Nuske et al., 2016

OTHERS' EMOTIONS TEACH, BUT NOT IN AUTISM: AN EYE-TRACKING PUPILLOMETRY STUDY

Social-Emotional Calibration

- A process by which, after observing or experiencing another's **emotional expression** (e.g. facial, vocal or bodily) in response to a particular **referent** (e.g. an object, event, topic, social or cultural practice, attitude or another person), the **observer's emotional reactions to that referent calibrate with those of the observed person.**

Research Questions

- Is emotional calibration disrupted in children with ASD compared to typically developing children?
- If so, are these difficulties a reflection of a lack of attention to others' emotional expressions, or difficulties in social-emotional calibration per se?
- Are ASD symptoms associated with social-emotional calibration?

Methods

Participants

- Children aged 2-5 years old
- 20 TD children
- 20 children with ASD
  - High variability in functioning

Apparatus

- Binocular eye tracker
  - Visual attention
  - Pupil diameter

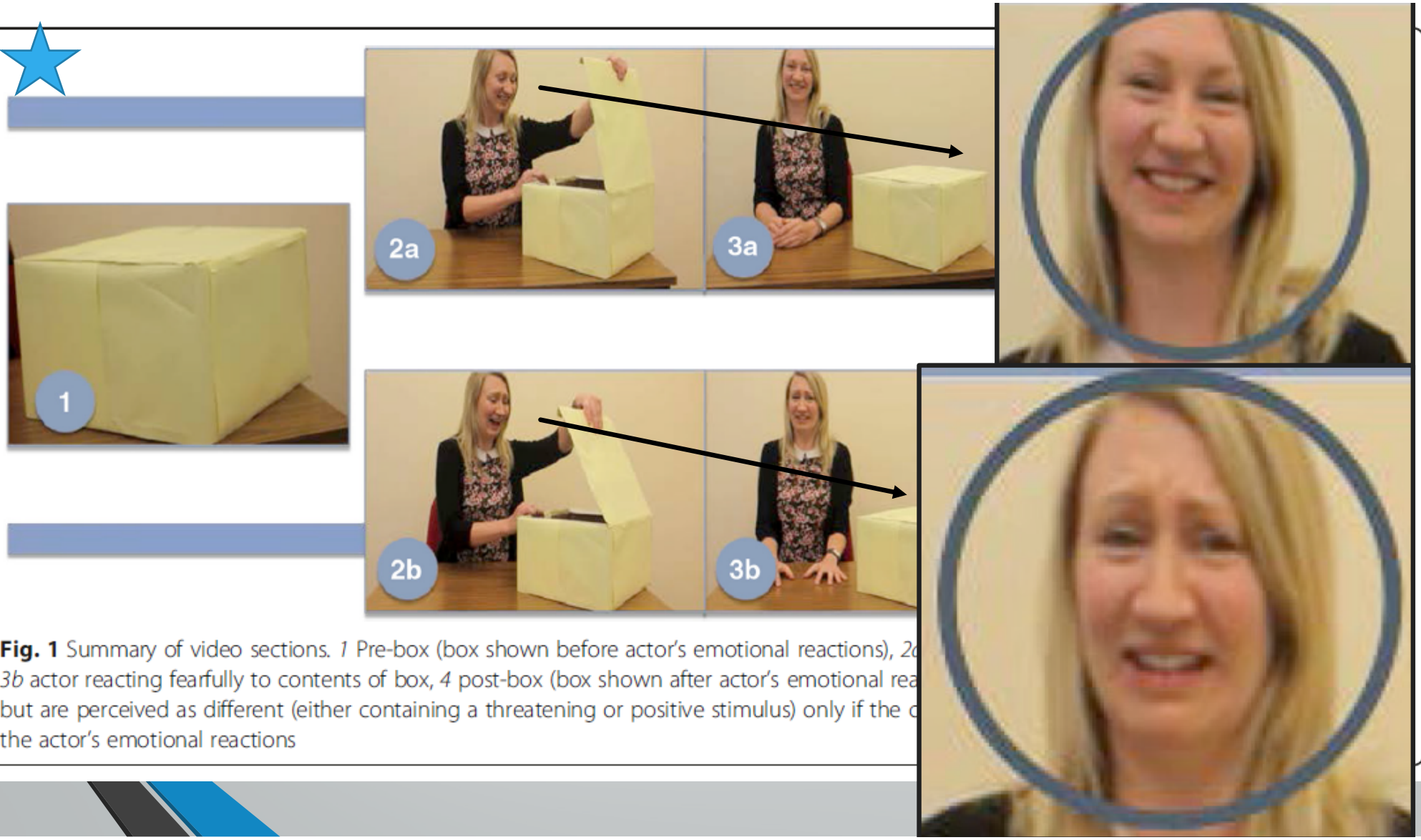


Fig. 1 Summary of video sections. *1* Pre-box (box shown before actor's emotional reactions), *2*
3b actor reacting fearfully to contents of box, *4* post-box (box shown after actor's emotional rea
but are perceived as different (either containing a threatening or positive stimulus) only if the c
the actor's emotional reactions

