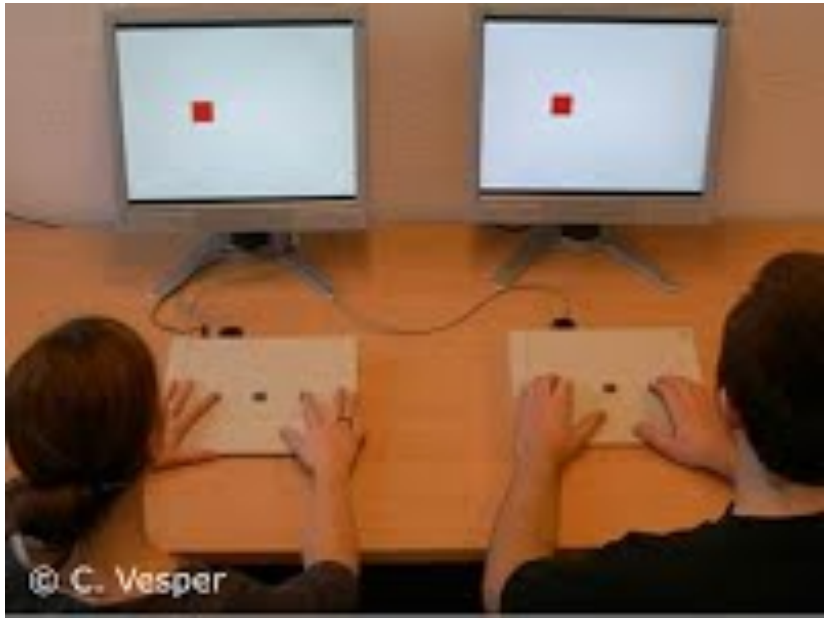
There is not only high-level long-term planning and low-level entrainment….

How do people plan and coordinate joint actions?

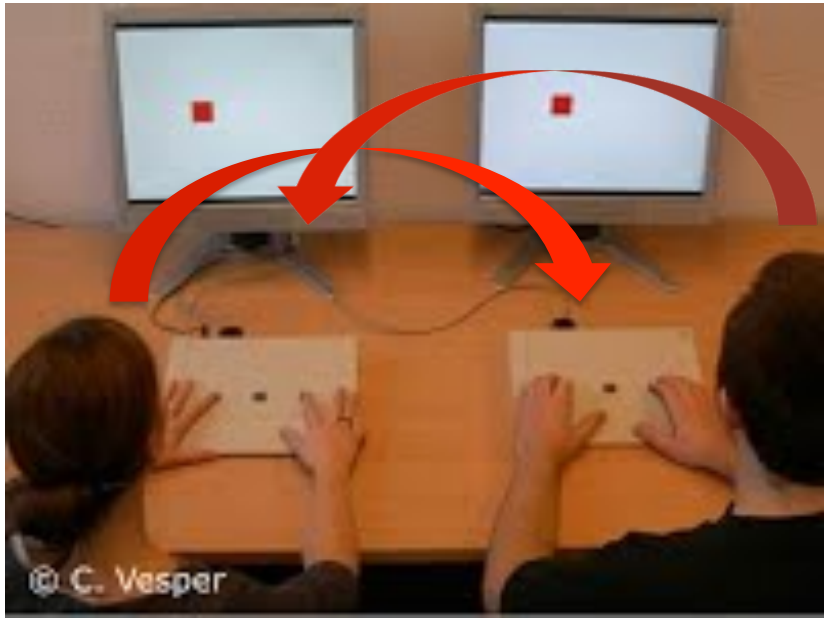
Which factors affect how much individuals feel in control during joint action?

