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# Shooting Your Accuracy in the Foot: The Effect of Action Video Games on Cognitive Control

Mickey Rice  
*Ohio Wesleyan University*

Lexi Lease  
*Ohio Wesleyan University*

MaLia Walker  
*Ohio Wesleyan University*

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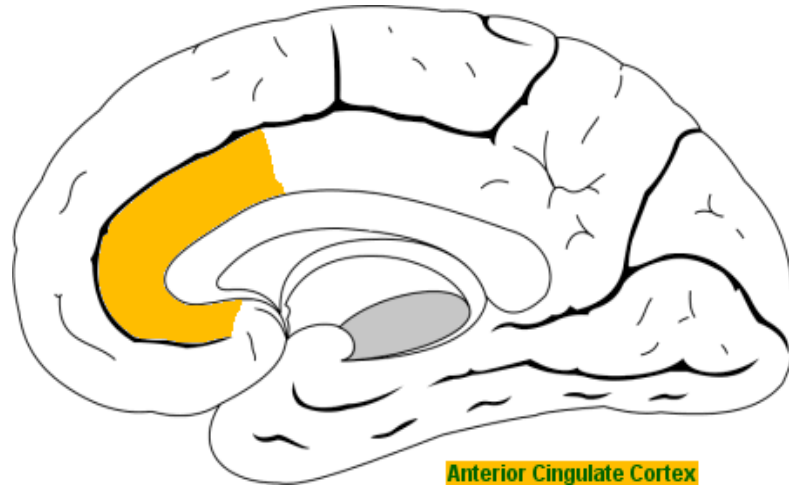
# Shooting Your Accuracy in the Foot: The Effect of Action Video Games on Cognitive Control

Mickey Rice, Lexi Lease, & MaLia Walker  
Mentor: Kira Bailey

## **COGNITIVE CONTROL**

the ability to regulate, coordinate, and sequence thoughts and actions in accordance with internally maintained goals (Braver, 2012)

One aspect of cognitive control is monitoring and resolving conflict...



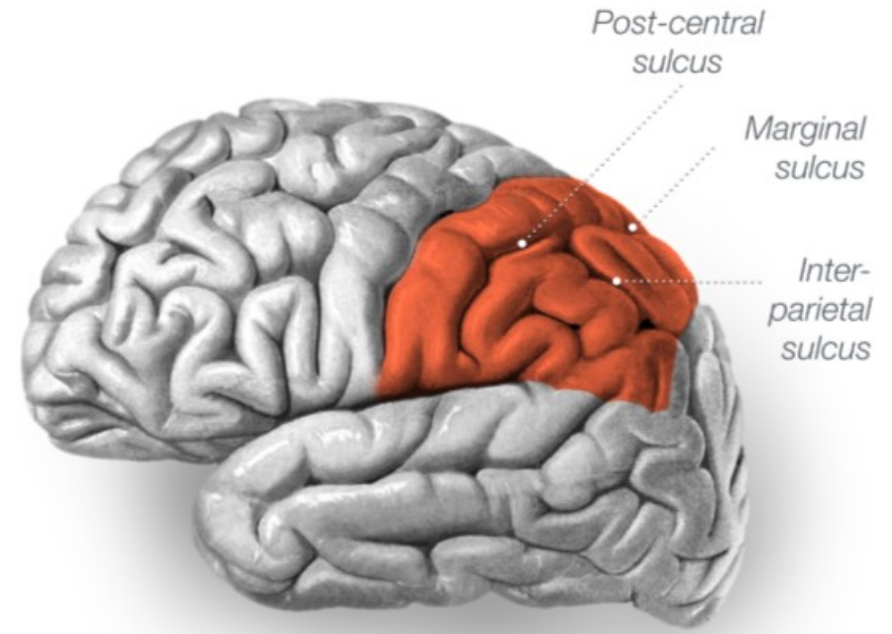
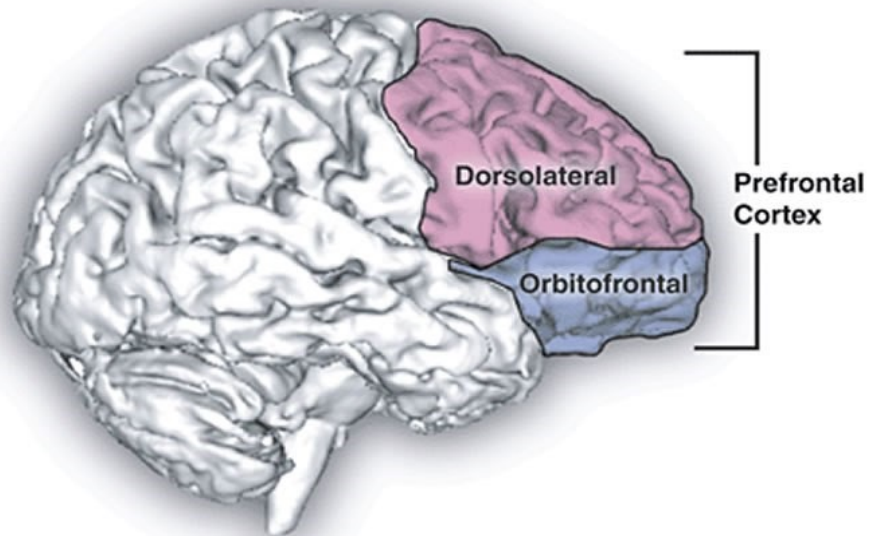
## Monitoring

