Can't stop (and) feeling lonely

Inhibitory control, social network and loneliness

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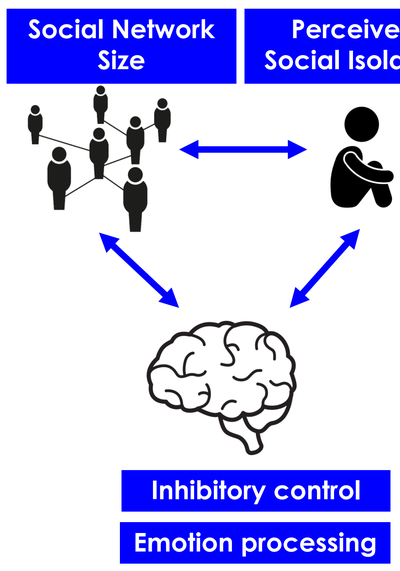
1. Introduction

The effect of social connectedness (and lack thereof) on neural activity underlying executive and social cognitive processes has received increased interest in the last decade

Objective Social Isolation can be measured by the Social Network Size (SNS). It has been shown that SNS may effect on executive functions, e.g. interaction between quality of the child's social environment and early social cognitive skills was shown to be predictive for development of inhibitory control abilities at 18 months. Furthermore, It was shown that little social network is linked to decreased emotion processing.

Perceived Social Isolation (loneliness, PSI) is a subjective experience that can be discriminate from objective isolation. It is linked to abnormal activity of prefrontal regions, that are crucial for executive control. It ia assumed that PSI may lead to social threat hypervigilance, and in effect decrease one's capacity for inhibitory control. Furthermore, it is hypothesized that high loneliness is linked to attentional bias towards social information. It was shown that individuals with high PSI display increased emotion processing.

- **Is Social network size linked to electrophysiological correlates of**
  - **Emotion processing?**
  - **Inhibitory control?**
- **Is loneliness linked to electrophysiological correlates of**
  - **Emotion processing?**
  - **Inhibitory control?**
- **Are the effects of each type of social isolation on cognition and socioaffective processing independent or interactive?**



2. Methods

Participants:

N=27
Age: 18-35
11 male

R-UCLA loneliness scale — M = 40, SD = 12

Social Network Index (Network Size subscale) — M = 19, SD = 10

Participants were recurited via online platforms and screened for psychiatric and neurological treatment. Each participant signed an informed written consent prior to participation in the study.

After completing RUCLA loneliness scale and Social Network Index, participants performed a modified version of a Go/No-Go task during EEG measurement.

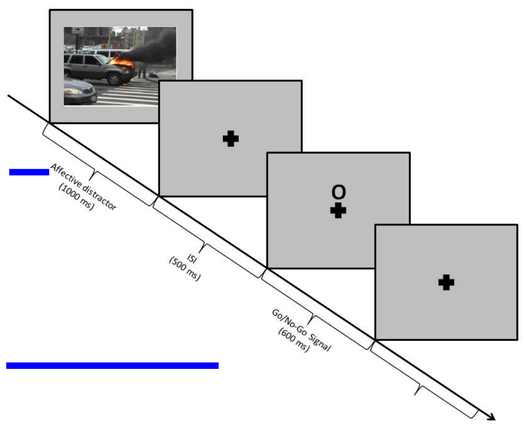
3. Task

EMOTION PROCESSING

IAPS pictures
type: positive / neutral / negative
content: social / nonsocial

INHIBITORY CONTROL

GO/NO-GO task



Each picture was presented for 1000ms and was followed by ISI(500ms). Then, a GO ('O') or NO-GO ('X') signal appeared on a screen for 600 ms. Participants were asked to press a spacebar whenever a GO signal was presented. The probability of the 'No-Go' trials was 25%. The whole procedure consisted of 4 runs each with 96 trials.

4. Analysis

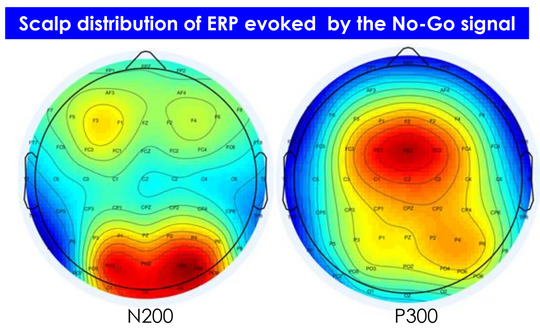
1. To indicate the neural response, we analized following ERPs :

Emotional processing
- **Late Positive Potential (LPP)** - a positive defletion between 500 -100 ms after emotional picture.