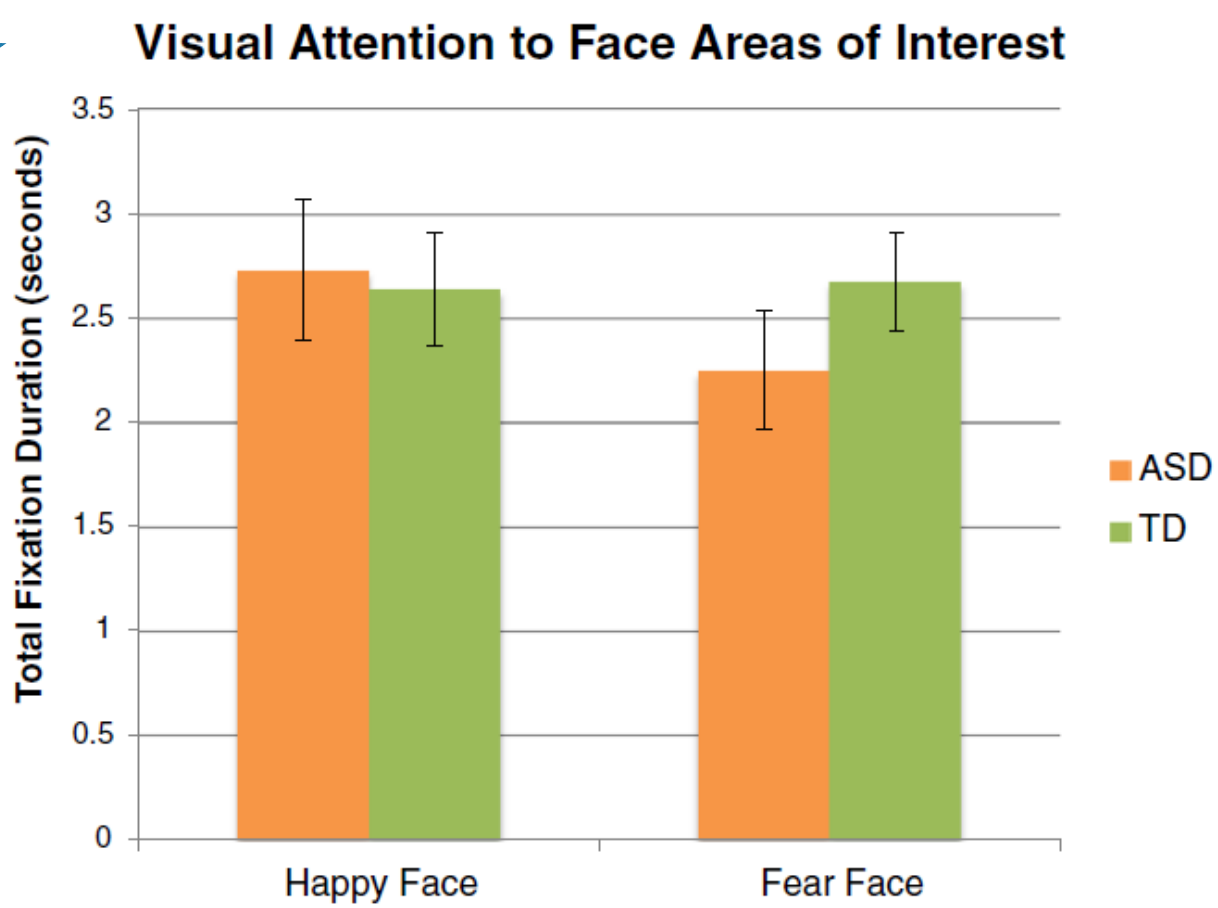


Fig. 3 Visual attention to the emotional expressions. Total fixation duration (sum of individual fixation durations) to the emotional facial expression area of interest for the happy and fear social-emotional calibration videos, for each group. *Error bars* represent standard error of the mean

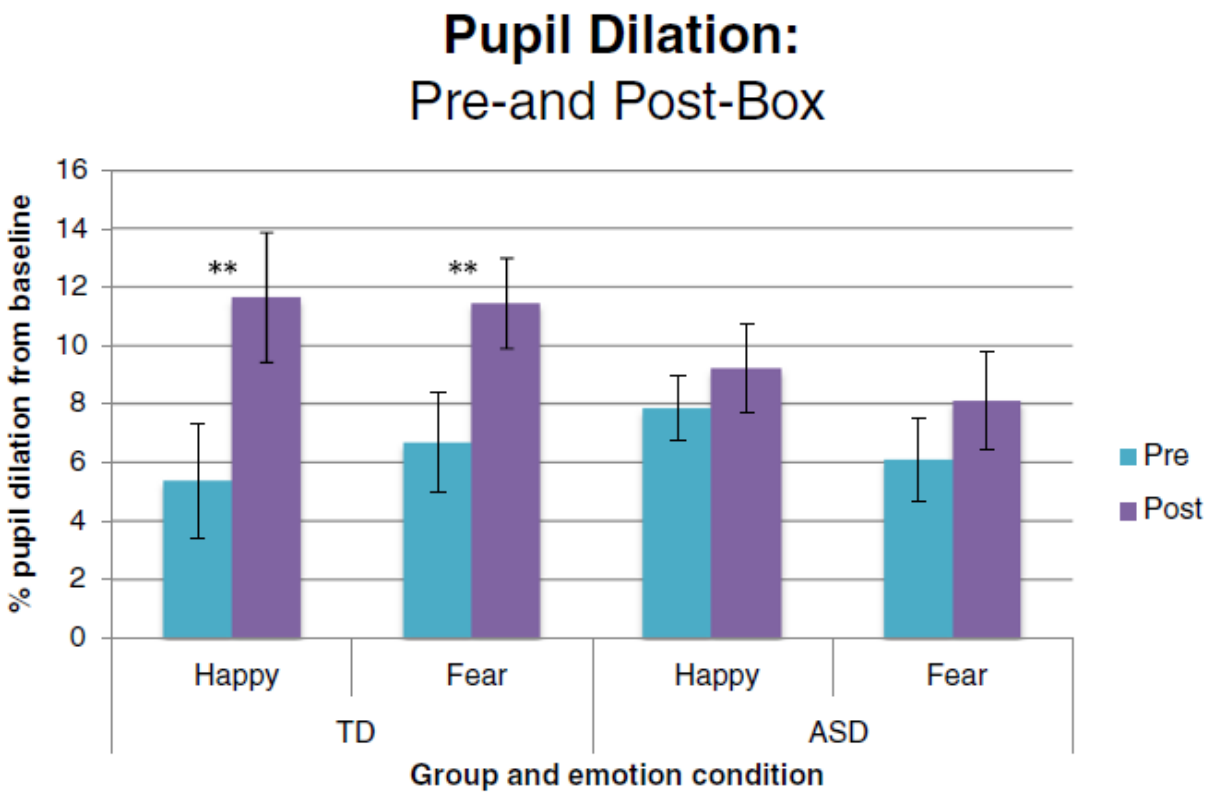


Fig. 4 Percentage dilation from baseline in each emotion condition for the pre- and post-box. *Error bars* represent standard error of the mean. **Pairwise comparisons (Bonferroni-corrected) show difference pre- to post-box in the TD group only, for happy ($p < .001$, $\eta^2 = .45$) and fear ($p < .001$, $\eta^2 = .31$). *Error bars* represent standard error of the mean