1. Making oneself predictable

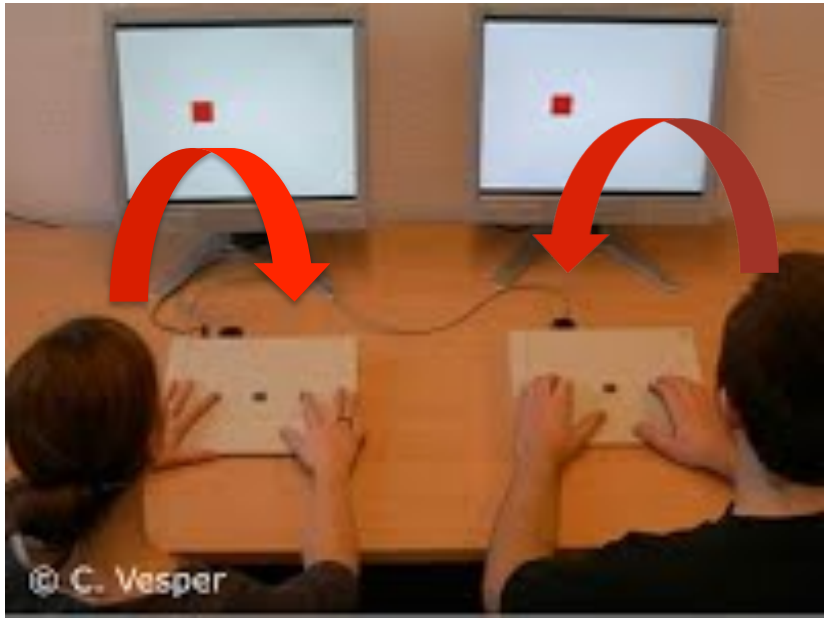
Task: Act in synchrony



Task: Act in synchrony

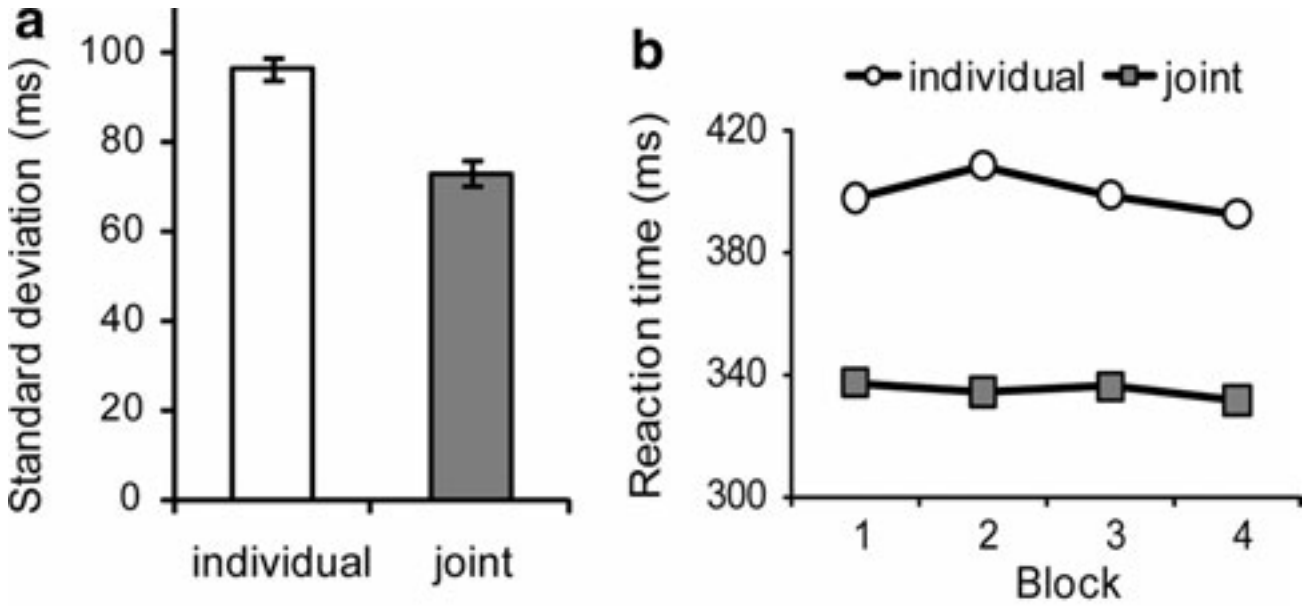


Task: Act in synchrony



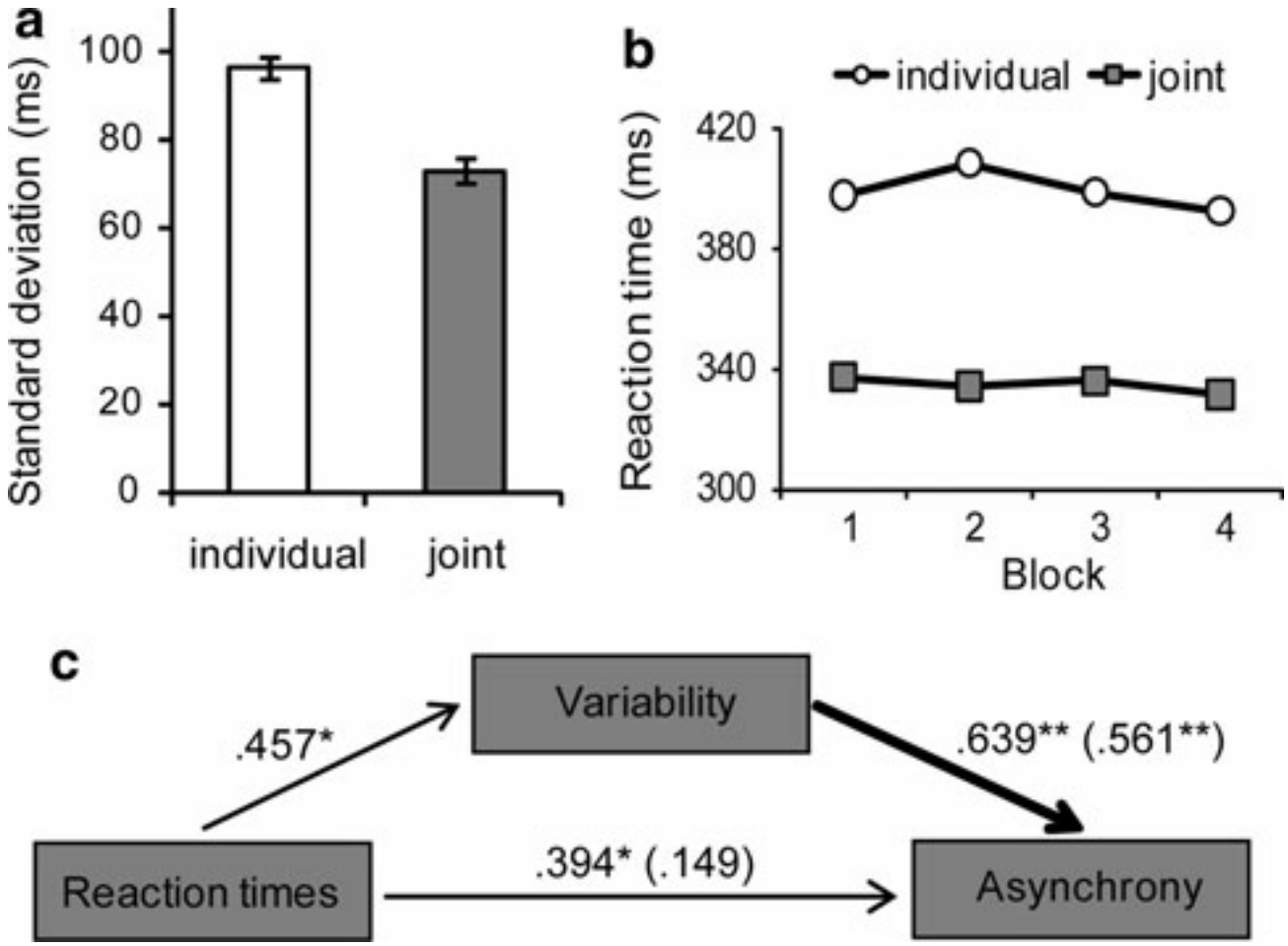
Reducing variability

Vesper et al., EBR, 2011: **Synchronous action coordination**