Inhibitory processing
- **N200** – a negatve peak between 180 - 250 ms after No-Go Signal
- **P300** – a positive peak between 250 - 500 ms after No-Go Signal

2. rmANOVA was used to establish where maximal effects of the task may be observed for each ERP. This way the following ERPs were extracted for further analysis:
- ✓ LPP for positive pictures on anterior sites
- ✓ N200 on Cz for No-Go cues
- ✓ P300 on FCz for No-Go cues

Scalp distribution of ERP evoked by the No-Go signal



N200 P300

3. To examine the effects of social funcitoning on each of the ERP markers the following predictors were entered to separate hierarchical regressions:

1. Social Network Size
2. R-UCLA Loneliness score
3. SNS x R-UCLA interaction term

5. Results

- No association between LPP to affective pictures or NoGo-N200 and outcome measures was observed
- **P300**: Social Network Size significantly predicted 29% of the NoGo-P300 amplitude ($F(2,24)=6.3$, $p < .01$)
- **More extensive Social Network associated with larger NoGo-P300 amplitude (Figure. 1)**
- Loneliness did not predict P300 over and beyond SNS.
- However, when the interaction term between SNS and PSI was added, predicted variance significantly increased to 46% ($\Delta R^2 = .11$, $F(1,25)=6.5$, $p<.05$), confirming that **the effect of Social Network Size on P300 amplitude was moderated by PSI.**
- **For individuals with low and average PSI, more extensive network size predicted increased P300. However, for individuals with high PSI (RUCLA score > 43), the relationship between P300 amplitude and SNS was not observed. (Figure. 2)**

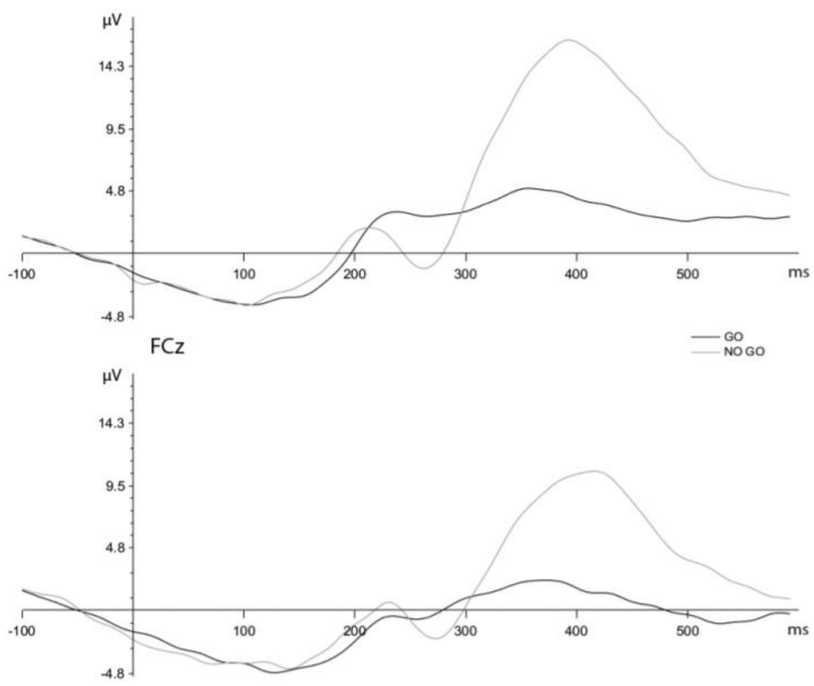
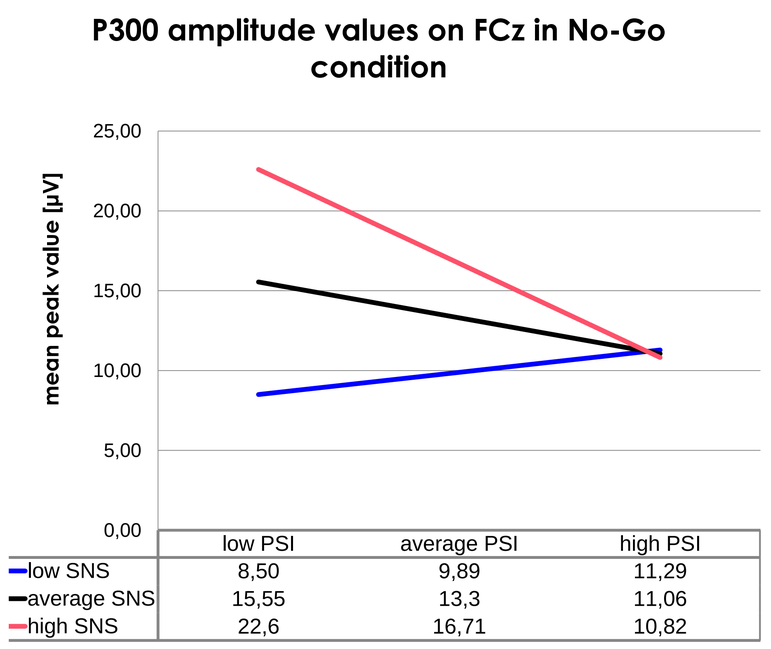