Transient lateral prefrontal cortex, anterior cingulate cortex

## Resolving

Sustained parietal cortex and lateral prefrontal cortex

Parietal lobe sulci



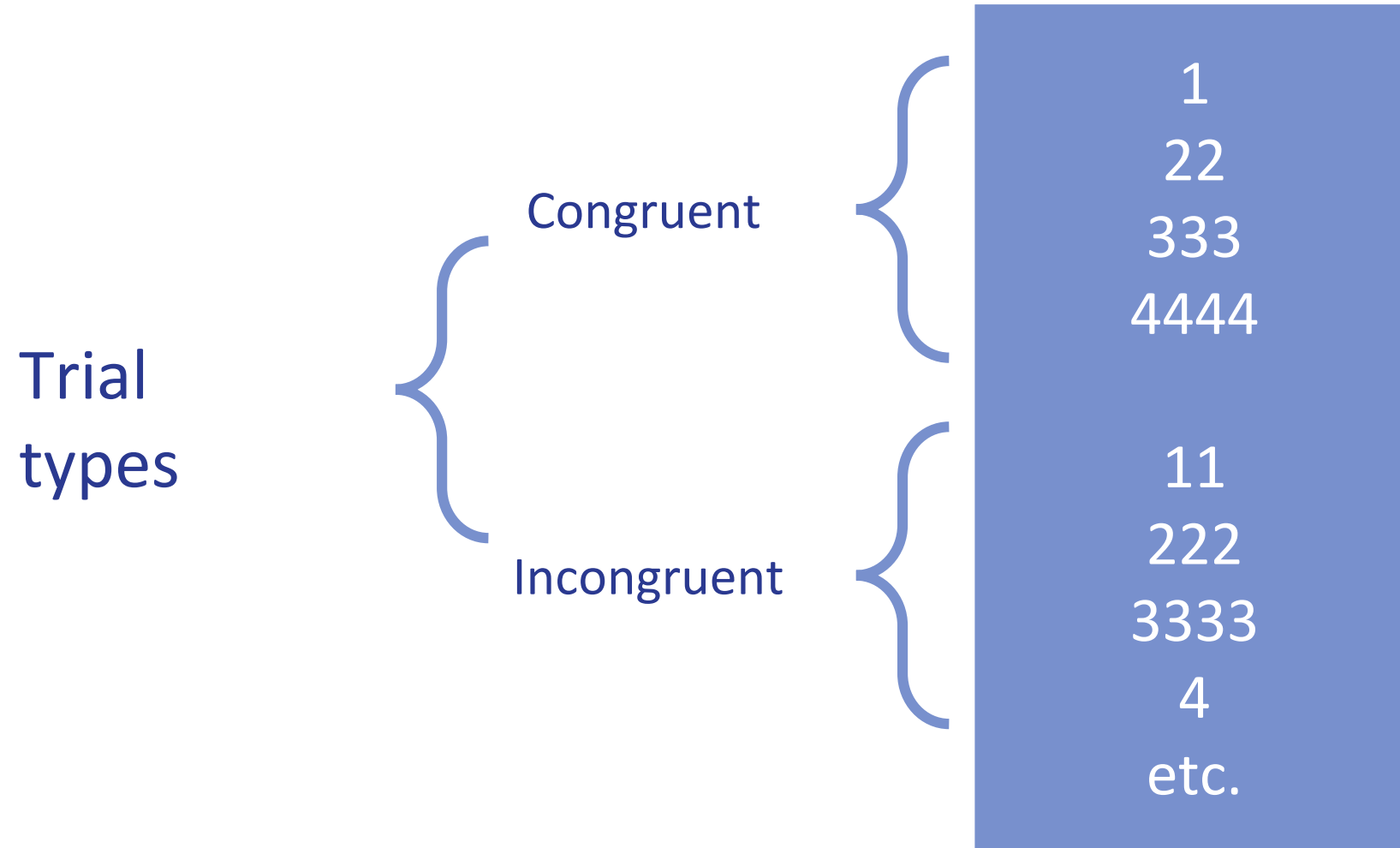




Conflict can be unexpected or expected. Your response to conflict will shift between unexpected and expected conflict responses based on your current goals and environment