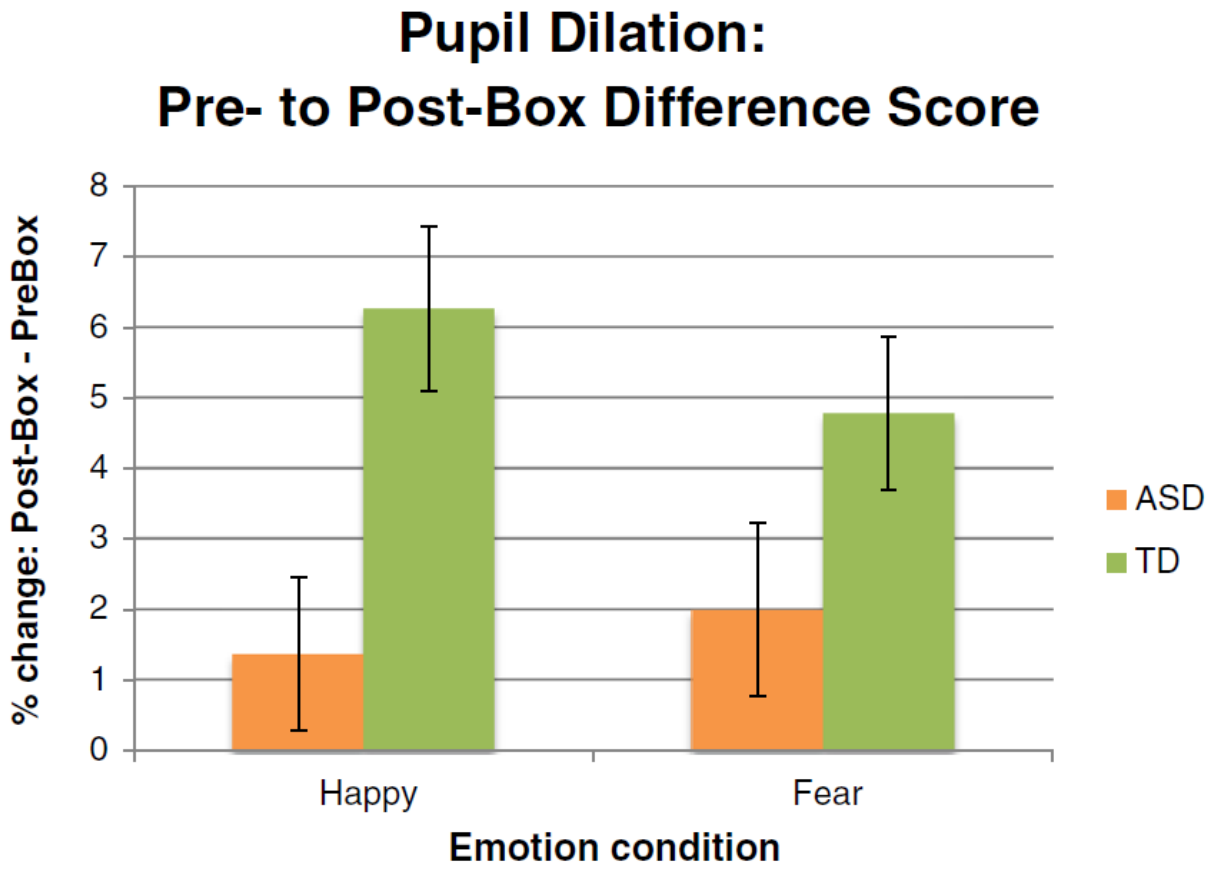
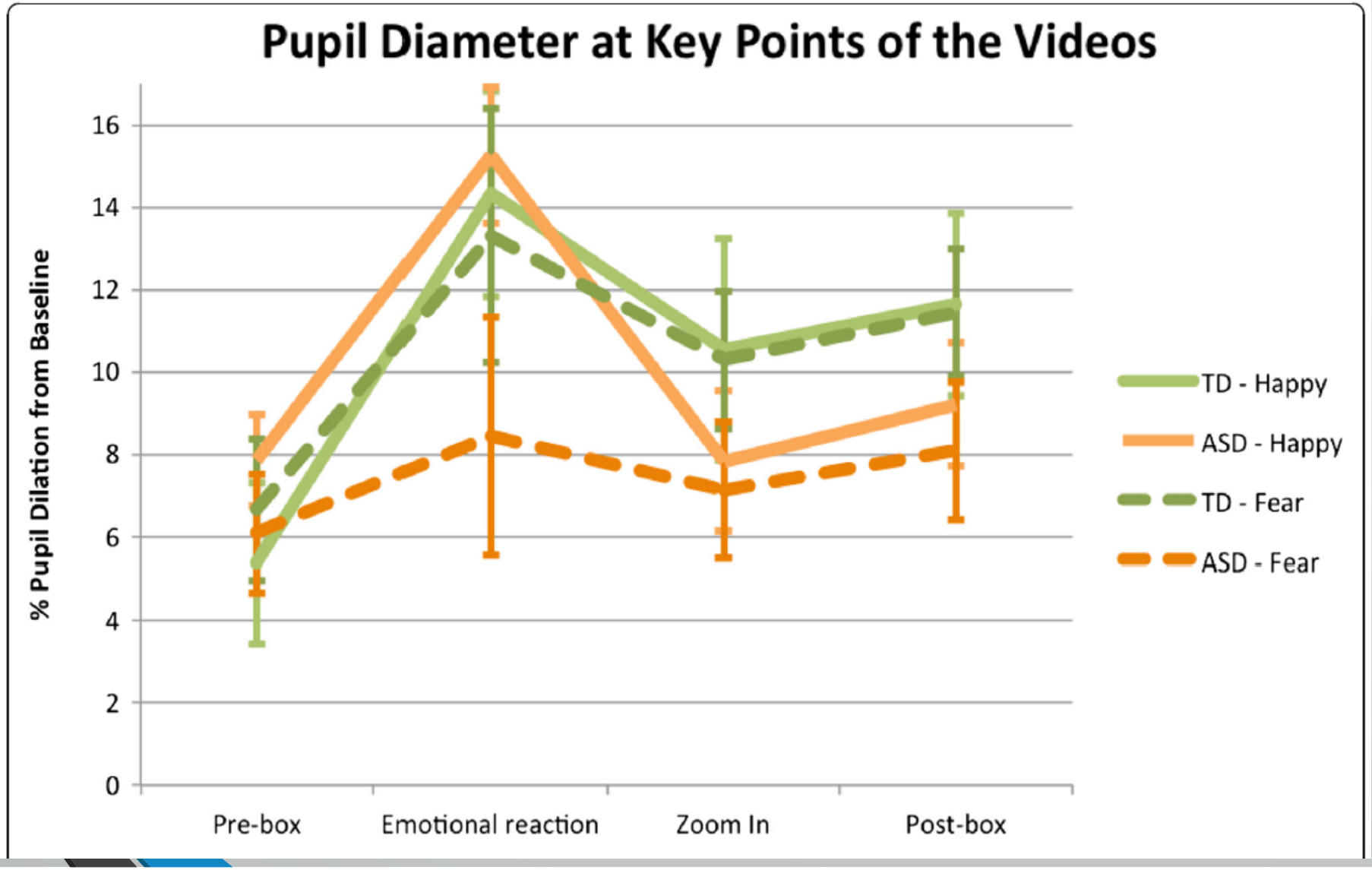


