INCREASED STRESS REACTIVITY THRESHOLD IN VICTIMS OF BULLYING

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Introduction
Impact of early-life experiences on quality of life and health over the life course

- ▶ adverse early-life experiences of threat and danger (see Anda et al. 2010; McEwen 2012)

- ▶ acute and chronic stressors (here: violent victimization by bullies) and their impact on mental and physical health

- ▶ stress process (see e.g. O'Connor, Thayer, and Vedhara 2021):
  1. perceptual threshold (of threat)
  2. perception bias
  3. excitation level
  4. gene expression

- ▶ in this study: **perceptual threshold of anger** in facial expression of others

Data

Outcome:
- ▶ **Zurich brain and immune gene study (ZGIG 2019, n=200)**, subsample of *z-proso*, biopsychological-experimental, genome and immune panel data
    - ▶ in this study: discrimination between joy and anger in facial expressions (perceptual threshold)

Treatment:
- ▶ *z-proso* (Ribeaud et al. 2022), waves 4 to 8, bullying data from ages 10 to 21
    - ▶ main focus: violent bullying (victimization and perpetration)
    - ▶ no clear definition of "bullying" in the literature (Slattery, George, and Kern 2019); we consider a subject victim/bully when they report respective incidences at least three times the last twelve months
    - ▶ further adjustment for: sexual assault, exclusion, insult, destroyed belongings

Baseline:
- ▶ *z-proso*, waves 1 to 3, baseline data for balancing using propensity scores
    - ▶ developmental delay, EHC life events, conflict resolution, violent peers, biological parents, corporal punishment, aggression, anxiety, isolation in class, teacher rated bullying, SES, SES squared, region, sex, integration, coparenting, healthy leisure, negative behavior, mother's age, birth rank, district ID, and important interactions[1]

[1] C_AnyDevDel, EHC1_10events_quarters2, K3_SPS_COMP2, K3_ViolentPeers2, P1_HHComp2, P2_corporal_r2, PTK3_SBQ_ADHD, PTK3_SBQ_AGGR, PTK3_SBQ_ANXDEP, T2.1_ROLE03_2_r, T3.1_ROLE02, female, region, female, integration, coparenting, leis_health2, c_neg_index, mo_by, birth_rank, distr_id, sessq, ses*integration, coparenting*leis_health2, c_neg_index*birth_rank, female*birth_rank

Method 1/3
Task

- ▶ facial emotion discrimination (FED) was measured at about age 22

- ▶ morphing task
    - ▶ 42 faces from the Chicago Face Database (Ma, Correll, and Wittenbrink 2015)
    - ▶ subjects identified the midpoints in a superimposed spectrum of expressions between joy and anger (100 frames)

Fig.1: Example symbolized representation of the morphing task.

Method 2/3

Challenges

- ▶ bullying is not binary: victim-, perpetrator-, victim-perpetrator-clusters
- ▶ Multichannel sequence analysis (MCSA)
- ▶ unaffected individuals serving as control
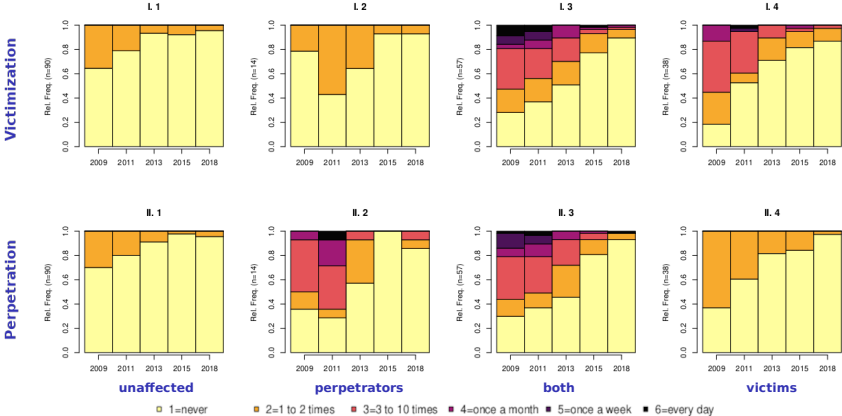- ▶ (further adjustment for other types of bullying such as exclusion and sexual assault)

Fig.2: Two-channel bullying clusters (threshold >= 3 times last 12 months).

