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Center for NeuroBehavioral DEVELOPMENT

Violent Video Game Effects on Brain Activation of High and Low Aggressive Game Players

Paper presented at the Center for the Study of Violence Conference
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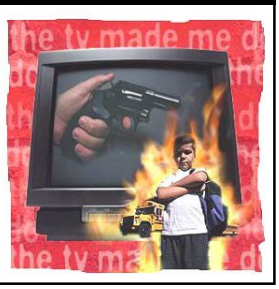
- Daniel Rinker
- Edward Swing

- Center for the Study of Violence
- Center for Magnetic Resonance Research

Historical Context

- There is a 50-year literature on the effects of media violence predicting subsequent aggression (e.g., Gentile, 2003)
- Most focuses on cognitive, arousal, affective, or behavioral effects
  - Psychology, medicine, communication, criminal science



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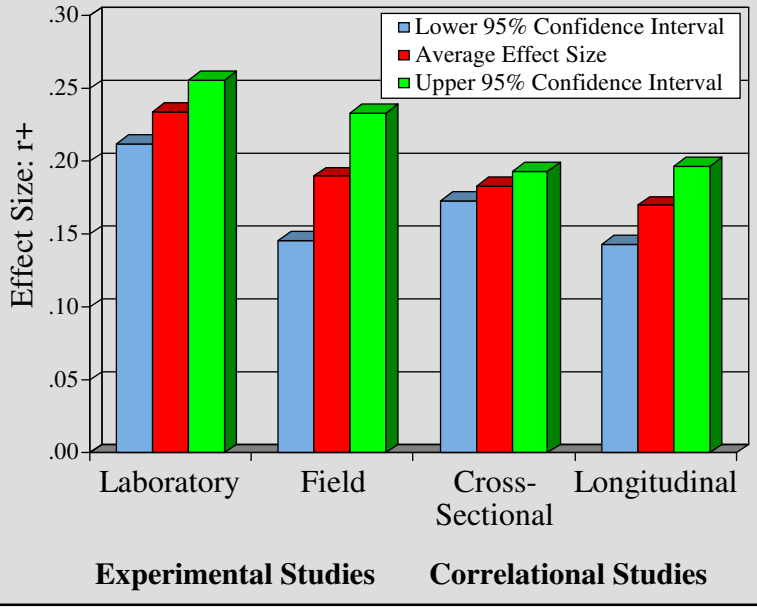
Meta-Analysis of Media Violence/Aggression



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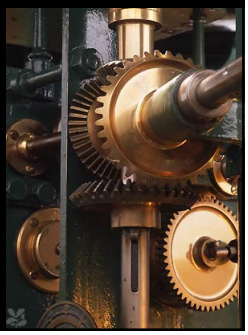
The Search for Mechanism

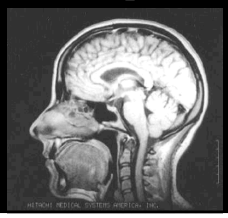
- Modern neuroscience opens up the possibility of moving beyond explanatory *description* to explanatory *mechanisms* (Weber, Sherry, & Mathiak, 2001)

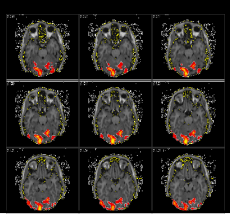
- To date, only a small number of studies have included neuroimaging measures of ongoing brain activity.

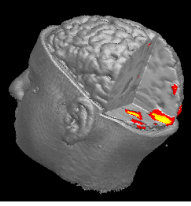


fMRI Analysis Paradigms

- Statistical Parametric Mapping (SPM)
  - Contrast brain activities across whole brain, often across whole testing session
- Region of Interest (ROI)
  - Contrast activities in *a priori* locations, often specific to time-coded events