Fig. 5 Post-minus pre-box difference score as an index of social-emotional calibration. Higher scores = more social-emotional calibration. *Error bars* represent standard error of the mean


Pupil Diameter at Key Points of the Videos
% Pupil Dilation from Baseline
16
14
12
10
8
6
4
2
0
Pre-box
Emotional reaction
Zoom In
Post-box
TD - Happy
ASD - Happy
TD - Fear
ASD - Fear

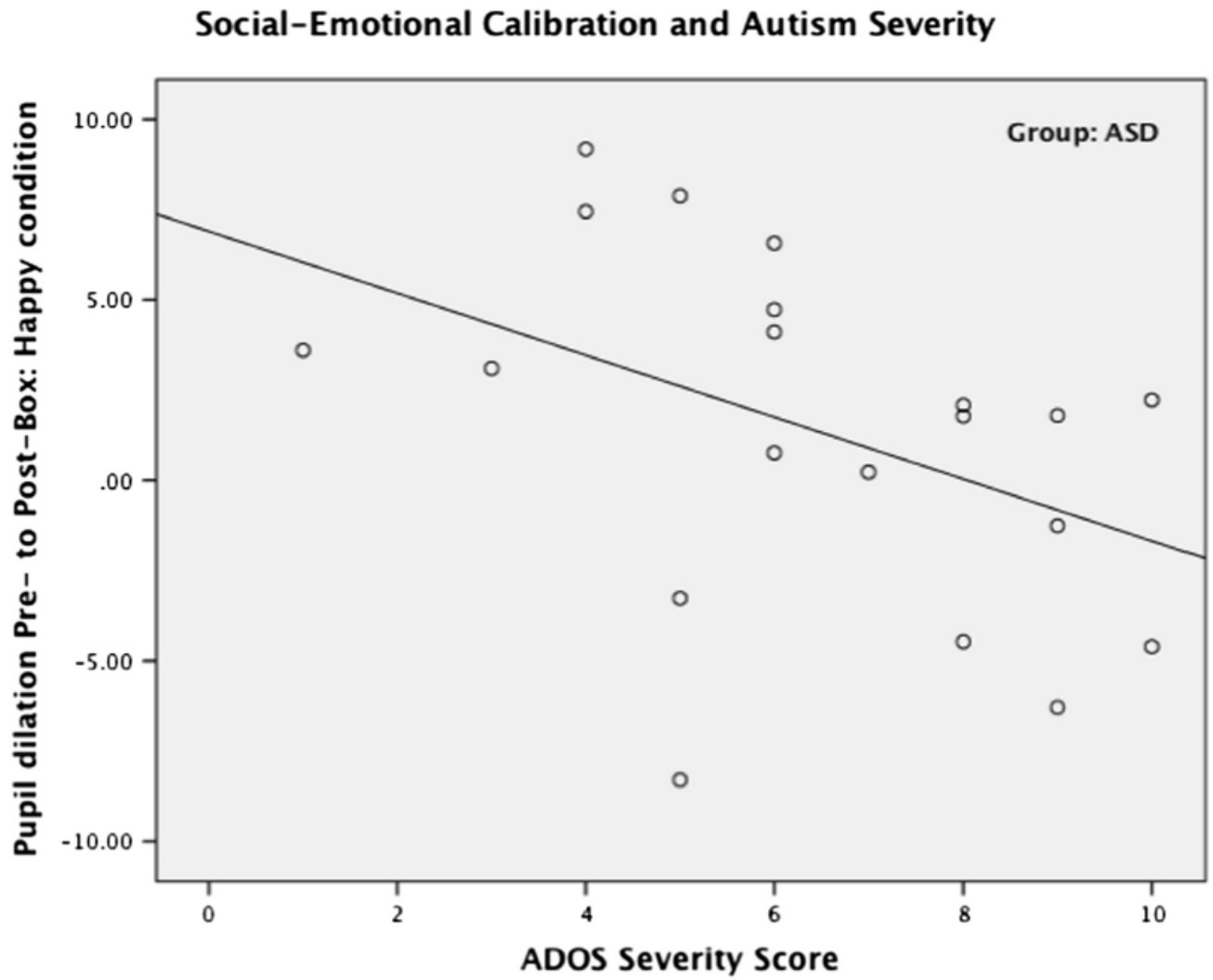


Fig. 7 Scatterplot with social-emotional calibration index on the *Y* axis and the ADOS Severity Score on the *X* axis, showing a moderate negative correlation ($r = -.43$, $p = .03$)