## Measuring the conflict responses in the laboratory...

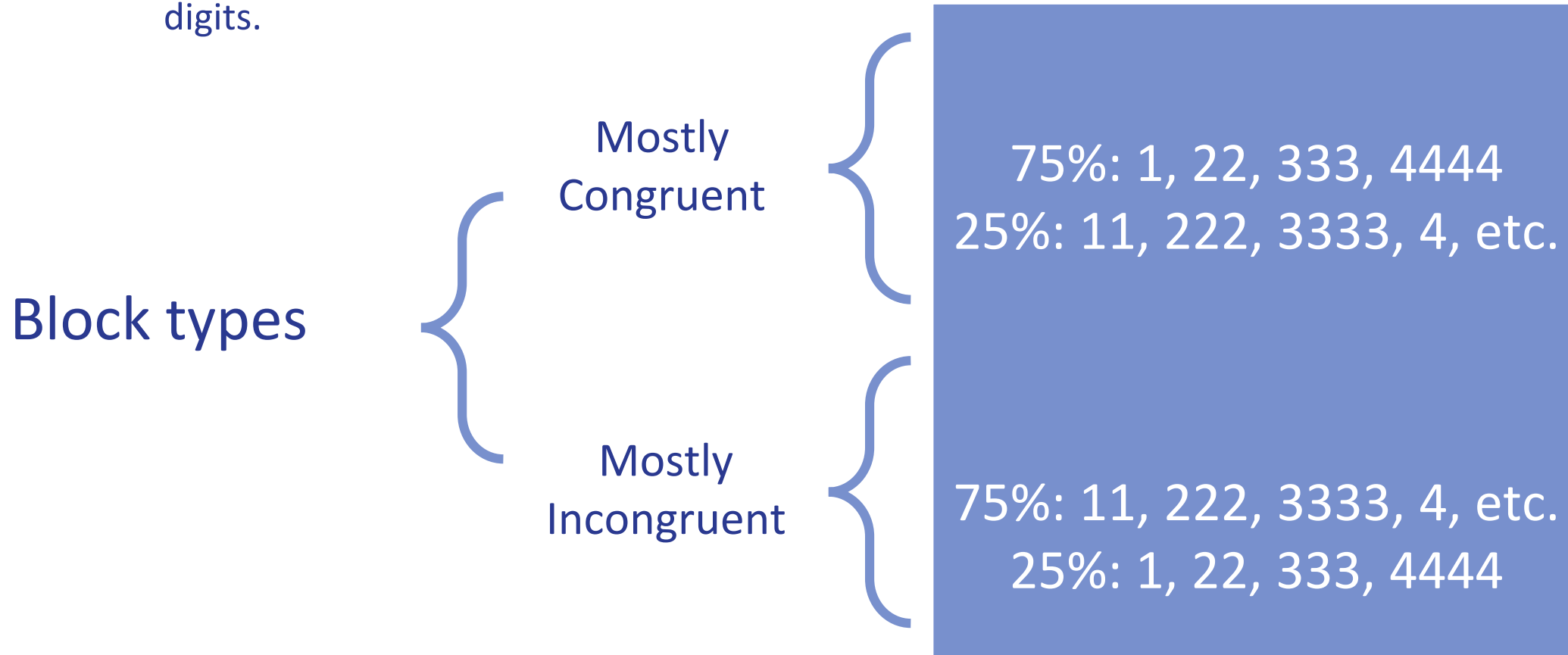
**Counting Stroop task:** indicate how many digits are presented, NOT the identity of the digits.



Responses are slower and less accurate for incongruent trials than congruent trials.