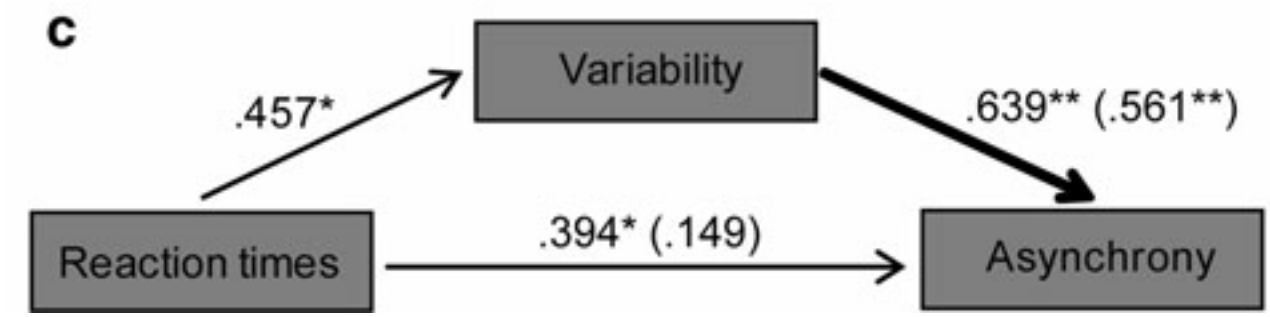
Reducing variability

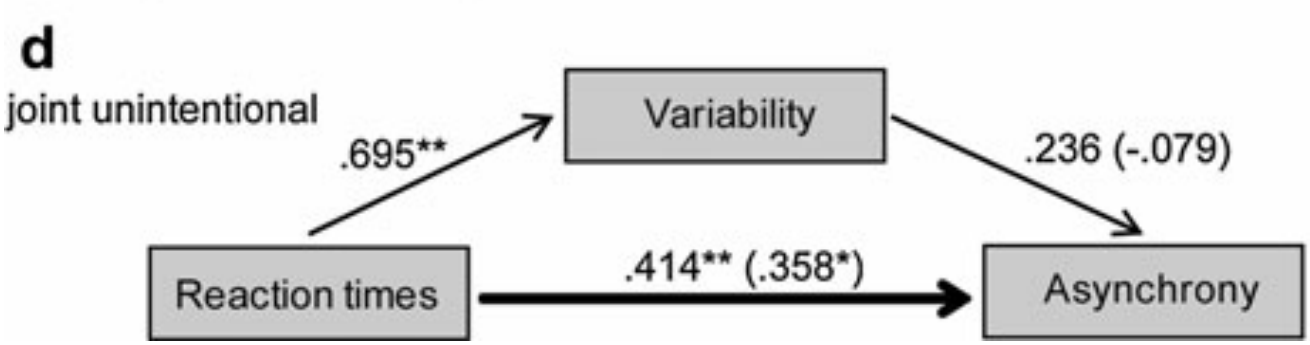
Vesper et al., EBR, 2011: **Synchronous action coordination**



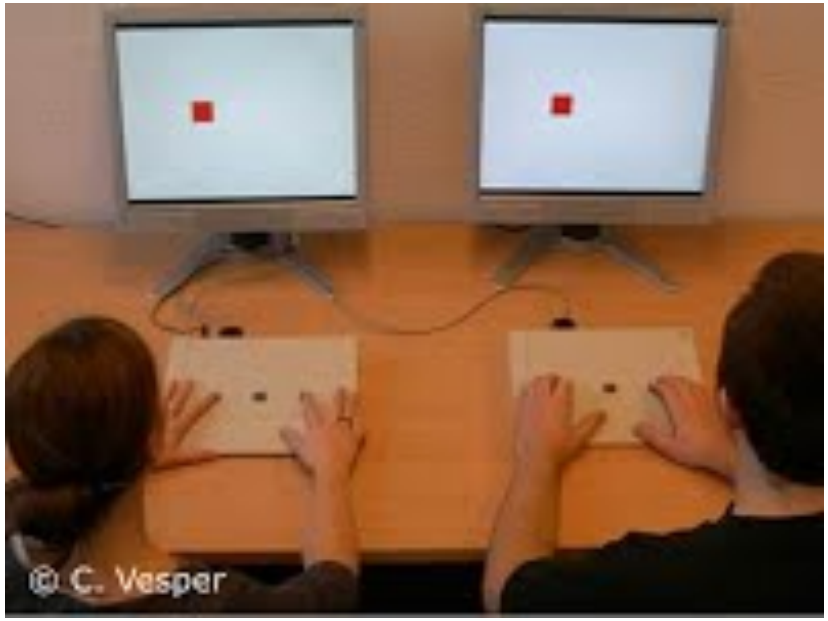
Reducing variability

Vesper et al., EBR, 2011: **Intentional vs. unintentional synchronous coordination**