Research Questions & Findings

- Is emotional calibration disrupted in children with ASD compared to typically developing children?
  - **Yes**
- If so, are these difficulties a reflection of a lack of attention to others' emotional expressions, or difficulties in social-emotional calibration per se?
  - **Not due to lack of attention due to others' emotional expressions**
- Are ASD symptoms associated with social-emotional calibration?
  - **Yes –at least for happy condition**

Discussion Point – The Sample

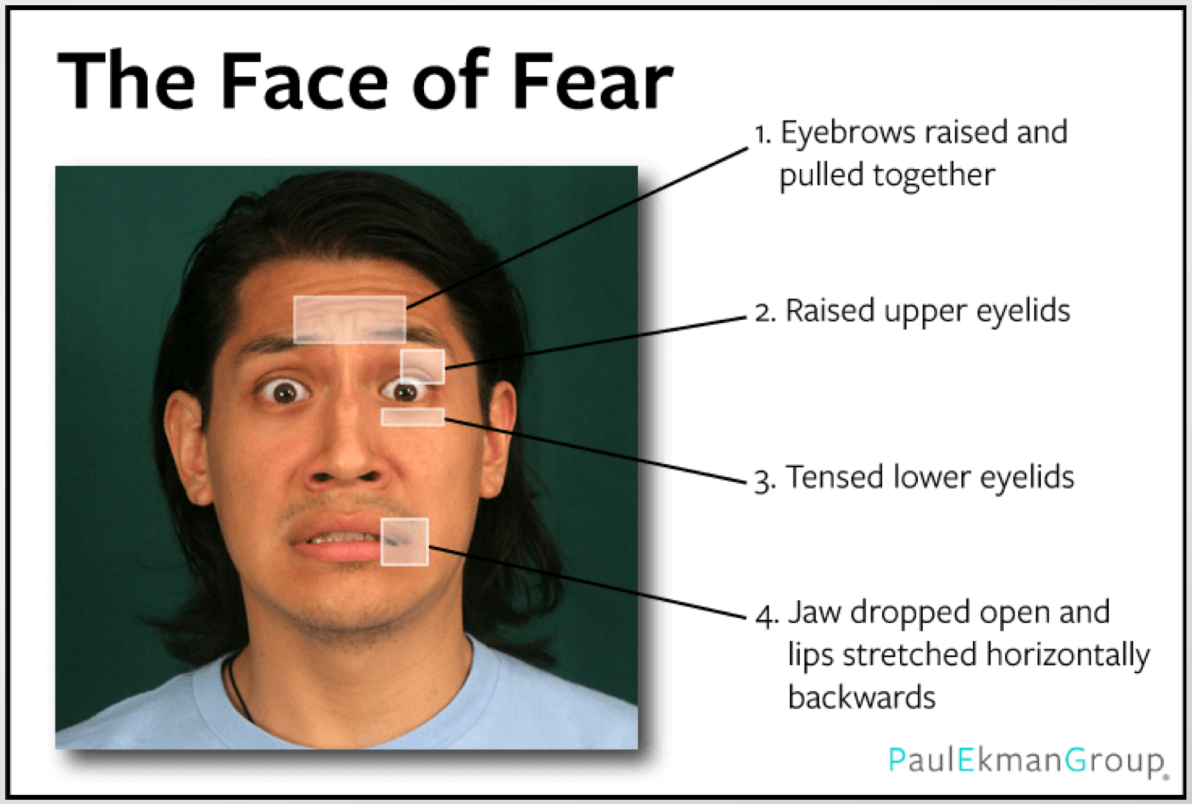
- The Nuske et al study (2016) did not provide information about the child participants' race, ethnicity, or culture. **How might a child's social-emotional calibration be impacted by his or her cultural background?** Might children from cultures in which emotional expression is generally more understated (e.g., in China) be more sensitive to others' emotional expressions? Further, this study utilized only 20% female participants (likely due to the overrepresentation of males with ASD). **With a larger sample size and more gender diversity, are there likely to be gender differences on this task?**
- In the article by Nuske et al. (2016), **they failed to match the TD group and the children with ASD group on cognitive ability. How, if at all, do you think the results of the study may have changed** (or how would the significance/interpretation of the data change) **if the two groups had been matched on both chronological age and mental age?** Don't forget to take into account that they found that the cognitive ability covariate was not significant in the analysis.

Discussion Point – The Findings

- Nuske , Vivanti & Dissanayake (2016) found no significant differences in fixation time to faces between preschoolers with ASD and their typically developing counterparts, suggesting the children with ASD paid just as much visual attention to emotional expressions; however, **no information is provided about what aspects of the actor's face participants attended to during the task**. It stands to reason that specific parts of the face can contribute to quicker and better emotion recognition (e.g., the mouth for happiness, the eyes for fear). To the extent emotion recognition functions to facilitate socio-emotional calibration**, could additionally analyzing the pattern of eye movements via eye-tracking shed light on what is happening earlier in the cascade of processes contributing to diminished social-emotional calibration in children with ASD?**
- I had the exact same thought you did regarding the Nuske, Vivanti & Dissanayake (2016) article. Simple looking at an emotional face is not indicative of emotional reception. **From other eye tracking studies, we know that children with ASD do not focus on the same facial features as typically developing children**, so when looking at understanding emotion**, it would be important to have an understanding of how the emotional facial features the groups looked at differed**.
- Nuske et al. (2016) noted that because the two groups of preschoolers did not differ in looking duration to the emotional expressions, the pupil dilation findings were not explained by differences in visual attention. I'm wondering if there **are additional ways to measure attention here**, such as self-report. **Is visual information enough to conclude that an individual is fully attending to the stimuli?**

Discussion Point – Other Ways of Measuring / Interpreting

- I think there can be an argument made about **a difference in theory of mind** and not assuming that a person's emotion is connected to the unknown stimulus on the table.
- In the Nuske et al. (2016) article the authors found that children with Autism had deficits in emotional calibration when viewing pictures of an actor opening a box and making an fearful or happy face. The children with Autism did not respond as emotionally when viewing the same box as typically developing children. **It would be interesting to see what the children from both groups answer the question: What do you think was in the box?**
- When looking at the emotional reactions elicited by the actress in Nuske and colleagues (2016) study on emotional-calibration in children with ASD and typically developing children, I was curious about how effective they were in conveying said emotion. **Would this study be more effective if a facial expression analysis was conducted to test the actress's expressions against still images that are often used in studies to elicit those reactions?** It was hard to decipher between the happy and fearful conditions from far away on my computer, so I'm curious if this was an issue at all (obviously results indicate discriminating facial expressions was possible, but I wonder if fear accurately did its job).


