

**ABSTRACT**

**Impact of the *Re-Mission* Videogame on Cancer Treatment Adherence in Adolescents:  
CNS Mechanisms of Action**

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**Oral Presentation, Childhood & Adolescence Track**

The *Re-Mission* videogame was developed as a rationally targeted behavioral intervention to improve health outcomes in adolescents and young adults (AYA) undergoing treatment for cancer. In a randomized controlled trial involving 374 AYA cancer patients at 34 medical centers in the US, Canada, and Australia, patients randomized to receive *Re-Mission* (vs. a control commercial videogame) showed a 70% faster acquisition of cancer-related knowledge ( $p = .035$ ), a 3-fold greater rate of increase in self-efficacy to manage their illness ( $p = .011$ ), 16% greater adherence to prescribed TMP/SMX antibiotic regimens ( $p = .012$  as measured by MEMS caps), and 41% higher blood levels of oral chemotherapy ( $p = .002$  as measured by HPLC for the 6-methylmercaptapurine metabolite) over the course of a 3-month follow-up.

To identify psychological mechanisms of action, a subsequent fMRI study monitored functional neural activity in 53 young adults playing *Re-Mission* (10 x 60 sec. bouts of game play separated by no-play periods varying randomly from 20-40 sec.). Analysis of T2\*-weighted images identified significant activation of reward-related regions (nucleus accumbens and mesial prefrontal cortex) at the onset of game-play, and activation of conflict-related regions (anterior insula, anterior cingulate) at the offset of game play ( $p$ 's < .001). Continuous game play activated regions implicated in visuospatial processing (visual cortex), motor control (motor cortex), arousal (thalamus), and memory (hippocampus) ( $p$ 's < .001). Game play was also associated with relative decreases in prefrontal cortical activation ( $p < .01$ ). The interactivity of game play critically contributed to these effects, which were not evident in participants who were passively exposed to the same stream of auditory and visual information (audio-visual recorded during active play).

Ongoing studies seek to determine which specific aspects of CNS response during game-play are related to subsequent behavioral changes outside the laboratory. These results show that a rationally engineered digital game intervention can positively impact multiple aspects of health-related behavior in AYA cancer patients, and suggest that emotional and motivational responses during game play may constitute key mechanisms of its impact on behavior.

**ABSTRACT**

**Emotion-Based Mediation of Cancer-Related Attitudes and Behavioral Outcomes in Adolescents: Impact of the Re-Mission Videogame**

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The Re-Mission videogame was developed as a behavioral intervention to improve health outcomes in adolescents and young adults (AYA) undergoing treatment for cancer. A randomized controlled trial showed that Re-Mission significantly accelerated acquisition of cancer-related knowledge and self-efficacy in AYA cancer patients, and produced greater adherence to prescribed antibiotic and oral chemotherapy regimens. To identify psychological mediators of treatment effects, the present study assessed changes in emotions, cancer-related knowledge, and control beliefs as determinants of subsequent attitudes towards chemotherapy and intent to adhere to a prescribed treatment in 107 healthy undergraduates.

Participants completed questionnaires before and after being randomly assigned to 45 minutes of Re-Mission game-play or a control commercial videogame. Immediately post game-play, the Re-Mission group showed relative increases in both arousal-related negative affect (nervous,  $p = .05$ ; scared,  $p = .008$ ) and positive affect (inspired,  $p = .007$ ; attentive,  $p = .033$ ) compared with the control group. Re-Mission game-play also induced more positive attitudes towards chemotherapy ( $p = .019$ ) immediately post game-play. One month later, participants who had played Re-Mission (versus the control game) reported higher perceived control over cancer ( $p = .042$ ) and greater intentions to use chemotherapy if ever diagnosed ( $p = .072$ ). Statistical mediation analyses indicated that up to 50% of Re-Mission's positive effect on attitudes towards chemotherapy could be attributed to affective changes. In contrast, perceived control and cancer-related knowledge did not significantly contribute to the effect.

Ongoing studies are examining whether similar effects occur in AYA cancer patients and testing whether these affective changes might mediate subsequent changes in adherence behavior outside the laboratory. Overall, results suggest that in-game emotional experience, rather than knowledge acquisition, might represent a key determinant of Re-Mission's effects on AYA's attitudes toward cancer and related treatments.