Centre for Lifespan Development Research

Brock University

Research Snapshot

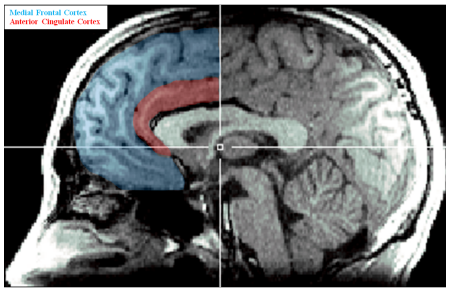
Centre for Lifespan Development Research

Brain activity, peers and personality:

Associations with adolescent risk-taking

Risky Business — What is this research about?

Figure 1: The medial prefrontal cortex is the section in colour

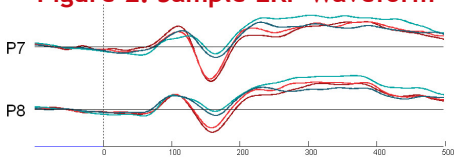


Adolescence is a developmental period where risk-taking behaviour increases for many. Risky behaviour has been connected to the medial prefrontal cortex (mPFC — see Figure 1), a brain structure that is related to the reward system as well as the self-regulation of reward-related behaviours and emotional states. Given that adolescence is a time of continuing brain changes, particularly around self-regulation, one can expect to find age differences in the functioning of the mPFC among adolescents engaging in risky behaviour.

Despite the immaturity of the frontal cortex (including the mPFC) during adolescence, youth do not have inherently have poor cognitive/decision-making skills as compared to adults. For example, when asked to make judgments about activities, it has been found that adolescents can identify dangers and risks as well as adults. But adolescents' cognitive judgement may be susceptible to being clouded by emotion and arousal and that they may weigh costs and benefits differently, particularly in the presence of peers. Specifically, research has indicated that peer interaction tends to increase adolescents' motivation for seeking out potential rewards, which may bias them towards risky behaviours in social contexts. In terms of cognitive structures, the increase in reward motivation among peers may negatively impact the mPFC's ability to self-regulate behaviour.

Drs. Sidney Segalowitz and Teena Willoughby, Director and Associate Director, respectively, of the Centre for Lifespan Development Research, have worked with colleagues to research the influence of peer presence on mPFC activity among adolescent males. This research was conducted through the use of electroencephalogram (EEG). EEG is a non-invasive procedure where electrical activity from the brain is recorded from sensors on the scalp. Specifically, EEG research analyzes Event-Related Potentials (ERPs — see Figure 2 for an ERP example), which are summations of the brain's electrical activity in response to stimulus. In Drs. Segalowitz and Willoughby's work the activity of the mPFC was isolated through analyzing specific ERPs elicited in response to negative events in a videogame (i.e., when taking a risk and failing).

Figure 2: Sample ERP Waveform



Individual differences and risk-taking

Besides the cognitive aspects, risk-taking has also been linked to individual differences in specific personality traits, such as *surgency*. Individuals high in surgency tend to engage in greater sensation-seeking and positive emotions (such as engaging in greater risk-taking), than individuals lower on the trait. Along with their work exploring the impact of peer influence on mPFC activity, Drs. Segalowitz and Willoughby also investigated the extent to which mPFC activity was related to levels of surgency.

How did they do it?

In order to conduct this research Drs. Segalowitz and Willoughby studied the risk-taking behaviours of 20 15-16-year-old adolescent males in a lab setting. Risk-taking responses were assessed using a driving simulation game where participants were instructed to move a car as far as possible without crashing. Crashing would elicit a negative performance ERP response in the mPFC. Participants either completed the task alone or in the presence of two friends. In the peer condition friends were instructed to verbally encourage their friend to keep playing.

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During the task, the participants were connected to an EEG machine, so that the activity of their mPFC could be monitored. Participants also completed personality measures to obtain their scores for surgency.