The Face of Fear
1. Eyebrows raised and pulled together
2. Raised upper eyelids
3. Tensed lower eyelids
4. Jaw dropped open and lips stretched horizontally backwards
PaulEkmanGroup

Discussion Point – Extending the Research

- Nuske and colleagues (2016) found that children with autism had diminished social-emotional calibration when compared to typically developing peers. I have a couple of questions about this outcome. In this study, the children observed the emotional reaction of an actor opening a box. **Would the identity of the person opening the box affect the outcome?** For example, what if the person opening the box were the child's parent?
- Nuske (2016) presents the concept of "social-emotional calibration" in which children learn to react appropriately to objects and situations in their environment based on the observed emotions of others towards those objects or situations. **For parents who have experienced trauma, do their children struggle more with understanding social cues compared to other children based on blunted emotions? Would their learning and visual emotion processing become delayed or changed in perception?** Also, going along with the theme of parental influence, **if the parents are sleep deprived and therefore have blunted emotions, does that effect the child's learning to process and express emotions?**

Discussion Point – Extending the Research

- Rachman's theory of the etiology of childhood phobias holds that one pathway by which children develop phobias is through modeling. Simply put, children learn maladaptive fear responses from parents and other significant individuals in their social environment. Would there be any difference in the rate of learned fear responses for children with diminished social-emotional calibration? Another way to put this question might be: **are children who have autism and parents with phobias less likely to have the same phobias as their parents (when compared to typically developing peers)?**
- Nuske and colleagues (2016) largely argue that social-emotional calibration is an adaptive skillset across the lifespan. **Are there examples of ways social-emotional calibration could actually be maladaptive?** For example, could children with this skillset learn to adopt fear towards non-threatening places (e.g., the grocery store) after observing agoraphobia in a parent? Conversely, in a home with substance abuse, might normally developing children attach positive affect to alcohol and/or drugs after observing how adults respond to these substances with excitement or joy?

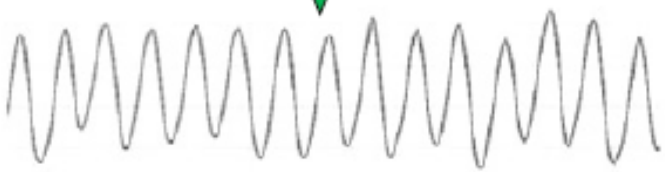
Discussion Point – Extending the Research

- From my reading of the article by Nuske and colleagues (2016), I was curious about the developmental period sampled (i.e., preschool aged children). Presumedly, we **can disentangle developmental mechanisms during this early developmental period**, but I would be curious if others have thoughts on **if/how the results would change as the child ages** (i.e., developmental course for social-emotional calibration)? Would we expect changes in both groups?
- I would be curious to see the experiment conducted in the Nuske et al. (2016) paper **replicated in populations with other neurodevelopmental disorders such as communication disorders and ADHD**. How do you think the results would differ across populations? Do you think these populations would also have deficits in emotional responses? What would this study look like in individuals different anxiety disorders? Would the eye-tracking device measure higher levels of emotional reactivity then typically developing children/adults?

Mather & Thayer, 2018

HOW HEART RATE VARIABILITY AFFECTS EMOTION REGULATION BRAIN NETWORKS

Breathing at the same frequency as the baroreflex feedback loop (resonance breathing; around 10-s per breath)



High amplitude oscillations in heart rate

Improved emotional well-being

HOW?

High amplitude physiological oscillations stimulate oscillatory activity in the brain, especially within brain regions sensitive to interoceptive information. This strengthens functional connectivity within these regions.