## Measuring the conflict responses in the laboratory...

**Counting Stroop task:** indicate how many digits are presented, NOT the identity of the digits.



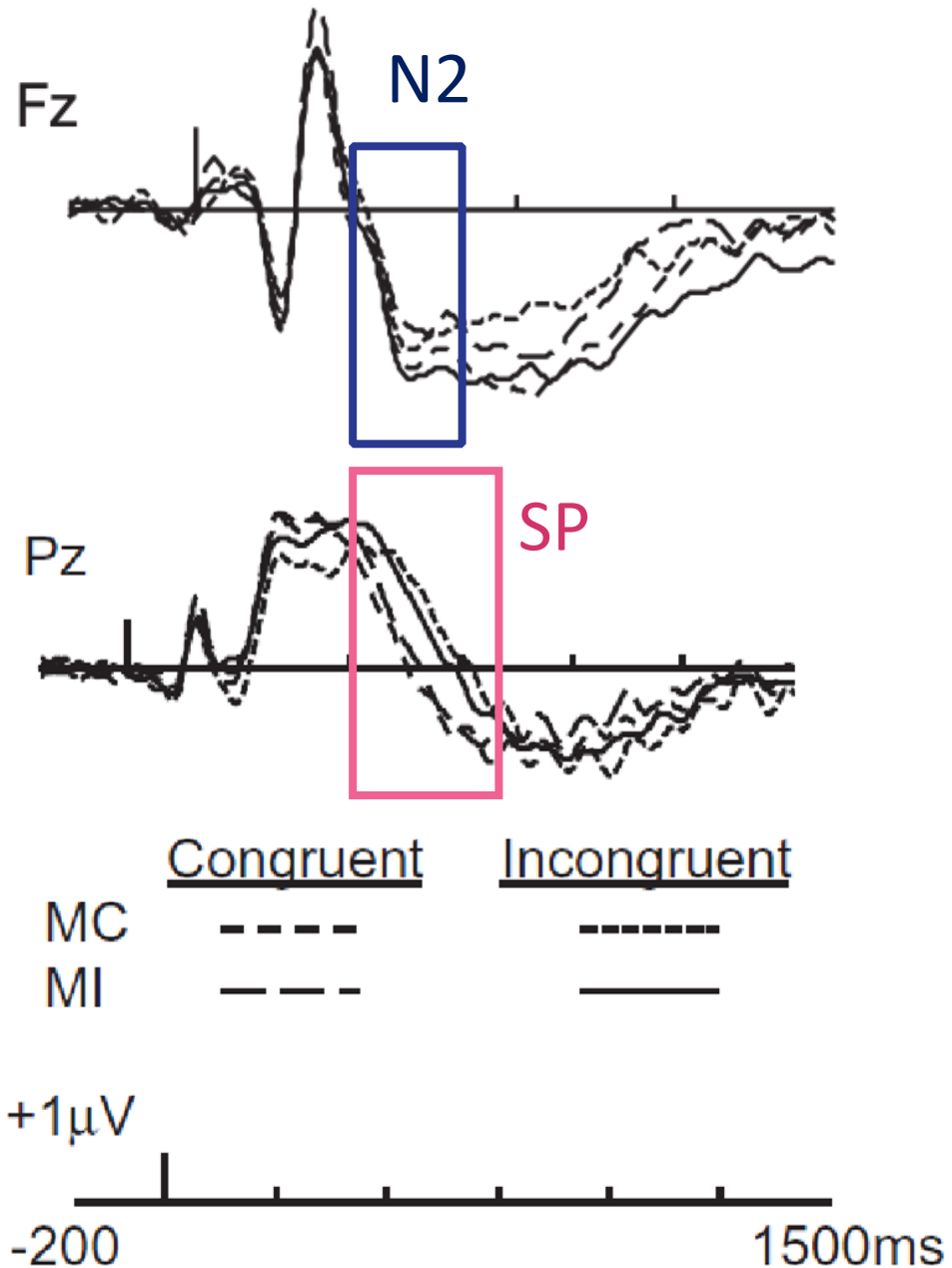
Conflict in the mostly congruent block is classified as **unexpected conflict**;  
conflict in the mostly incongruent block is classified as **expected conflict**.

## **EEG and ERPs**

Electroencephalogram (EEG) is a tool used to measure the brain's electrical activity. The electrodes are inserted into a cap and applied to a participant's head with the help of conductance gel. EEG has high temporal resolution.

Event-related potentials (ERPs) are time-locked events within the EEG. It is time-locked from when the stimulus is presented and can also be associated with the participant's response. Specific ERPs reflect psychological processes. The C-Stroop and Flanker tasks are common cognitive tasks that are used to measure cognitive control.





The **N2** differentiates the Congruent from Incongruent trials; reflects monitoring and detection of conflict on a trial-by-trial basis

The **SP** differentiates Congruent from Incongruent trials; reflects relatively fast processing and resolution of conflict on a trial-by-trial basis

## Methods for the current study...

- The participants answered questionnaires assessing video game experience, video gaming disorder, impulsivity, and ADHD
- An EEG cap was applied to the participant
- They played either a strategy game or a first-person-shooter game for 20 minutes
  - strategy – Starcraft (18 total, 10 female, 8 male)
  - first-person-shooter - Unreal Tournament (16 total, 9 female, 7 male)
- Another questionnaire was administered to assess video game immersion
- They completed the tasks and ERPs were recorded
  - C-Stroop and Flanker



**Research Question:** Will playing a first-person-shooter game or strategy game have different effects on cognitive control as indicated by the ERP recordings and task results?

# Past studies vs our own: similarities and differences

- Experience with at least some types of video games may have a negative effect on cognitive control (Bailey et al., 2010; Kronenberger et al., 2005)
- Action/First-Person-Shooter Games
  - Multiple studies have shown that playing an action video game can lead to an increase in aggressive thoughts or behavior (Carnagey & Anderson, 2004)
  - Training on an action game can improve reaction time, processing speeds, and reduce stress levels (Chandra et al., 2016).
- Strategy Games
  - Training on a strategy game significantly improved performance on cognitive tasks relating to attention (Maclin et al., 2011).
  - One study has found no difference in cognitive improvement between strategy games and action games (Boot et al., 2008).