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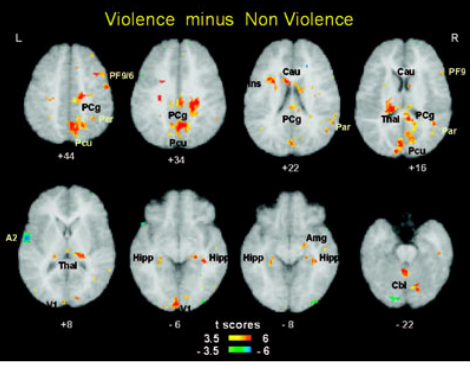
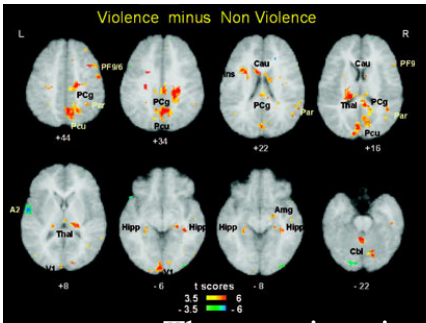
Murray et al. (2006)

Media Psychology

- 8 normal children
- Watched violent and non-violent movie sequences in fMRI
- Viewing violence associated with
  - Right hemisphere: precuneus, posterior cingulate, amygdala, inferior parietal, and prefrontal and premotor cortex.
  - Bilateral activations of hippocampus, parahippo-campus, and pulvinar.





Murray et al. (2006)

Media Psychology

  - These regions involved in the regulation of emotion, arousal and attention, episodic memory encoding and retrieval, and motor programming.
- Authors conclude viewing may result in aggressive scripts stored in long-term memory in the posterior cingulate, which facilitates rapid recall of aggressive scenes that serve as a guide for overt social behavior

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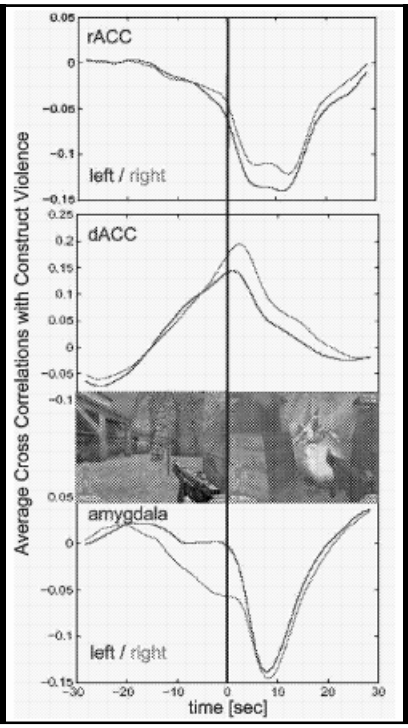
Weber, Ritterfeld, & Mathiak

(2006) *Media Psychology*

- 13 normal young adult gamers (18-26)
- Targeted three Regions of Interest
  - Anterior cingulate cortex (ACC),
    - Dorsal (dACC – more cognitive processing)
    - Rostral (rACC – more affective processing)
  - Amygdala
- Played violent game – time and activity coded
- Hypothesis: Violent VG activity increases dACC, and reduces rACC and amygdala activity

- Time coded to each violent event
- Increase in dACC (cognitive response) just before violence
- Decrease in rACC and amygdala (emotional responses) just after it



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Goals of the Present Study

- To compare violent and non-violent versions of games, rather than only one violent game.
- To compare gamers who play violent VGs with gamers who play an equivalent amount of video games, but with low violent content.

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Participants

- 13 young adult males (18-20 years)
- Video game play at least 10 hrs/wk
- No current or past diagnosis or treatment for behavioral or psychiatric disorder, including depression, anxiety, learning disability, or attention deficit
- No psychoactive medications
- Classified as having high (n=7) or low (n=6) violence experience based on most frequently played video games

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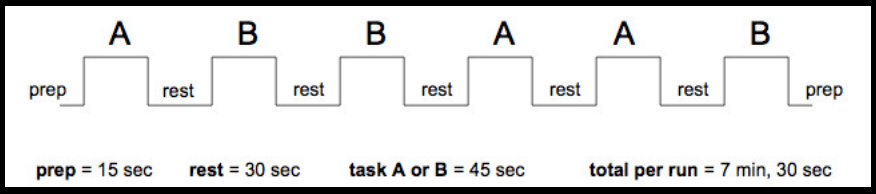
Design & Methods

The violent and non-violent video games were selected to be as similar to one another as possible.

Participants practiced the games briefly in an MRI simulator

- 15-30 minutes on non-violent version
- 5-10 minutes on violent version.