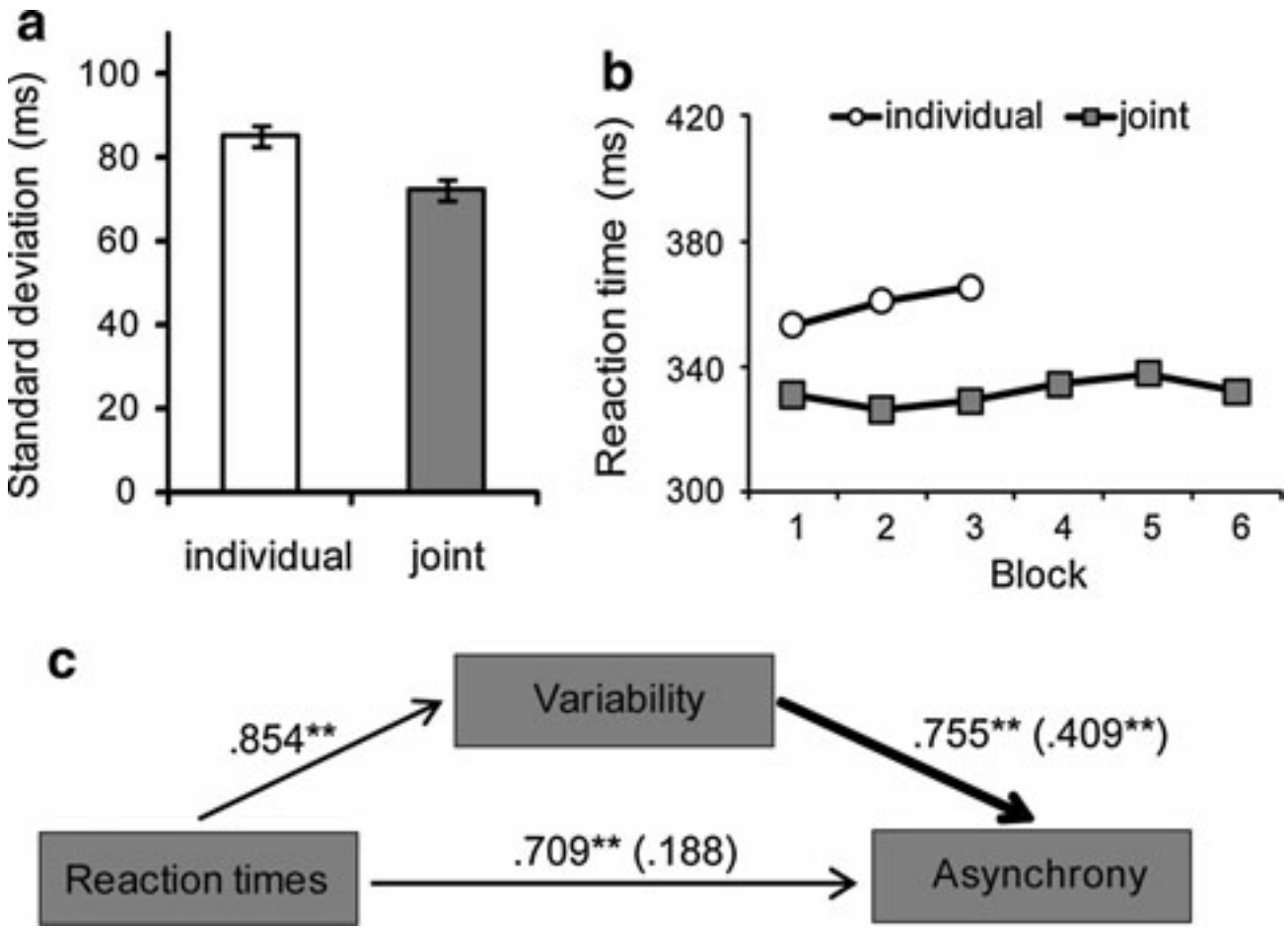


Task: Act in quick succession



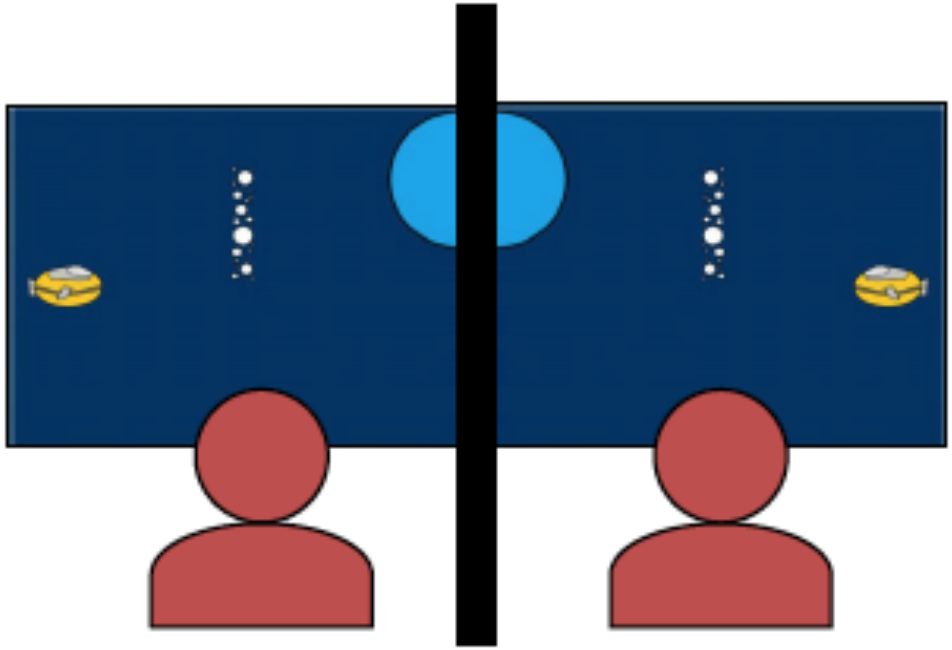
Reducing variability

Vesper et al., EBR, 2011: **Sequential coordination (leader-follower)**

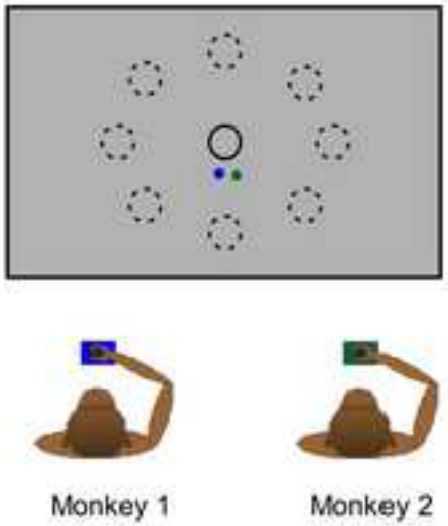


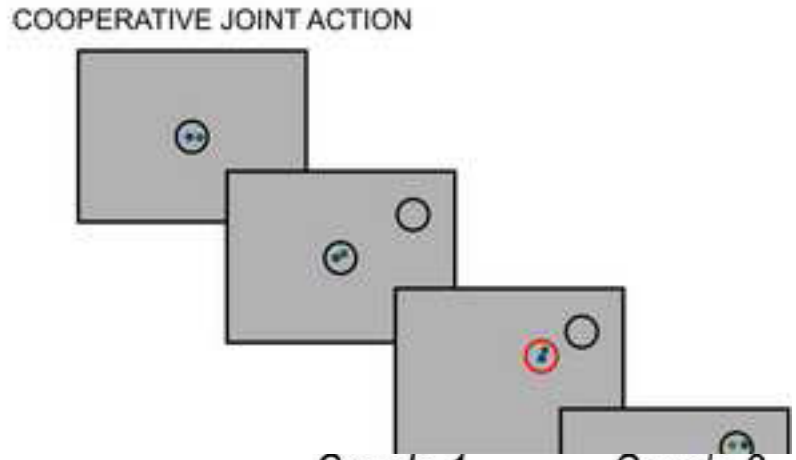
Reducing variability

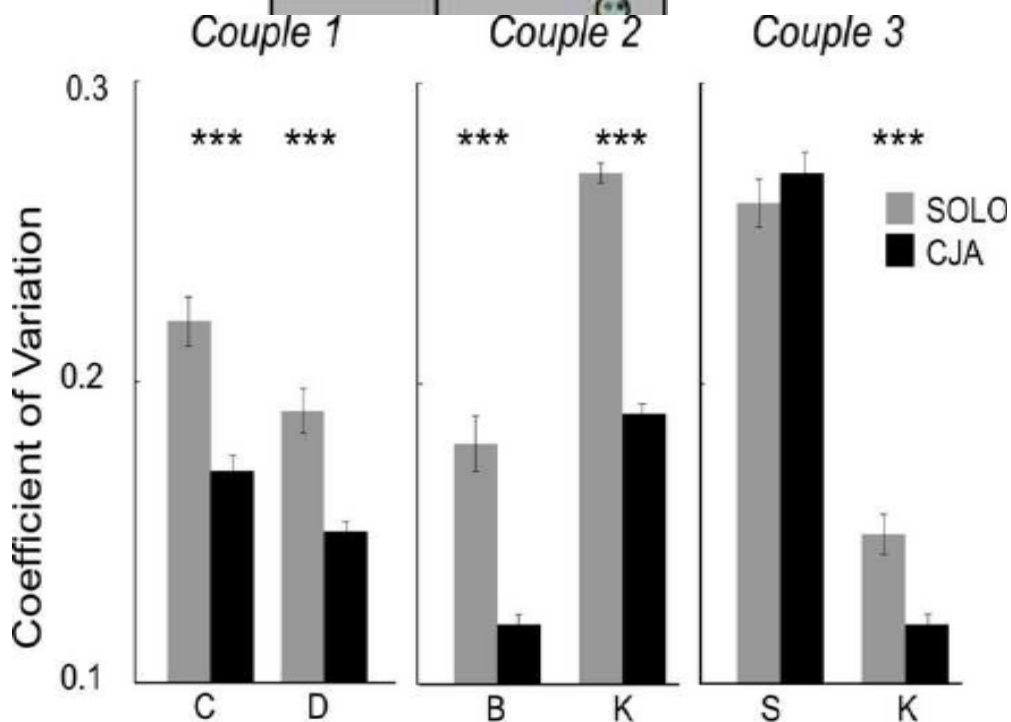
Also works in space!