Current Opinion in Behavioral Sciences

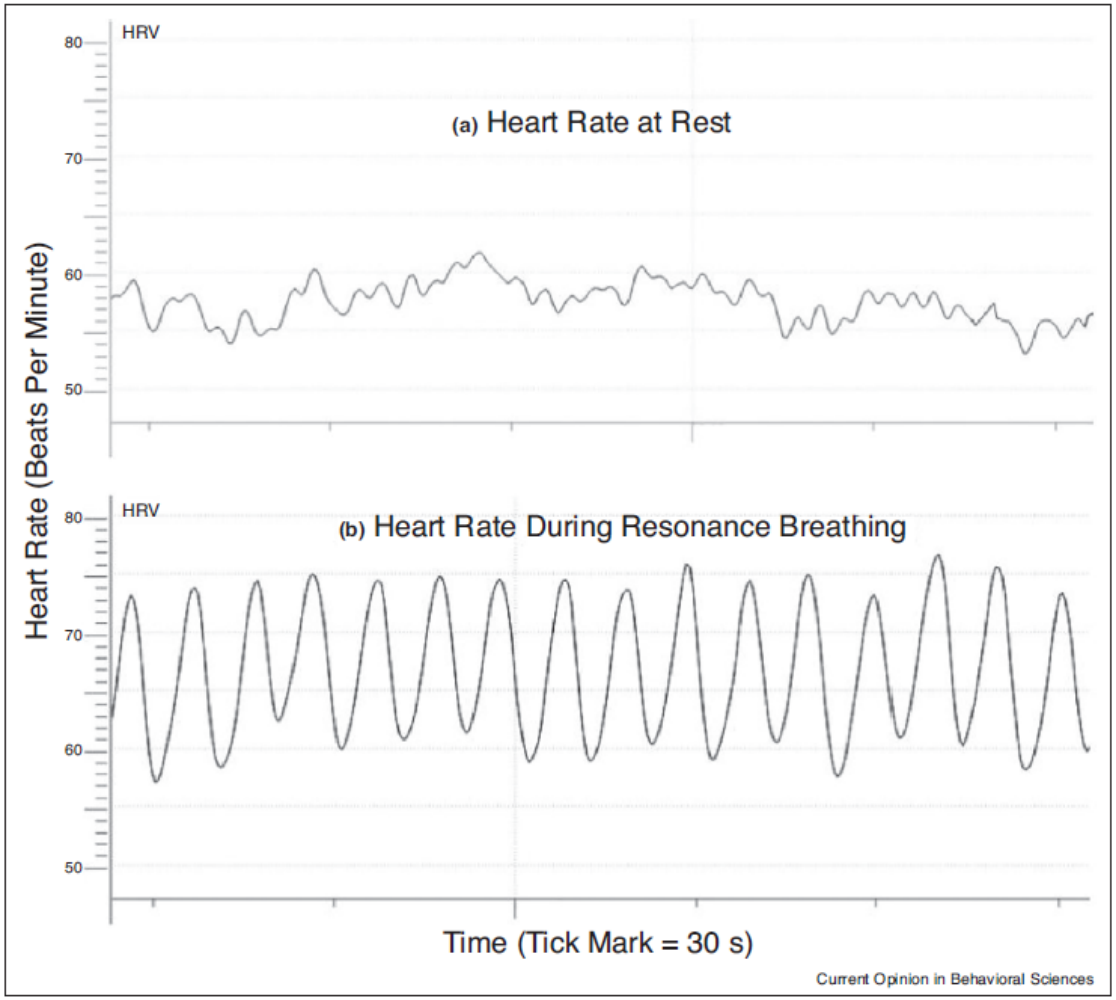
Links Between HRV and Brain Regions Involved in Emotion Regulation

- HRV & regional cerebral blood flow in:
  - Ventromedial prefrontal cortex (VMPFC)
  - Amygdala
    - Higher functional connectivity

Inducing High Amplitude Oscillations in Heart Rate Improves Emotional Well-being

- Increased heart rate oscillations led to:
  - Reduced stress
  - Reduced anxiety
  - Reduced depressive symptoms
  - Increased athletic performance
  - Decreased expressive and suppressive hostility
  - Reduced PTSD symptoms

Figure 1



(a) An example of heart rate variability during about a 2.5 min time period during quiet rest. **(b)** The same person's heart rate during resonance breathing during another 2.5 min time period.

Discussion Point – Bidirectional?

- Mather & Thayer (2018) conclude that heart rate oscillations enhance regulatory brain networks and thus enhance emotion. I'm interested in learning more about this relationship. When I first read through this paper, it seemed like the authors were proposing that emotion regulation was downstream of heart rate variability, which is the opposite of how it has traditionally be conceptualized. Now I am wondering **if this could be a bidirectional relationship, with emotion regulation and heart rate variability acting in a positive feedback loop.**

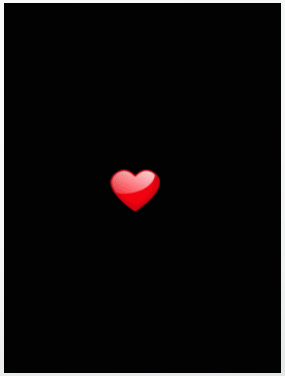
Discussion Point – The Benefits

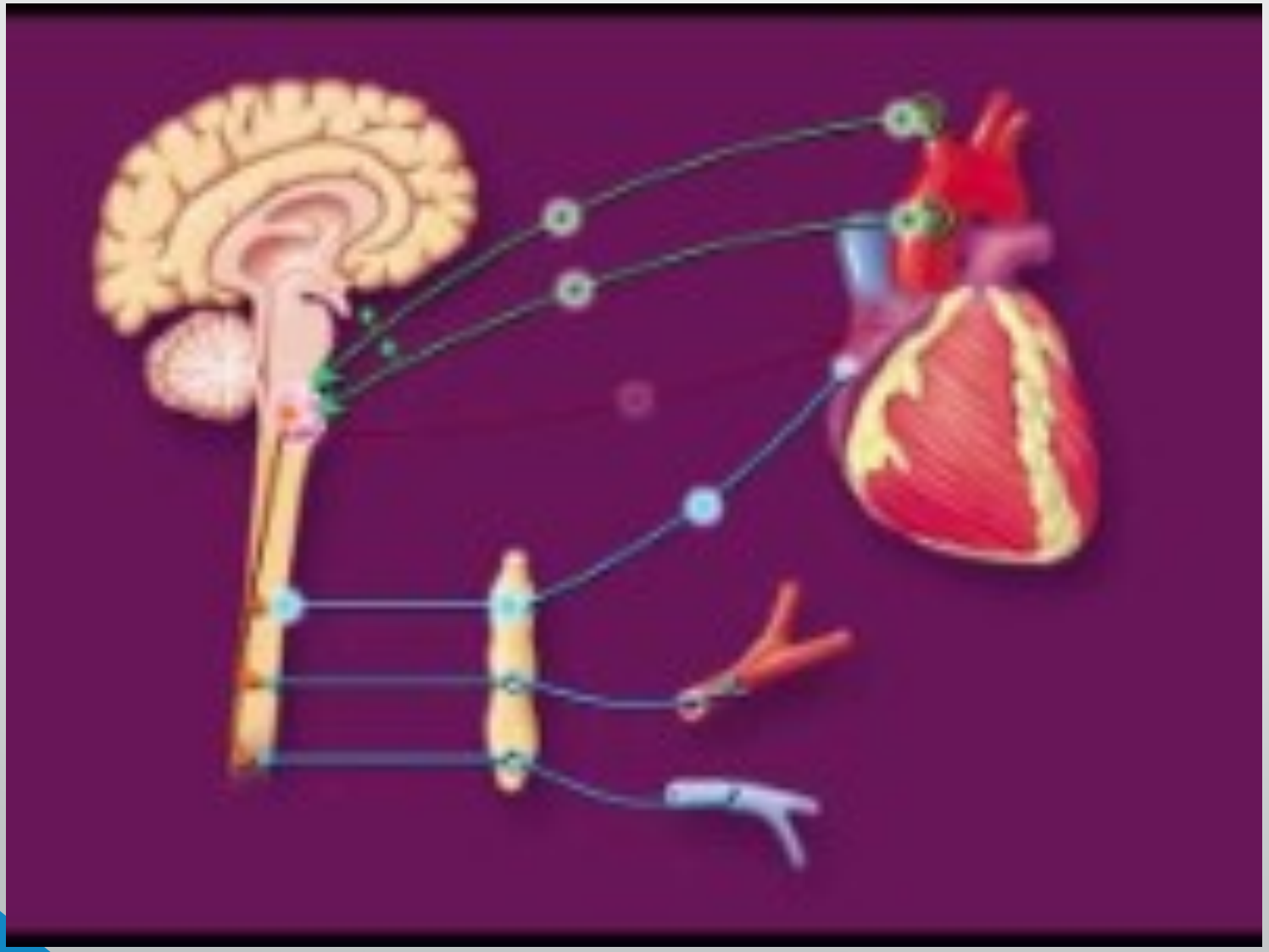
- Mather and Thayer (2018) reviewed the link among breathing, emotional regulation, heart rate variability, brain networks, and stress level. I think what this paper argued maps onto behavioral observation where rhythmic/resonance breathing regulates stress/emotion. What I'm curious about is that the paper mentioned the relationship between PTSD symptoms got relieved after 8 weeks of breathing training. **Is there any evidence showing how PTSD symptoms are manifested in terms of neural networks?**
- Mather and Thayer (2018) mentioned studies that used heart rate variability biofeedback to decrease symptoms like stress and anxiety. One study showed improvements up to one month after doing the heart rate variability biofeedback. This makes me wonder **how long these effects may last after doing heart rate variability biofeedback? How much and how often would someone have to use biofeedback to decrease their symptoms and for maintenance?**

