# Gaming the Brain: P300 Differences in Task vs. Game Paradigms

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Decades of human cognitive neuroscience experimentation has been conducted using parsimonious tasks. While these tasks allow for strict control of variables, they're often contrived and not representative of the complexity of everyday events encountered in modern society. Leveraging the rich history of standard tasks alongside modern computational and recording techniques as well as paradigm design concepts from experimental psychology and game design, we are well positioned to begin studying cognition with complex, naturalistic paradigms such as video games. In the present pilot study, we recorded electroencephalography (EEG) from participants (n=6) while they completed an oddball-like task designed to elicit the most well-studied event-related brain potential (ERP) component – the P3b – as well as a simple game that was designed to elicit the same events as the task. The P3b has been shown to be sensitive to various factors, most notably subjective and sequential probability. In the present study, our primary goal was to examine if the P3b's sensitivity to target-to-target intervals (TTIs) varied between the game and the task. Both the task and game had various blocks designed around a two stimulus oddball paradigm, however, blocks varied in the standard and oddball probabilities, as well as the responses required to the oddball stimuli (no response, respond once, or respond twice). While our primary goal was to investigate the TTI impacts on the P3b, we found a more striking initial finding; although the task replicates standard P3b findings, the game exhibits considerable differences, including a large P3-like component to standard stimuli and a late P3-like component to oddball stimuli that seems to be modulated by the same factors as the P3b (see Figure 1). These preliminary findings are discussed in an attempt to explain these game/task differences by examining how they fit in P3 theory including the triarchic model (Johnson, 1986), the context updating hypothesis (Donchin & Coles, 1988), the context-closure hypothesis (Verleger, 1988), and Polich's integrative theory (2007).

*(Figure attached on next page)*

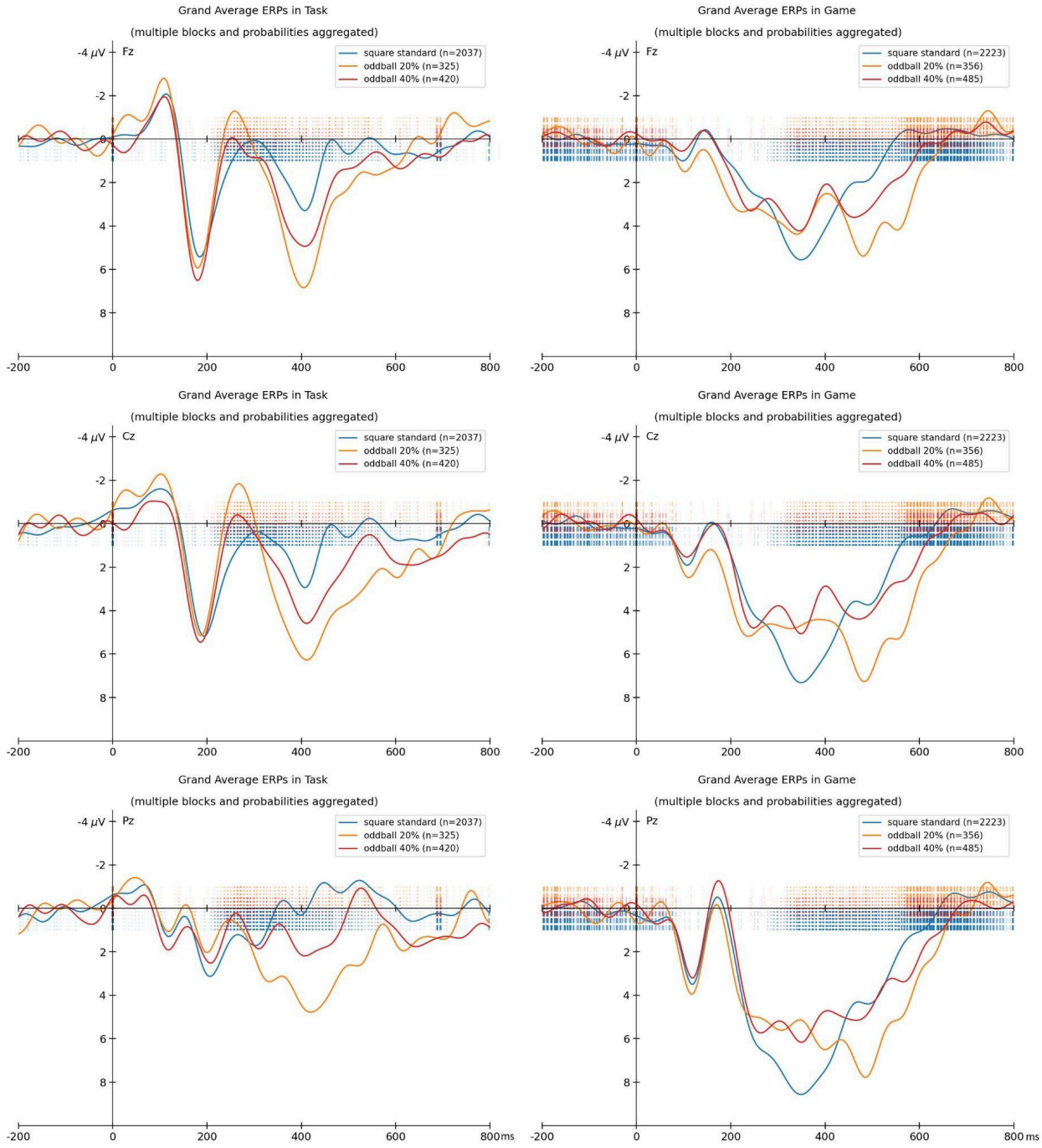


Figure 1. Grand average ERPs (n=6) from a task (left column) and game (right column) paradigms. Averages from three electrode sites Fz (top row), Cz (middle row), and Pz (bottom row) are shown from 200 ms preceding stimulus onset to 800 ms proceeding onset. Three conditions of stimuli are plotted and aggregated across various blocks. ERPs on the left show a stereotyped behavior of lowest frequency (20%) P300s being more positive than low frequency (40%) stimuli, compared to the smallest P3 amplitude exhibited by the standard (pooled 80% and 60%). However, the video game paradigm, although utilizing the same stimuli, exhibits vastly different neural responses, with an apparently early positive P3 from standard stimuli.