Reduced variability in macaque monkeys

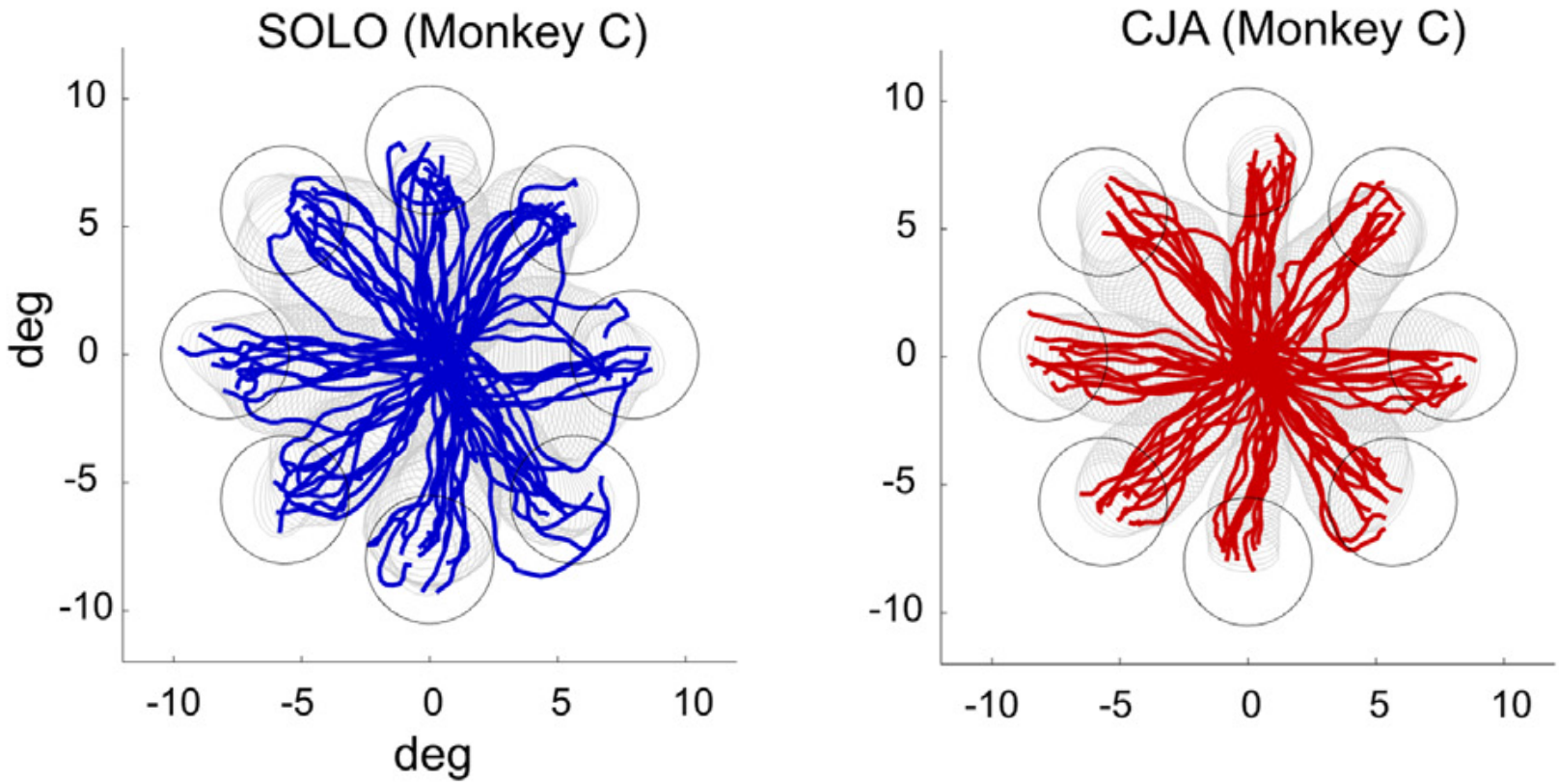






Visco-Comandini et al., Cortex, 2015

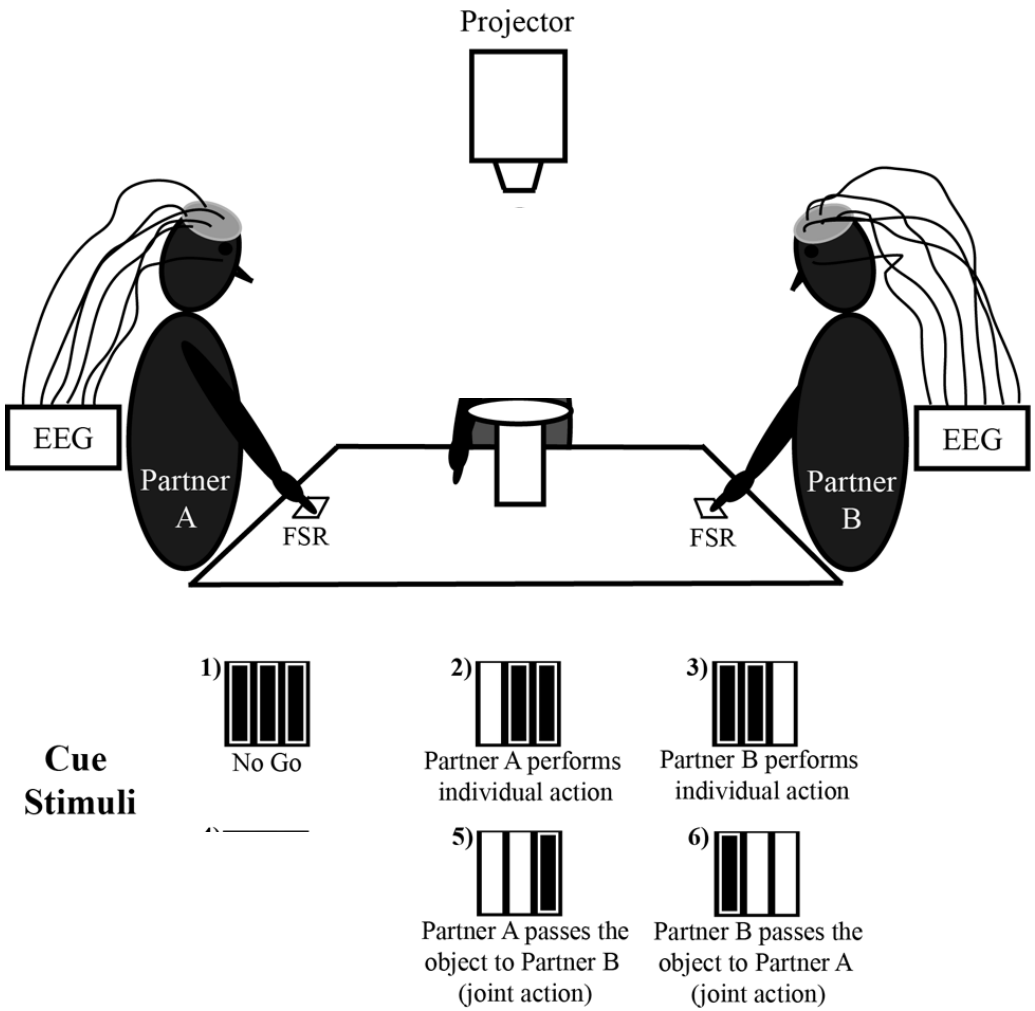
Reduced variability in macaque monkeys



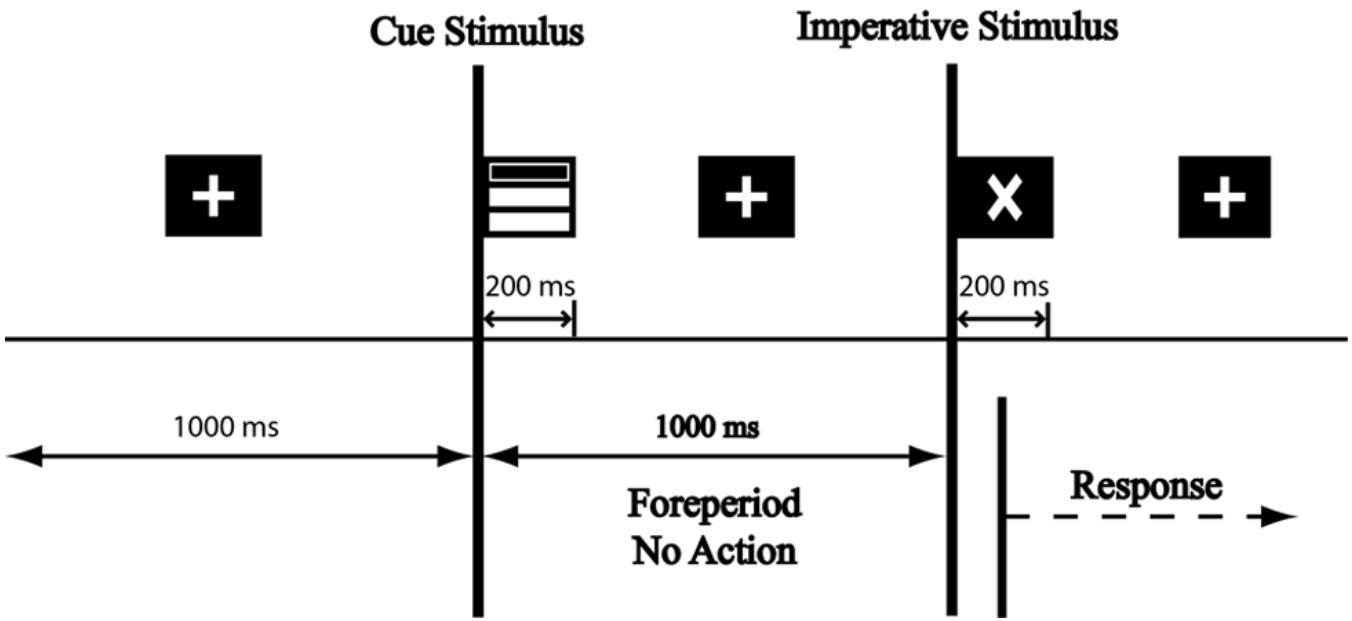
A principle that could scale up...