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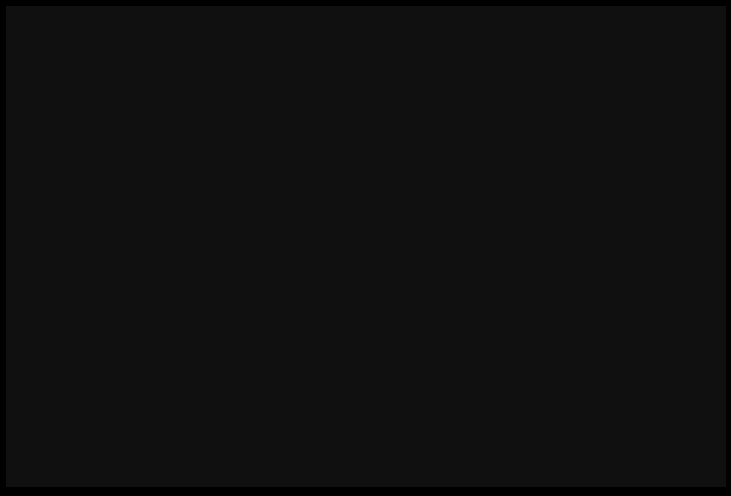
Game Example 1



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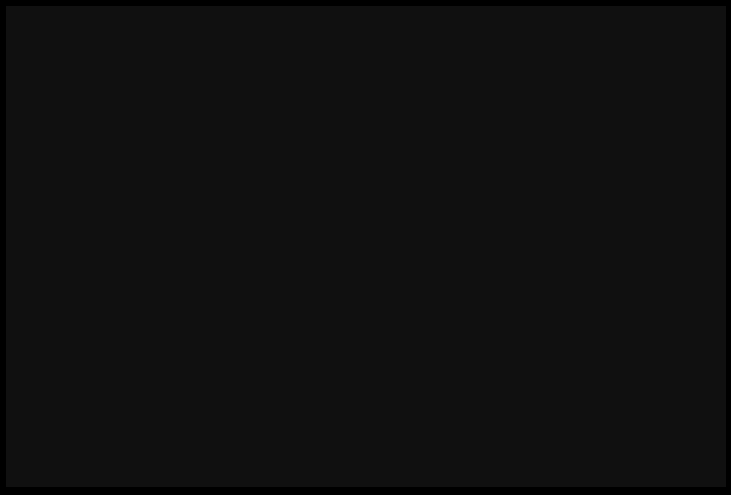
Game Example 2



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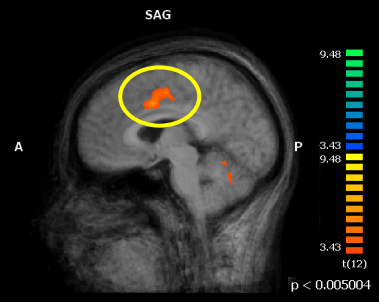
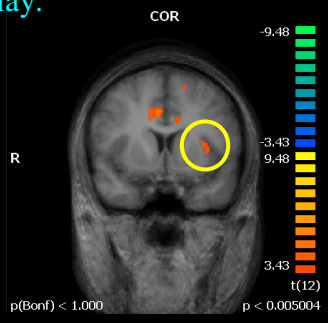
Activity during Violent vs. Non-Violent Game



Activity in the dorsal anterior cingulate cortex (dACC) and left insula was greater during violent game play.



Additional regions showing this effect included: bilateral motor cortex, bilateral fusiform gyrus, posterior cingulate, thalamus/pulvinar, and cerebellum.

No brain regions showed greater activity for the non-violent game.

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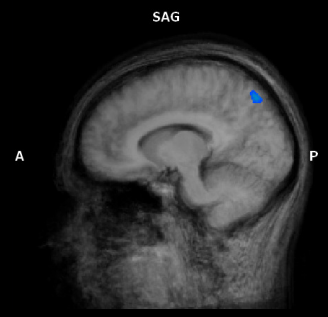
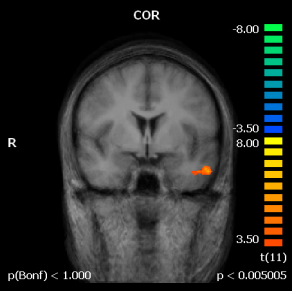
Group Differences in Activity

The low violence experience group showed significantly *greater* activity in the precuneus during video game play, regardless of the specific game.