Discussion Point – Who Benefits

- Mather and Thayer (2018) present an interesting and compelling hypothesis regarding how heart rate variability may affect emotion regulation brain networks. In their discussion of supporting evidence, they mention that many meditative and religious chanting practices involve breathing slowing to the same frequency as resonance paced breathing. Breathing techniques are also central to many martial arts disciplines, and there is evidence that practicing martial arts can improve overall physical and mental health (Croom, 2014) and improve HRV (Liu et al, 2018). I'm wondering: **would we find that practitioners of martial arts have the corresponding improved connectivity and blood flow in the ventral-medial prefrontal cortex that Mather & Thayer (2018) hypothesized to be related to greater HRV and sense of well-being?**
- Mather and Thayer (2018) briefly talk about meditative and religious chanting practices slowing down ones heart rate. I would be curious to see if there **may be other activities people can engage in to help raise their HRV and emotional well-being?** For example, would long **distance running** be something that (over time) could result in the higher HRV, which then strengthens certain neural networks? Is this possibly where the term "runners high" is coming from?

Why Resonance Breathing Increases the Amplitude of Heart Rate Oscillations

- Baroreflex + Breathing = 
- Meditative & religious chanting practices
  - Slows breathing to 10-s



Discussion Point – The 10 s Dilemma

- Mather and Thayer (2018) discussed relevant research showing that breathing at the same frequency as the baroreflex feedback loop (~10s per breath) can improve emotional well-being through higher amplitude oscillations in the heart rate. Apparently, many meditative and religious practices cause breathing to slow to this frequency, which increases blood pressure and heart rate oscillations but there has been little research on the physiological rhythms induced by meditative practices. This caused me to think about mindfulness practices that we often implement in therapy, specifically the use of mindful breathing scripts. **Would we see the same physiological and emotional outcomes with these techniques that focus on attentive/slower breathing or would the breathing frequency be different when the 10s pace is not specifically taught?**
- The Mather & Thayer (2018) article was very interesting. I believe they are saying that slowed breathing practice leads to less anxiety. Further, they discuss how in meditative chanting slows breathing to around 10-s rate. This slowed breathing then leads to a higher amplitude oscillation in the heart rate. They say this leads to improved emotional well-being. The authors discuss how mindful practice has shown to be beneficial for attention and body awareness, but not physiological rhythms that are brought on by meditative practice. The breathing exercises that I have used are counted out, 4 in, hold for 4, and exhale for 4-6. **How would I modify the breathing exercise to achieve the 10-s rate and get the benefits of heart rate resonance breathing?**

High Amplitude Heart Rate Oscillations Should Promote Functional Connectivity, Especially in Brain Regions Involved in Emotion Regulation

- Blood flow
- Breathing
- Heartbeat

Slow Oscillations can Modulate Faster Frequencies of Neural Activity

- Resonance breathing → promotes functional connectivity between non-adjacent brain regions
- HR = basic frequency & scaling factor for EEG frequency domains

Another Potential Pathway of Action of Resonance Frequency Heart Rate Oscillations on the Brain

- Baroreflex & resonance breathing → regulate arousal pathways

Discussion Point – Other Considerations

- In their article, Mather & Thayer (2018) make a compelling case for the hypothesis that high amplitude heart rate oscillations promote functional connectivity in brain regions involved in emotional functioning, thus improving emotion regulation processes. However, the authors present their hypothesis through a more general lens that **does not directly consider how development may factor in**to the relationship between heart-rate variability and emotion regulation, despite key regulatory regions like **the prefrontal cortex maturing relatively slowly**. In light of this, **wouldn't we expect brain networks to be differentially sensitive to the effects of increases in heart rate oscillations on emotion regulation at different points in development?**
- People who engage in resonance breathing often experience positive effects (e.g., reduced anxiety/stress), and according to Mather and Thayer (2018), meditative practices and religious chants induce this physiological sensation. With this knowledge, is **it more important to either incorporate meditative practices into therapy and/or account/control for religious or meditative practices in research looking at mental health and stress outcomes?**