2. Planning and predicting other’s actions

Planning partner´s action?



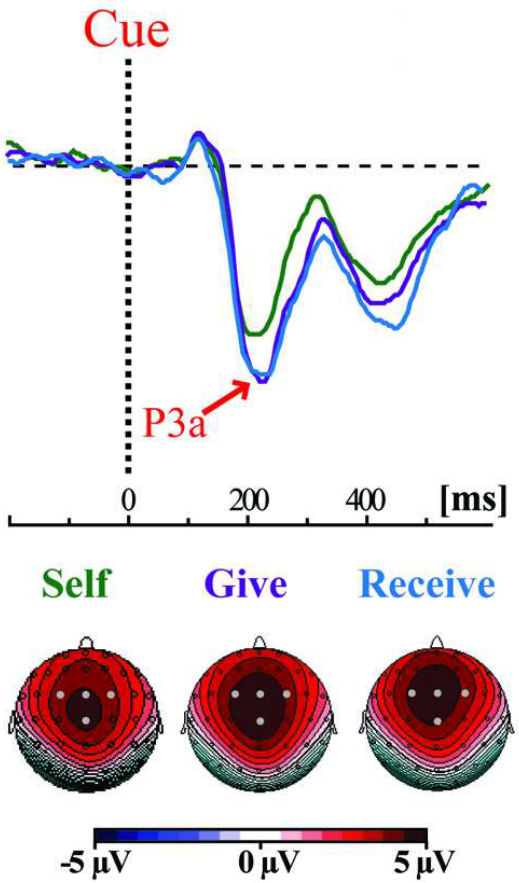
Kourtis, Sebanz, & Knoblich, Social Neurosci, 2013


Cue Stimulus
Imperative Stimulus
200 ms
200 ms
1000 ms
1000 ms
Foreperiod
No Action
Response

Planning partner´s action?