Figure 1. Comparison of the waveforms over FCZ in groups with groups with more (upper) and less (lower) complex social networks (as defined by the median split of the sample)

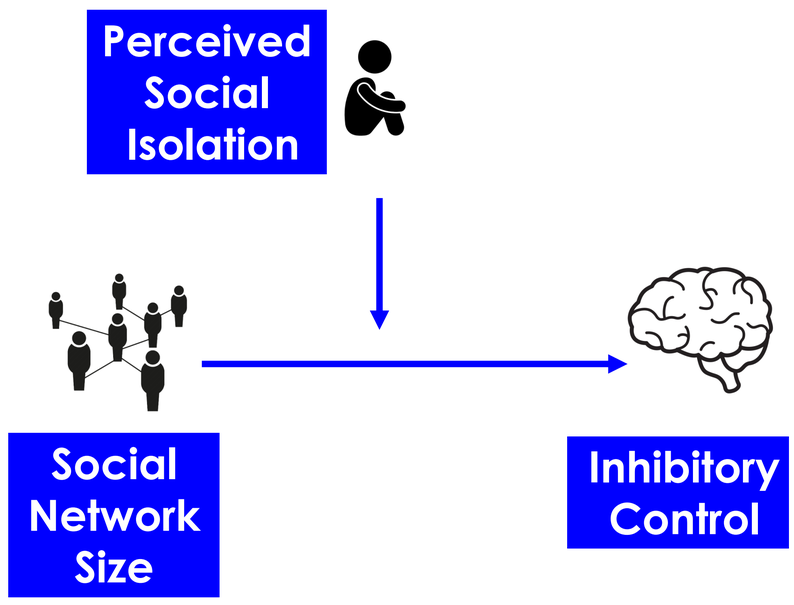


	low PSI	average PSI	high PSI
low SNS	8,50	9,89	11,29
average SNS	15,55	13,3	11,06
high SNS	22,6	16,71	10,82

FIgure 2. High (>43) RUCLA score redces the effect of Social Network Size on inhibitory control marker P300

6. Discussion

- Less complex social networks is linked to reduced inhibitory control (as indexed by amplitude of P300 to No-Go trials).
- This finding is in line with a large body of previous behavioral findings suggesting that richer social activity is one of the predictors of inhibitory control capacity across developmental stages (Marciszko et al., 2019).
- This link is believed to be bidirectional, as the development of executive functions has been shown to predict social functioning in children (Selcuk, Yavuz, Etel, Harma, & Ruffman, 2017).
- Loneliness suppresses the positive relationship between one's network size and inhibitory control.
- These results emphasize the need for deeper investigation the relationship between objective and perceived social isolation, as well as thier interaction on mental processes.



This study was completed as a part of the Loneliness Project (NCN signature: 2018/31/B/HS6/02848). Special thanks to prof. Łukasz Okruszek for help and supervising

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