**Hypothesis:** we expected to see the FPS game to have a negative impact on cognitive control while the strategy game might have a positive impact or no impact at all



## Block/Trial Type

Mc/C → Mostly congruent block, congruent trials

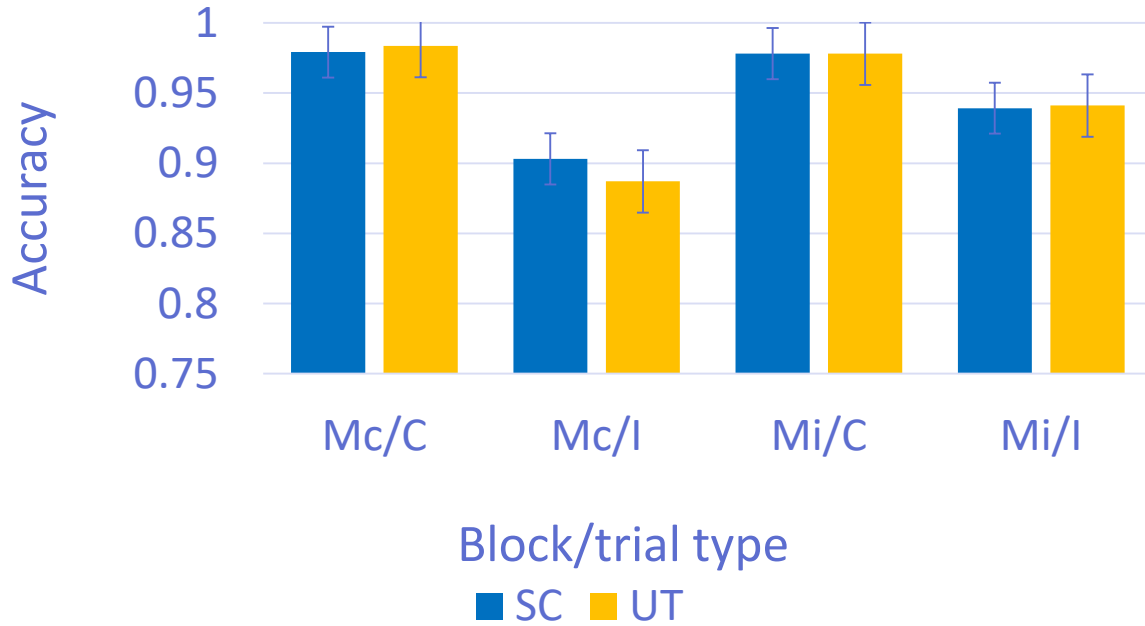
Mc/I → Mostly congruent block, incongruent trials ← Unexpected conflict

Mi/C → Mostly incongruent block, congruent trials

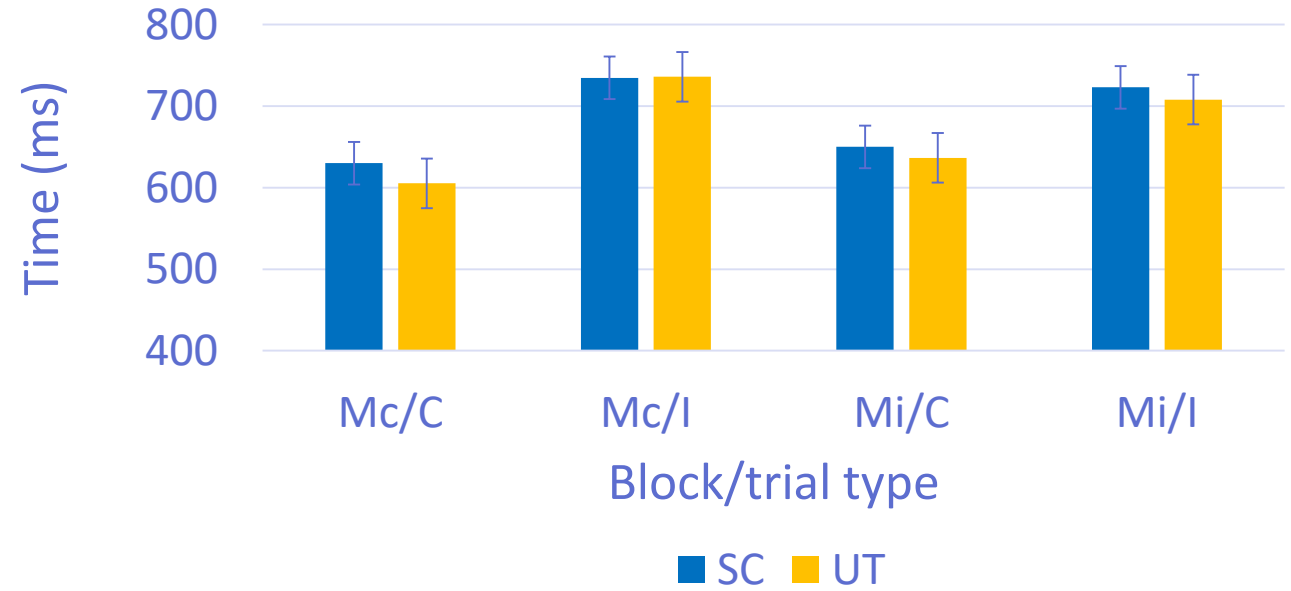
Mi/I → Mostly incongruent block, incongruent trials ← Expected conflict