This group also showed significantly *less* activity in the middle temporal gyrus compared to the high violence experience group.



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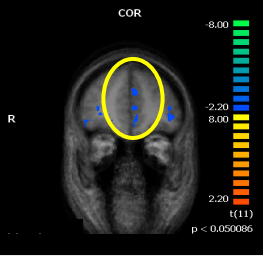
Group Differences by Game

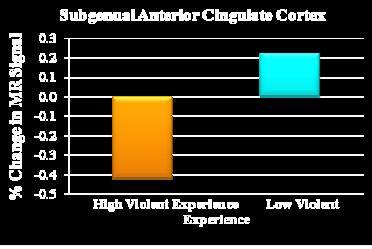
Despite many regions of similarity, a number of brain areas showed differential activation by game type for the two groups of participants.

Rostral anterior cingulate gyrus (rACC) was greater during violent game play for players with low violence experience.

The same regions showed reduced activity during the violent game for players with high violence experience.

This pattern was particularly true in the subgenual ACC, although the signal change in this regions was more variable across individuals.





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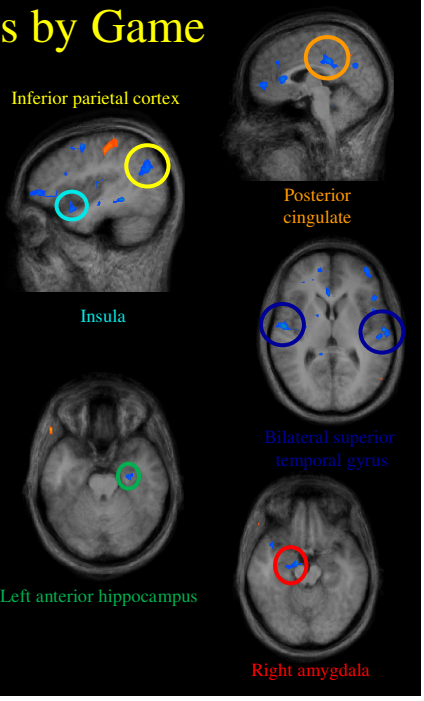
Group Differences by Game

Multiple brain regions showed opposite effects for the two groups of gamers.

In general, the low violence experience group showed greater MR signal during violent game play, whereas the high violence experience group showed greater activity during the non-violent game.



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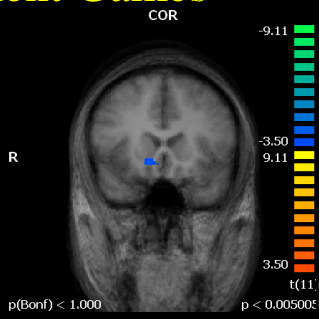
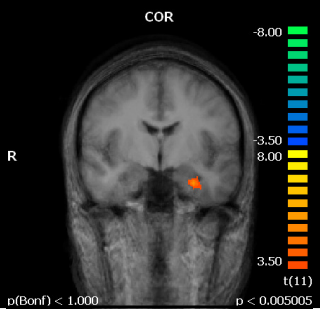
Group Differences in Response to Violent and Non-Violent Games

Players with low violence experience showed significantly *greater* activity in the nucleus accumbens those in the high violence experience group during violent game play.

High violence group showed equally large deactivation.





Players with low violence experience showed significantly *less* activation in the left amygdala compared to players in the high violence experience group during non-violent game play.

Both groups showed deactivation from fixation.

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Conclusions

- Replicated prior findings – Violent game play:
  - Increased cognition areas, dACC
  - Decreased emotion areas, rACC
  - Increased alertness/arousal, maintaining orientation in space, coordinated motor action
- Evidence of impact of violence experience
  - Effects moderated by group
  - In general, High Violence Exposure shows lowered activation of emotion areas (and others)
  - Low Violence Exposure shows heightened activation in the same areas

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Conclusions

- It is too simplistic to say that emotion areas are deactivated during violent game play
  - Not true for both groups of participants

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