Results

Previous research looking at a similar driving game found that adolescents tend to take more risks (i.e., crash into the wall more) when playing in the presence of peers who were offering advice, although there were individual differences. In their work, Drs. Segalowitz and Willoughby were able to show that peer presence may relate to significantly weakened activation of the mPFC in response to negative feedback from crashing (see Figure 3). Meaning that when with peers, adolescent males may not be as cognitively influenced by negative feedback as they would be when alone.

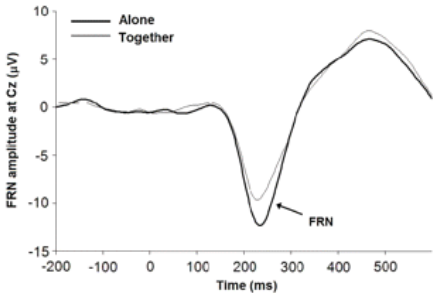

Figure 3: Group averaged ERP waveforms showing a weakened response of the mPFC to negative feedback from crashing when with peers as compared to alone

More importantly, Drs. Segalowitz and Willoughby were able to show that mPFC activity may correlate negatively with individual levels of surgency, but only when in the presence of peers (see Figure 4). Specifically, adolescents who are higher in trait surgency (greater tendency towards sensation-seeking) may be more susceptible to peer influence in risky situations than adolescents lower in trait surgency. However, more work is needed to understand the cause and effect of this relationship. For example, it could be that increased surgency places adolescents in a state of low-mPFC activity or that poorer cortical response of the mPFC may increase surgency.

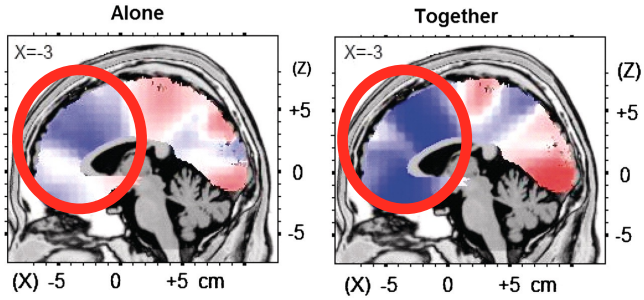

Figure 4: Cognitive activation (mPFC circled in red) as related to surgency scores — blue indicates a negative correlation

Taken together, along with previous work, the research of Drs. Segalowitz and Willoughby has indicated that social stimulation may reduce adolescent males' cognitive reaction/attention to the negative outcomes of risky behaviours (as demonstrated by reduced mPFC activation when crashing). Moreover, it appears that individual differences in personality traits reflecting excitement, reward and sensation seeking (i.e., surgency) may negatively influence the impact of peers on risky behaviour.

So what — Where can this research be used?

Practitioners, Policymakers & Parents — The work of Drs. Segalowitz and Willoughby has indicated that young males with certain personality traits may be particularly sensitive to rewards when with peers. As such, efforts to help youth make healthier choices may be more successful if, rather than using scare tactics to highlight the costs of risky behaviour, they focus on tailoring interventions to high-surgency individuals while highlighting the rewards of responsible behaviour and presenting safe methods for indulging in sensation-seeking with peers.

Future Research — The work of Drs. Segalowitz and Willoughby has expanded the knowledge base of using EEG to examine risk-taking. Moreover, it has also directed future researchers to focus on mPFC activity and surgency traits when examining peer influence on risk-taking. In particular, this work has suggested that understanding the limitations of the mPFC in real-life scenarios may be key to understanding psychological growth during adolescence.

Want to read more on this research?

Find it online here: https://scan.oxfordjournals.org/content/7/1/115.full

Citation: Segalowitz, S. J., Santesso, D. L., Willoughby, T., Reker, D. L., Campbell, K., Chalmers, H., & Rose-Krasnor, L. (2012). Adolescent peer interaction and trait surgency weaken medial prefrontal cortex responses to failure. *Social cognitive and affective neuroscience, 7*(1), 115-124. doi: 10.1093/scan/nsq090

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