Accuracy for StarCraft vs. Unreal Tournament



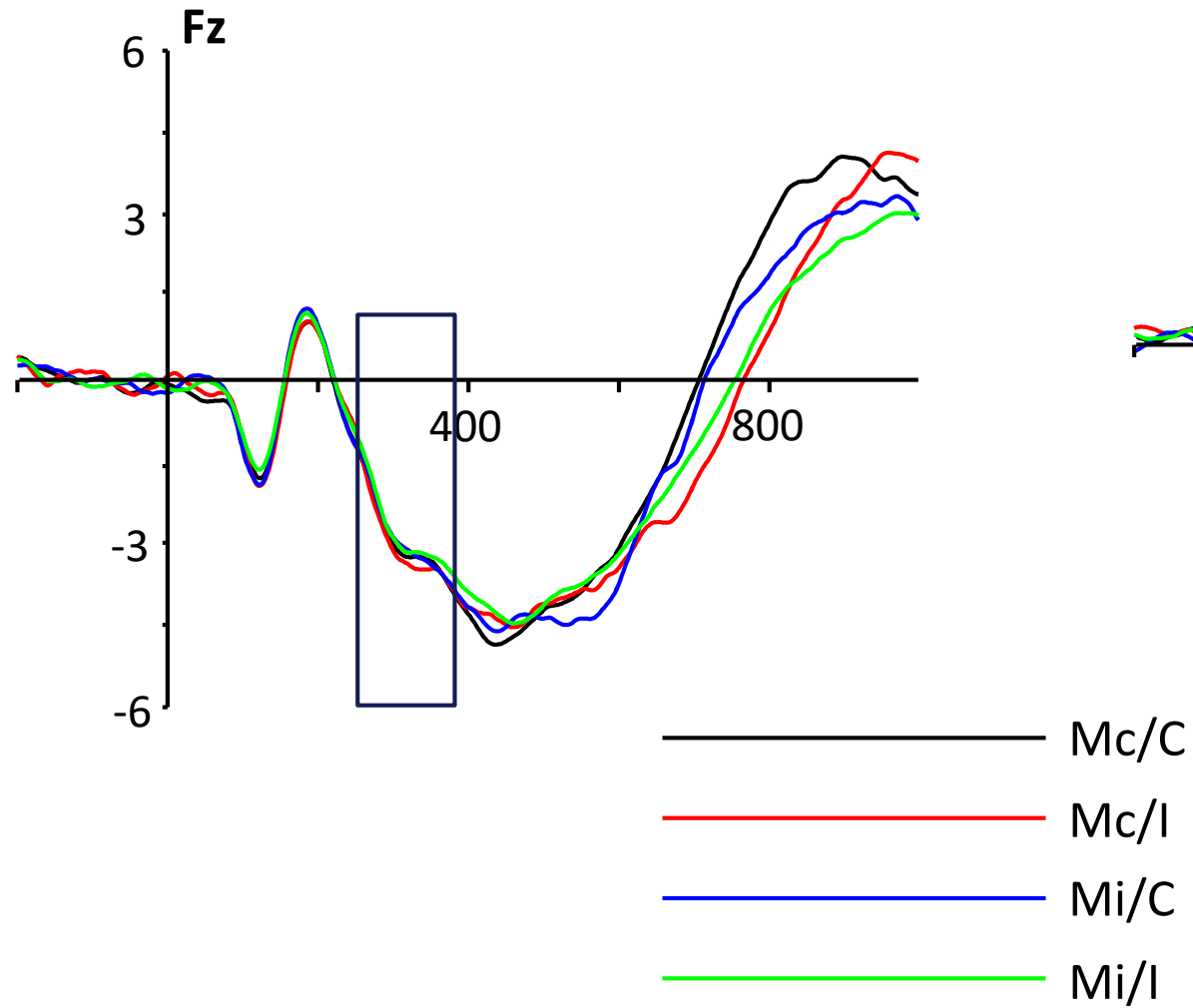
Reaction Time for StarCraft vs. Unreal Tournament