The P3a amplitude is larger when participants prepare for joint action.

This likely reflects a more complex task representation, where the other's part is specified in addition to one's own.



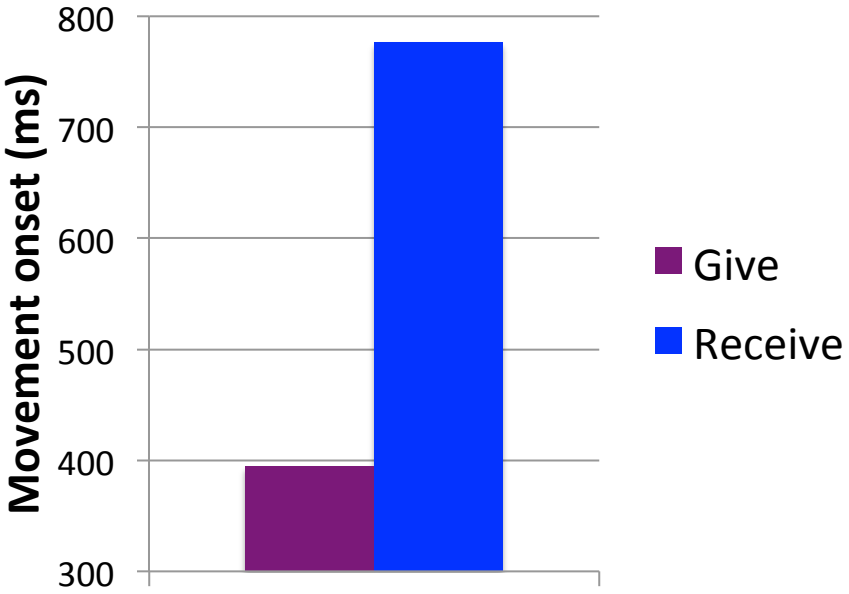
Kourtis, Sebanz, & Knoblich, Social Neurosci, 2013

Predicting other´s timing?

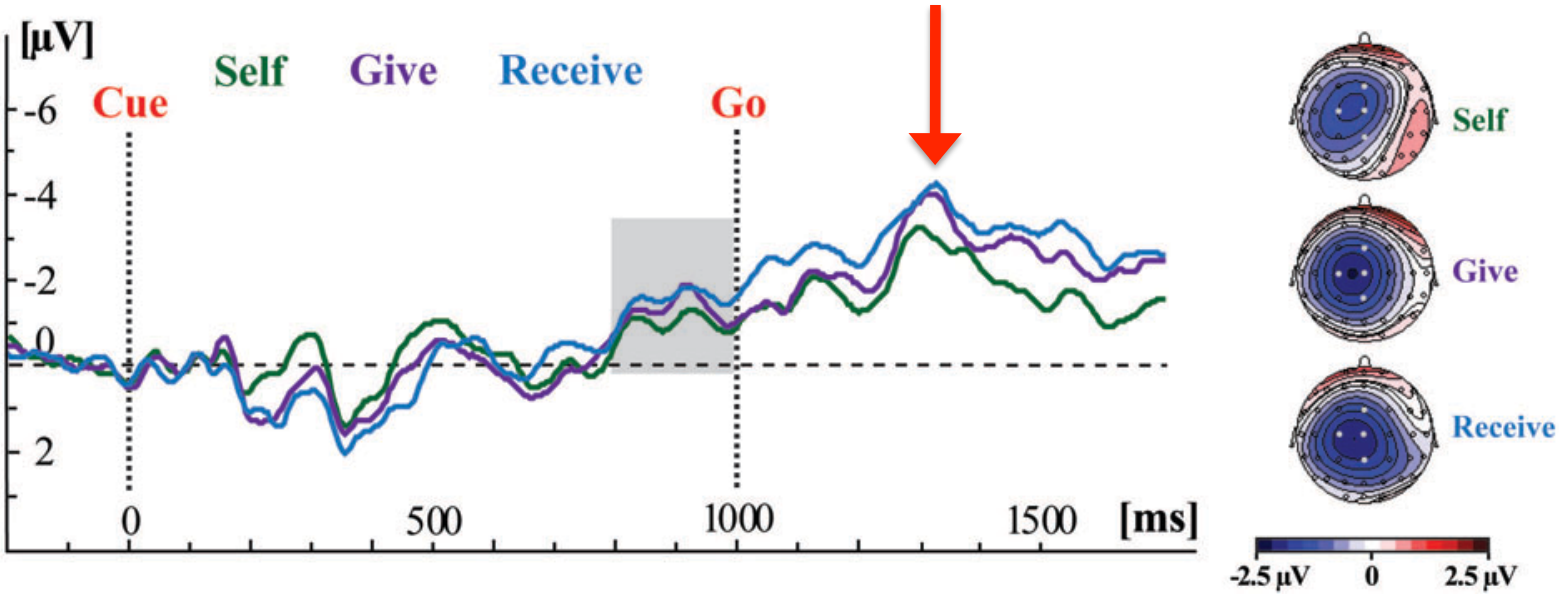
Giving actions are initiated much faster than receiving actions.

The late CNV is a neural marker of motor planning - peaks when people start to act.

If the receiver simulates the giver´s action, the CNV should peak at the onset of the giver´s action.

