Escalating Risk and the Moderating Effect of Resistance to Peer Influence on the P200 and Feedback Related Negativity

John Kiat, Elizabeth Staley, Jacob E. Cheadle

LifeHD Research Lab, University of Nebraska-Lincoln

Summary

- Young people are often exposed to social situations in which peer pressure to engage in high-risk behaviors is present.
- Individual differences in considering the likelihood of negative outcomes may be one of the factors underlying individual differences in resisting peer pressure.
- In this study, a novel analytic approach was used to analyze data from the Balloon Analogue Risk Task (BART), a well-established risk-taking propensity assessment.
- With this approach, changes in ERP components associated with risk coding and negative outcome expectation, and the moderating effect of resistance to peer pressure, were modeled as a function of progressively increasing risk levels.

Materials

BART Task

- The BART is a widely used measure of risk-taking (Lejuez et al., 2002) that is predictive of "real-world" risk taking in a wide range of populations (see Cazzell et al., 2012 for a review).
- In the version of the BART used in this study, participants completed 50 trials. In each trial they either inflated or compressed a digitally presented balloon via button presses.
- Each successful expansion/compression attempt earned the participant $0.05. Each attempt had a risk of causing the balloon to explode [set at 1/(20 – number of prior attempts)].
- Participants continued inflating/compressing the balloon until it either exploded (resulting in the loss of all accumulated monies on that trial), or they decided to cash out and transfer the accumulated monies to a permanent bank.

Resistance to Peer Influence (RPI) Scale

- The 10 item RPI scale developed by Steinberg & Monahan (2008) was used.
- Satisfactory levels of internal consistency was shown among RPI scores from this study's sample (α=0.75)

Procedure

- 31 Subjects (18 female, 4 left-handed, mean age =20.03, SD =1.78) participated, first completing the RPI scale via an online survey and then the BART task in-lab.

EEG Acquisition Parameters

- 256 AgCl electrode Hydrocel Geodesic Sensor Net
- High-input impedance NetAmps 300 amplifier
- Recorded using a Cz reference, later re-referenced to average
- Impedances <60 kΩ, appropriate for the system
- Recorded with 0.1-100 Hz filter at a 250 Hz sampling rate

EEG Preprocessing

- 0.3-30 Hz zero-phase shift FIR bandpass filter used.
- 100 ms pre, 500 ms post-onset segments to the onset of each balloon size change.
- AAR toolbox (Gomez-Herrero et al., 2006) used to remove ocular and EMG artifacts.
- Channels with poor (r <0.40) inter-neighbor correlations or extreme voltage fluctuations (>100 µv min-max) re-interpolated. Trials with >10% interpolated channels removed.

ERP Processing

- ERPs from pumps 1 -> 5 analyzed.
- Mean number of trials/response : 18.4 (SD = 2.65).
- Components quantified using temporal-spatial PCA. (Dien, 2010).
- 34 temporal & 4 spatial factors extracted based on a 99% variance and parallel analysis criterions.
- P200 and FRN factors selected based on topography and time course. Source localization of factors assessed using a single dipole and 4-shell head model.

Behavioral Results

- Risk-taking levels across expansion and compression trials were significantly correlated, r(28)=.38, p=.045.
- Participants made an average of 2.43 pumps (SD=.95) in the expansion condition and 2.25 pumps (SD=.91) in the compression condition.
- Number of pumps across conditions (i.e. risk taking levels) did not differ, t(30)=.93, p=.36.
- Participants successfully cashed out on 86.87% (SD=.04%) of trials across conditions.
- Consistent with prior work (Cavalca et al., 2013), no significant relationship between RPI and risk level in either condition was observed (expansion: r(28)=.031, p=.876, compression: r(28)=.231, p=.238).

Like the Poster? Read the Paper!

- This study has been recently published (as of Spring 2016) in the leading social neuroscience journal of *Social Cognitive and Affective Neuroscience*.
- Scan this QR code to be brought to right to it!

Base EEG Results

- The FRN & P200 scalp topographies (1n) & waveforms (1c) depicting raw ERPs for pumps 3, 4, and 5, averaged across conditions for electrodes with high loadings (>0.6) (1a) + changes in factor voltages as a function of pump number (1d) are presented in figure 1.