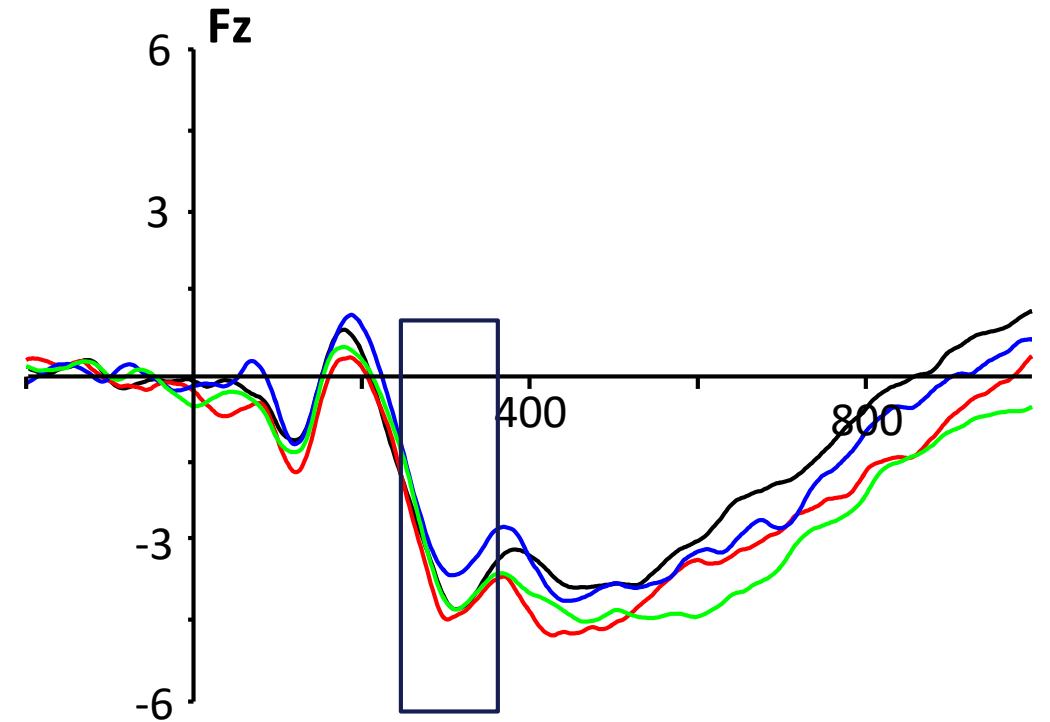
Unreal Tournament group was less accurate and slower to respond what conflict was unexpected.

## N2

StarCraft



Unreal Tournament

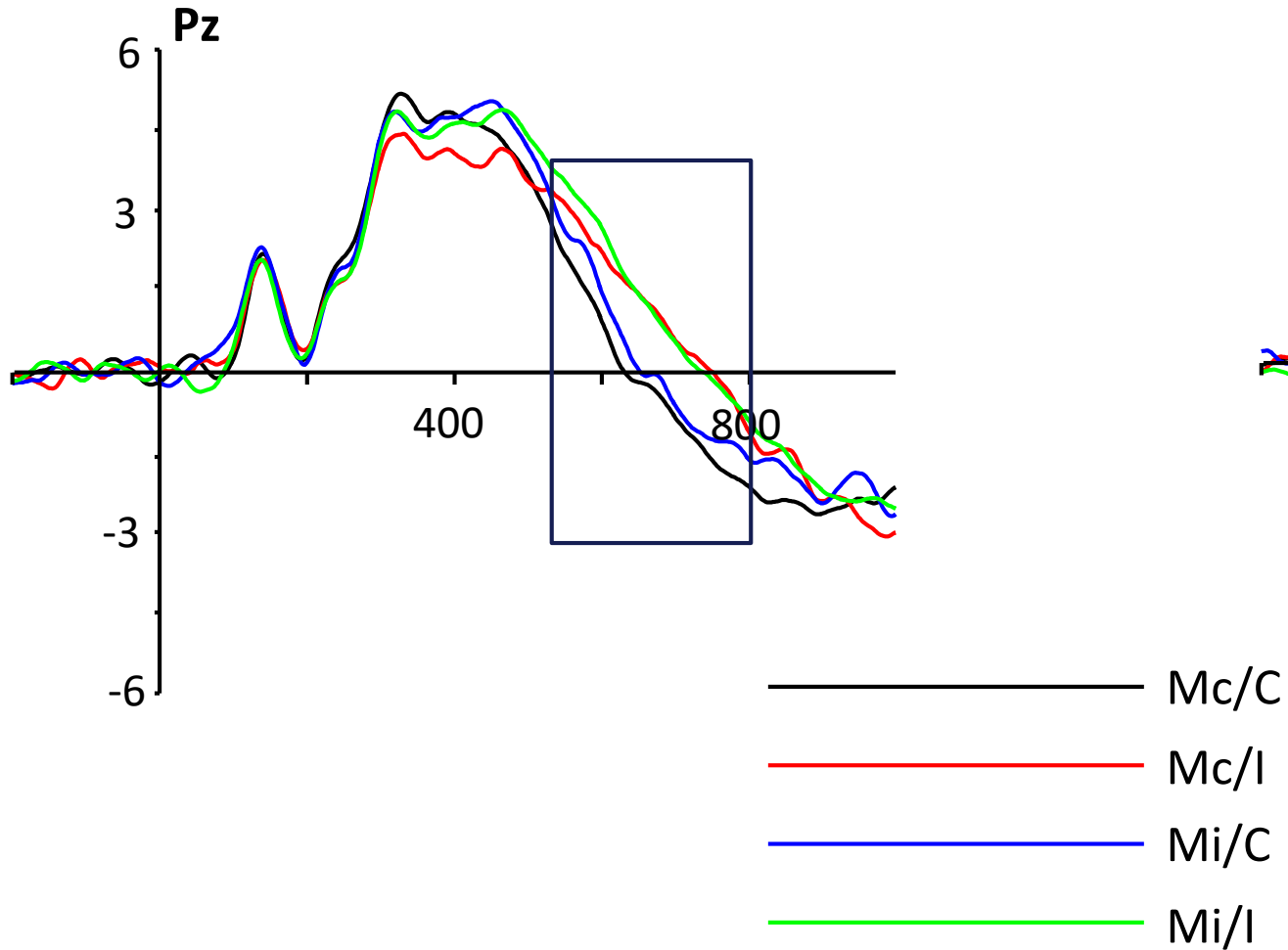


For both block types, the Unreal Tournament group shows a greater difference in neural responses between congruent and incongruent trials.