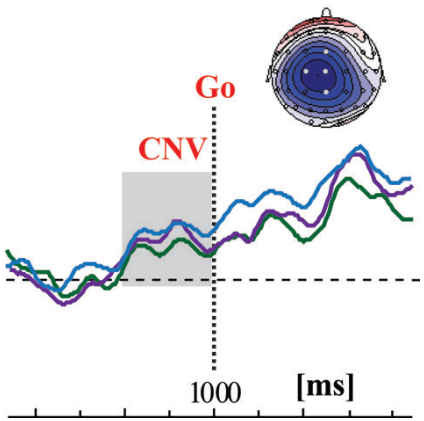


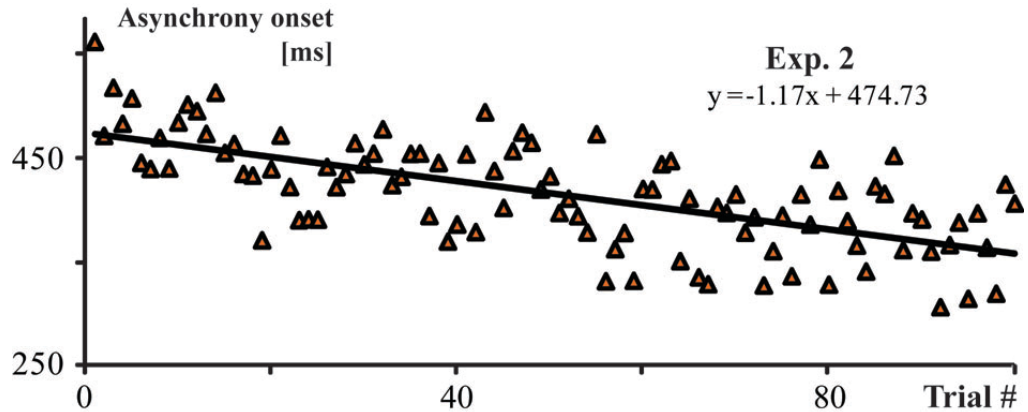
Predicting other´s timing?



The **motor CNV** in the receiver **peaked** around the time of the **giver's action** onset even though the receiver's response onset occurred much later.

Correlation with Joint Performance





The amplitude of the motor CNV in the receiver was correlated with the improvement in coordination performance ($r = 0.585$, $p = 0.022$).

How similar is solo and joint planning?

Kourtis, Knoblich, & Sebanz, JoCN, 2014

Bimanual Action

How similar is solo and joint planning?

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Bimanual Action

Joint (Unimanual) Action

How similar is solo and joint planning?

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Bimanual Action

Joint (Unimanual) Action

Unimanual Action

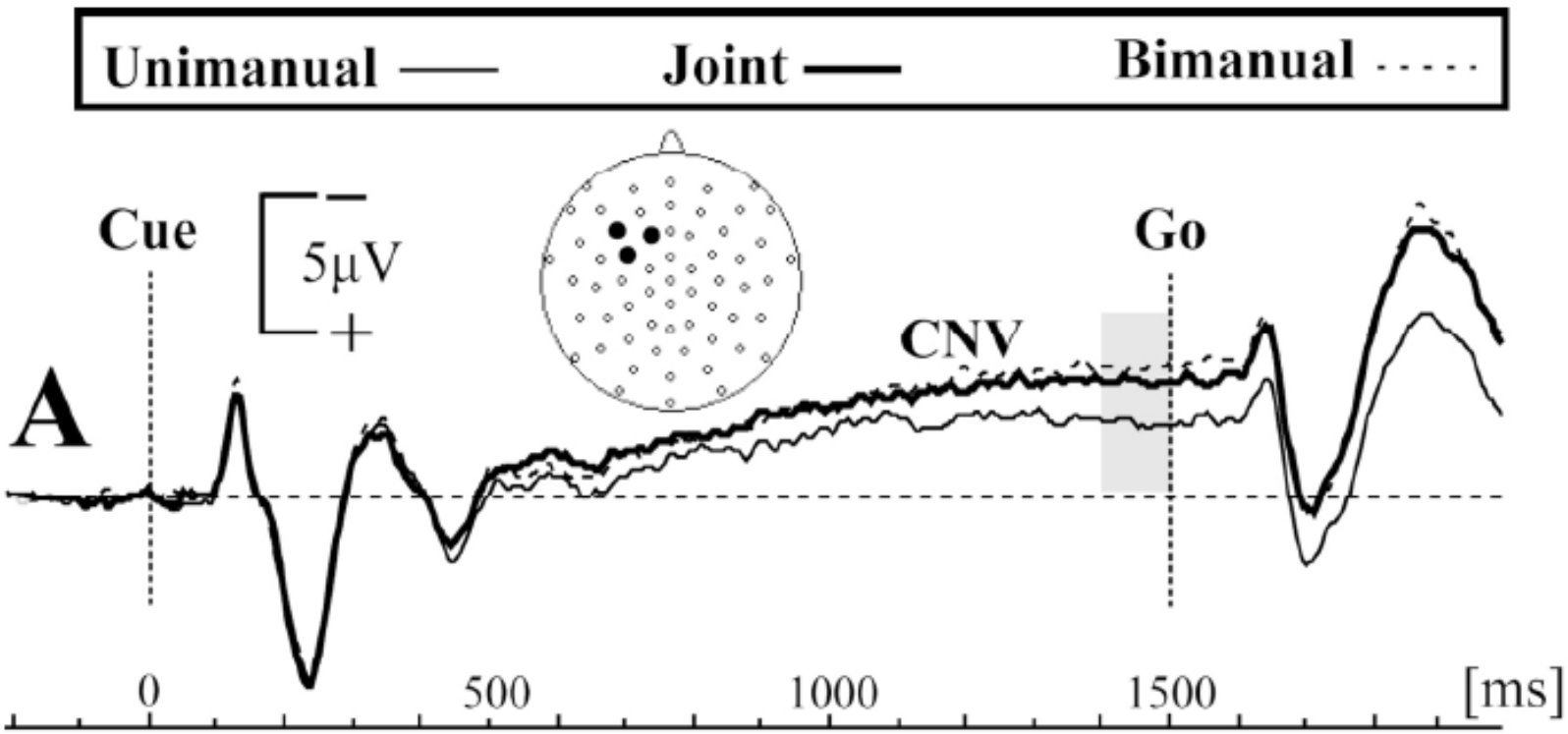
Predictions

Focus on marker of motor activation: CNV

Higher CNV in bimanual than in unimanual condition

Is CNV in joint action condition like bimanual or like unimanual?

Action Representation: CNV



Kourtis, Knoblich, & Sebanz, JoCN, 2014

Conclusions

Reducing variability of one's own actions is a basic and useful coordination mechanism.

A further key process is predicting task partners' actions through motor simulation.

Planning and coordination processes are often tightly linked.