Figure 1 : High loading electrodes (n), Scalp Topographies (a) and Raw Waveforms (c) for the P200 [left] & FRN [right] Factors

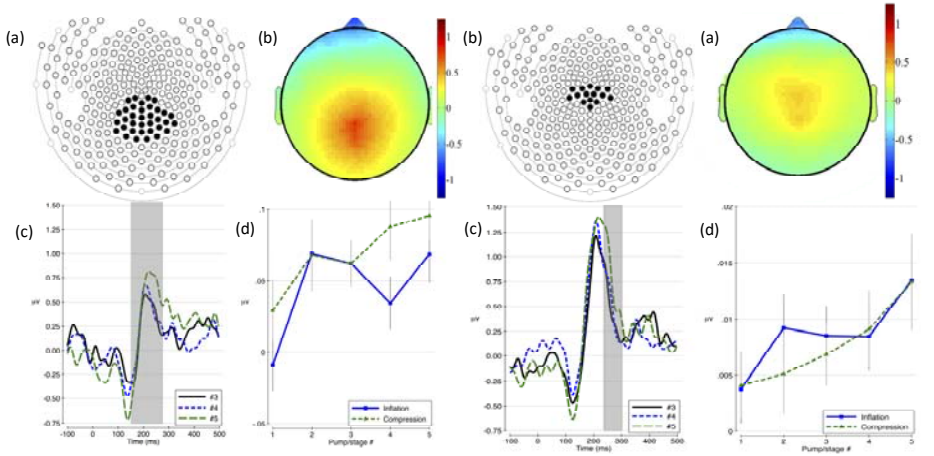
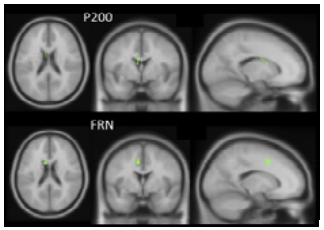


Figure 2 : Source Solution for the P200 and FRN factors

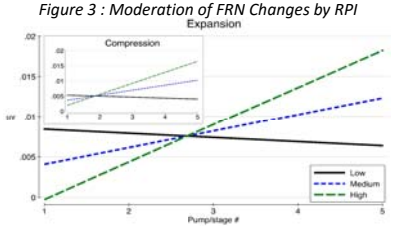


- A positive relationship between pump order and P200 and FRN factor voltages was present in both the expansion (F(1,123)=4.81, p=.03, F(1,123)=6.03, p=.02) and compression (F(1,123)=7.29 p=.01, F(1,123)=5.97, p=.02) conditions.
- As shown in figure 2, source localization of the components identified the left caudate nucleus and left dACC as being the most likely sources of the P200 and FRN components respectively.
- To assess the possibility of a noise confound, noise in the ERPs was estimated using the Schimmel (1967) procedure. No significant relationship between noise and pump order in either the expansion (F(1,123)=1.33, p=.25) or compression (F(1,123)=1.97, p=.16) conditions was found.

Resistance to Peer Pressure + EEG Results

- RPI did not significantly moderate the relationship between pump order (i.e. risk taking level) and P200 voltages.
- RPI significantly moderated the relationship between pump order and FRN voltages in the expansion condition, F(1,110)=6.41, p=.01, with a trend towards significance in the compression condition, F(1,110)=2.66, p=.10.
- In both conditions the direction of moderation was positive, such that as hypothesized higher levels of RPI were associated with higher rates of increase in FRN factor voltage.
- The relationship between FRN voltage and pump level is depicted in Figure 3 for high (+1 SD), medium (mean), and low (-1 SD) RPI levels for both the expansion and compression conditions.

Figure 3 : Moderation of FRN Changes by RPI



Summary

- The results of this study indicated that components associated with risk level encoding (the P200) and signed reward prediction (FRN : Feedback-Related Negativity) display a linear relationship with risk taking levels.
- Furthermore, changes in the FRN were not present among participants with lower levels of resistance to peer pressure, suggesting that these individuals were not moderating their expectations of potentially negative outcomes in tandem with increasing risk levels.

Funding & Acknowledgements

This study was supported by generous contributions from the University of Nebraska-Lincoln Office of Research & Economic Development, College of Arts & Sciences, Sociology Department, and Center for Brain, Biology, and Behavior with special thanks to Dennis Molfese and the Developmental Brain Laboratory for training and gratis use of equipment.

LifeHD Contact Author: John E. Kiat : johnkiat@huskers.unl.edu website : www.johnkiat.com