Method 3/3
Challenges

- ▶ bullying is no randomly assigned "treatment"
- ▶ multivariate propensity-scores (PS) to equalize sample and infer causal effects
- ▶ mixed models (covariate-adjustment, PS-adjustment, IPW), subjects / faces as RE
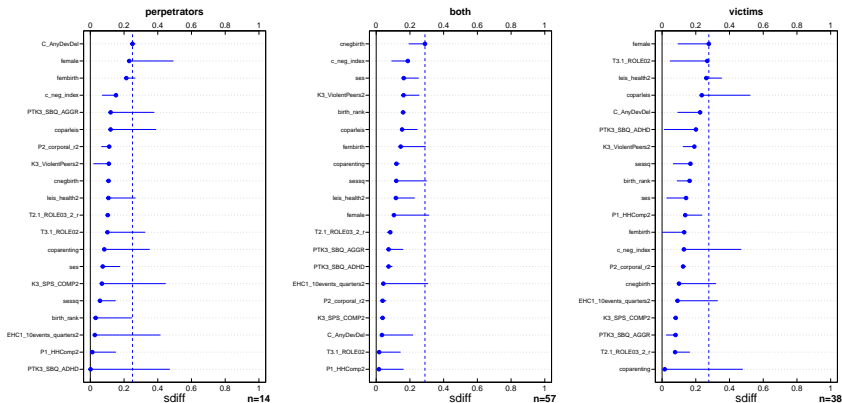- ▶ ATT using focal group (McCaffrey et al. 2013)

Fig.3: Improving balance in bullying clusters after matching. Absolute standardized differences all $< .3$.

Results 1/4
threshold changes

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##                    I. covariate-adjusted    II. PS-adjusted        III. IPW
## (Intercept)              38.254±45.836        45.559±4.097 ***   44.054±2.818 ***
## perpetrators              0.430±4.987          1.495±5.434        1.866±4.999
## both                      0.390±2.997          0.659±3.081        1.306±3.115
## victims                   4.226±3.480 *        4.013±3.681 *      3.701±3.276 *
## other bullying                   yes                  yes                yes
## covariates                       yes                   PS                 no
## Cohan's D                       0.288                0.271              0.267
```

Note: *p<.05. **p<.01. ***p<.001, two-tailed tests. Coefficients $\pm$ 95% CI. Other bullying:
perpetration/victimization such as sexual assault, exclusion, destroyed belongings, and insult (all models).
Covariates: PS-balancing variables (model I.), propensity scores (model II.), none (model III.).

- ▶ subjects in the victim cluster rated on average about 4 frames higher levels of
  anger in faces as the mid-point compared to the unaffected group
- ▶ the corresponding *Cohen's D* ($D \geq 0.267$) shows a considerable effect size
  (Kohler 2011)
- ▶ sensitivity analyses using leave-one-out validations (subjects, faces, and variables)
  showed that effects remained robust

Fig.4: Facial expressions rated as mid-point between joy and anger; unaffected group (left panel), victims (mid panel), difference (right panel).

Results 3/4

Results 4/4

Discussion

- ▶ the results from PS-weighted (*quasi-experimental*) analyses of panel data provide evidence for *causal effects* of acute and chronic stressors such as bullying victimization on perceptual threshold of anger in facial expression of others

- ▶ supporting other results and theories of blunted response due to overstimulation, e.g.
  - ▶ blunted cortisol reactivity among bullied children (Ouellet-Morin et al. 2011)
  - ▶ blunted response to chronic unpredictable stress in mice; up-regulation of receptor for advanced glycation endproducts (e.g. associated with depression) (Franklin et al. 2018)
  - ▶ deactivation of the sensorimotor network in victims (Stouwe et al. 2019)

- ▶ subanalyses, suggesting that children from families with low socioeconomic status (especially low educational attainment) are at much higher risk of victimization, imply corresponding policy support

Thank you!

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Appendix
Results SES

```
##            unaffected      perpetrators           both           victims
## SES_Q2  0.181±0.275      -0.044±0.286      0.151±0.272      -0.288±0.224 *
## SES_Q3  0.146±0.151       0.044±0.136      0.072±0.143      -0.262±0.171 **
## SES_Q4  0.137±0.141       0.060±0.122     -0.029±0.147      -0.168±0.171


##            unaffected      perpetrators           both           victims
## SES_Q1 -0.025±0.152       0.054±0.258     -0.136±0.219       0.107±0.147
## SES_Q4 -0.165±0.136 *     0.003±0.143     -0.114±0.168       0.276±0.138 ***


##               unaffected     perpetrators           both          victims
## educ_Q1      -0.091±0.170      0.078±0.331     -0.067±0.002 ***  0.080±0.234
## educ_Q4      -0.430±0.184 *** -0.016±0.216      0.048±0.147      0.397±0.133 ***
## hh_income    -0.001±0.141     -0.000±0.169     -0.000±0.136      0.001±0.120
## hh_prestige   0.150±0.145 *    0.006±0.169     -0.106±0.114     -0.050±0.283
```

Note: *$p < .05$. Coefficients $\pm$ 95% CI, Q1: upper 25%, Q4: lower 25%, covariates: other PS-balancing variables (of which SES is highlighted here), and other perpetration/victimization such as sexual assault, exclusion, destroyed belongings, insult.

- ▶ average marginal effects from multinomial logistic regression show that subjects from low SES households were more likely to fall into the victim cluster
- ▶ decomposition of the SES association shows that the effects are mainly driven by low educational attainment of the parents