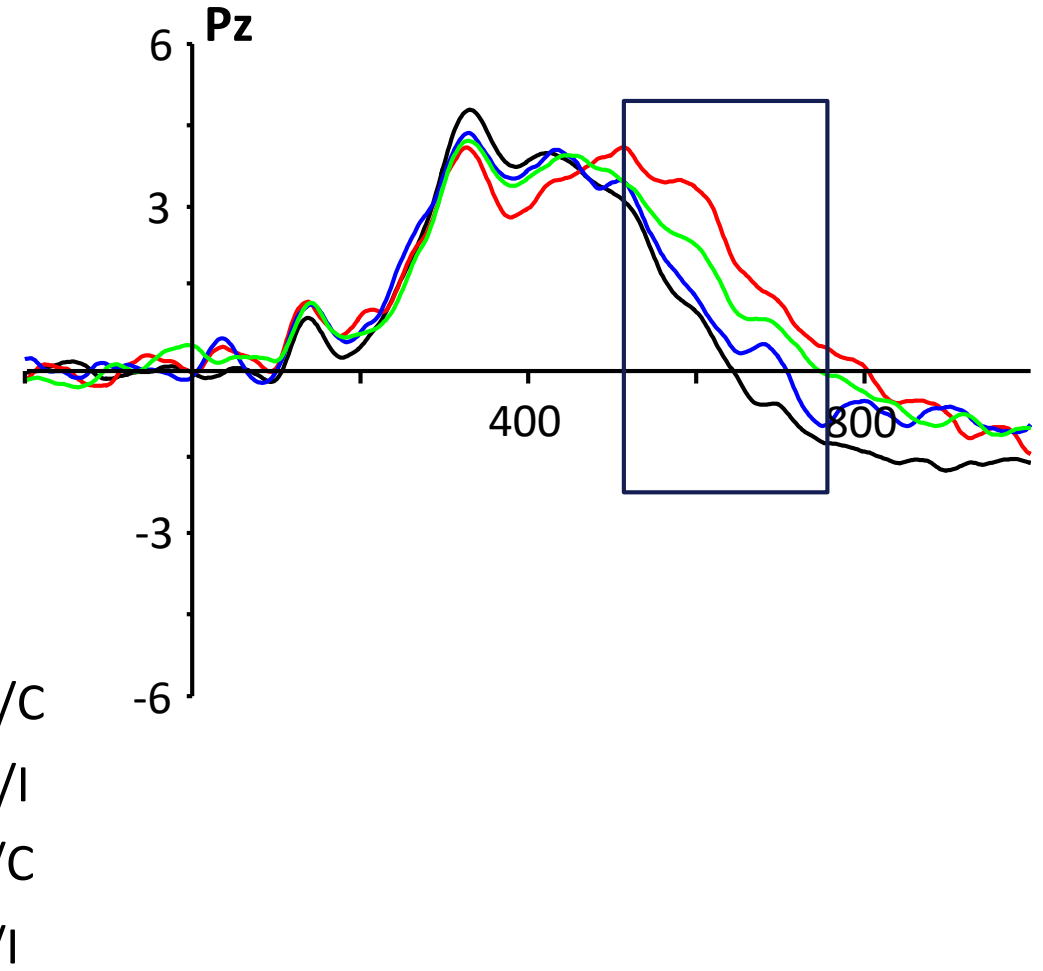


# SP

## StarCraft



## Unreal Tournament



For Unreal Tournament, the difference between the incongruent and congruent trials of the mostly congruent block is larger than that of the StarCraft group.

## Conclusions

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## Conclusions

- These results suggest greater difficulty in resolving conflict when it was unexpected after playing an action video game.
- After playing UT, accuracy was lower, reaction times were slower, and brain activity was different for unexpected conflict.
- Playing UT may disrupt the ability to resolve unexpected conflict.

Overall, the results of this study are consistent with previous work demonstrating that action video game exposure impacts cognitive control, but expand on past research by showing that exposure to action games may specifically decrease the ability to handle conflict when it is unexpected.

# Limitations

- Limited number of people per group
  - Ideally, we would hope to have 20 in each group
  - Unfortunately, data had to be thrown out due to excessive artifacts in the EEG data or other technical issues



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- Participants only played the game for 20 minutes
  - We cannot tell from the design of our study how long these effects could last
  - Follow up studies should address this
- Only used one video game of each type
  - We do not know about the generalizability of these results for other strategy or first-person-shooter/action games

