



Introduction

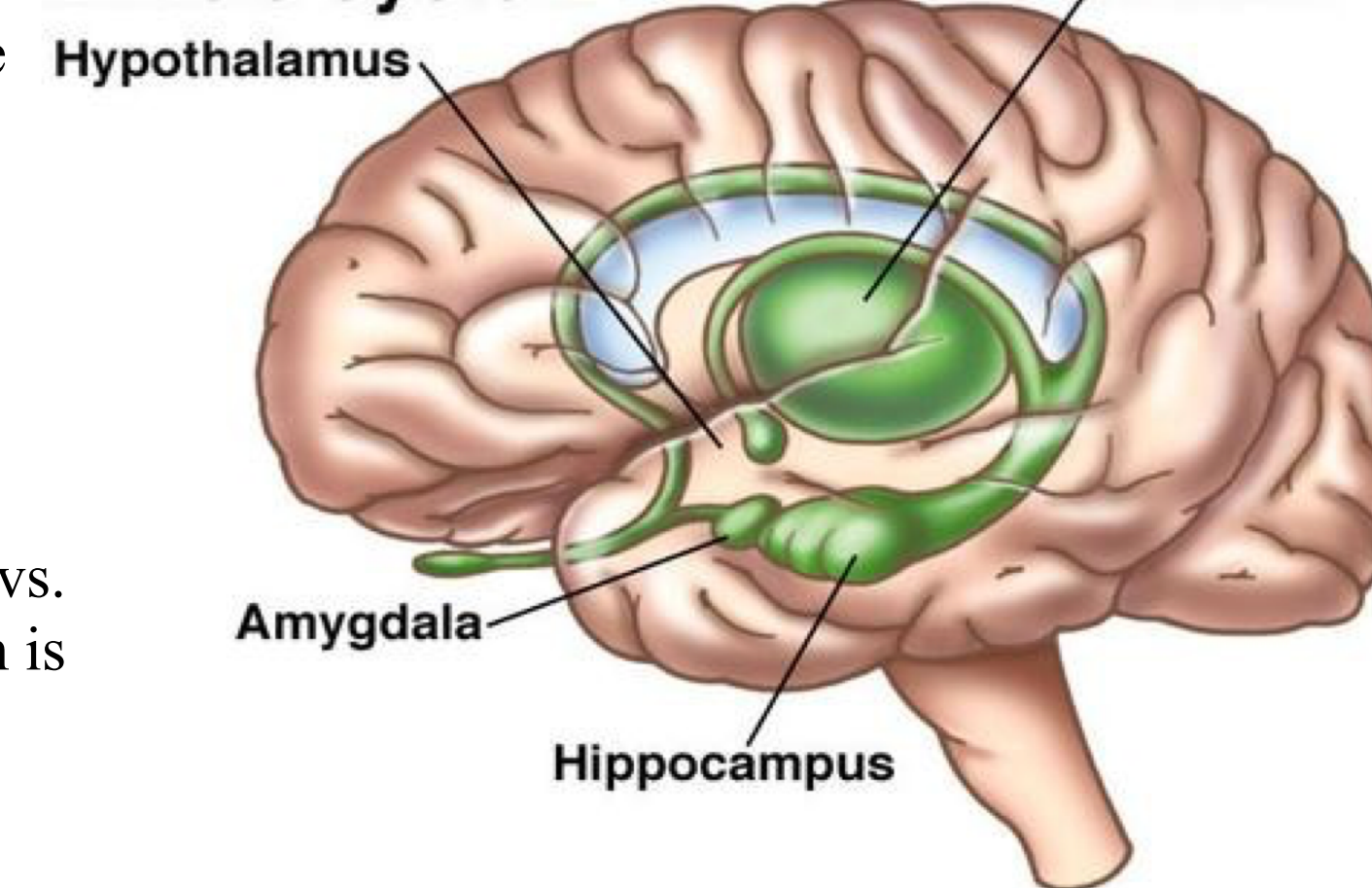
Background:

- As a crucial component of social interaction, empathy lies at the center of all human emotions and without it the “human” part ceases to exist.¹
- Empathy is a multifaceted concept: Interpersonal Reactivity Index:²
 - **Empathic Concern**
 - Perspective Taking
 - Personal Distress
 - Fantasy
- This study focuses on Empathic Concern (“other-oriented” feelings of sympathy and concern for unfortunate others) because it is an adaptive trait.

Development of Empathy During Childhood:

- Parent-child interactions are likely to influence the child’s development of empathy.³
- Parental affection is likely to foster secure attachment.⁴
- Secure attachment fosters empathy in children.
- Maternal affection is positively correlated with children’s empathy development.
- Previous research has shown differences for male vs. female children, suggesting that maternal affection is closely linked to female children’s empathy compared to male children.⁵

Limbic System



Neural Correlates of Empathy:

- Maternal affection likely influences the child’s empathy through changes in brain regions, i.e., right & left hippocampi.⁶
- Hippocampus is part of the limbic system and is closely interconnected with the amygdala. Both regions are associated with emotions.
- Its contributions towards social emotions (e.g., empathy) have not been systematically investigated thus far.⁷

Hypotheses

1. a) Maternal affection (empathy included) is positively correlated with child’s empathic concern in adulthood.
b) Maternal affection is positively associated with child’s hippocampal volume in adulthood.
c) Hippocampal volume is positively correlated with their level of empathic concern.
2. There will be an interaction with child’s gender such that female children’s empathy will show a stronger association with maternal affection compared to male children.

Methods

MIDUS (Midlife in the United States):

- National Longitudinal Study of Health and Well-Being
- Funded by National Institute of Aging

Dataset:

- MIDUS Refresher: Survey Project 2011-2014
- MIDUS Refresher: Neuroscience Project 2012-2016

Participants:

- N = 138; Milwaukee Sample = 44
- Age (*M, SD*) = 47.15 (11.61)
- 54.3% females
- Race (White) = 61.6%

Measures

Maternal Affection

- Part of the Survey Project⁸
- Continuous variable based on 7 items
- Sample items:
 - “How much love and affection did she give you?”
 - “How much time and attention did she give you when you needed it?”
- Item rating from 1 = a lot to 4 = not at all
- Higher scores reflect greater levels of maternal affect the respondent received during their childhood.

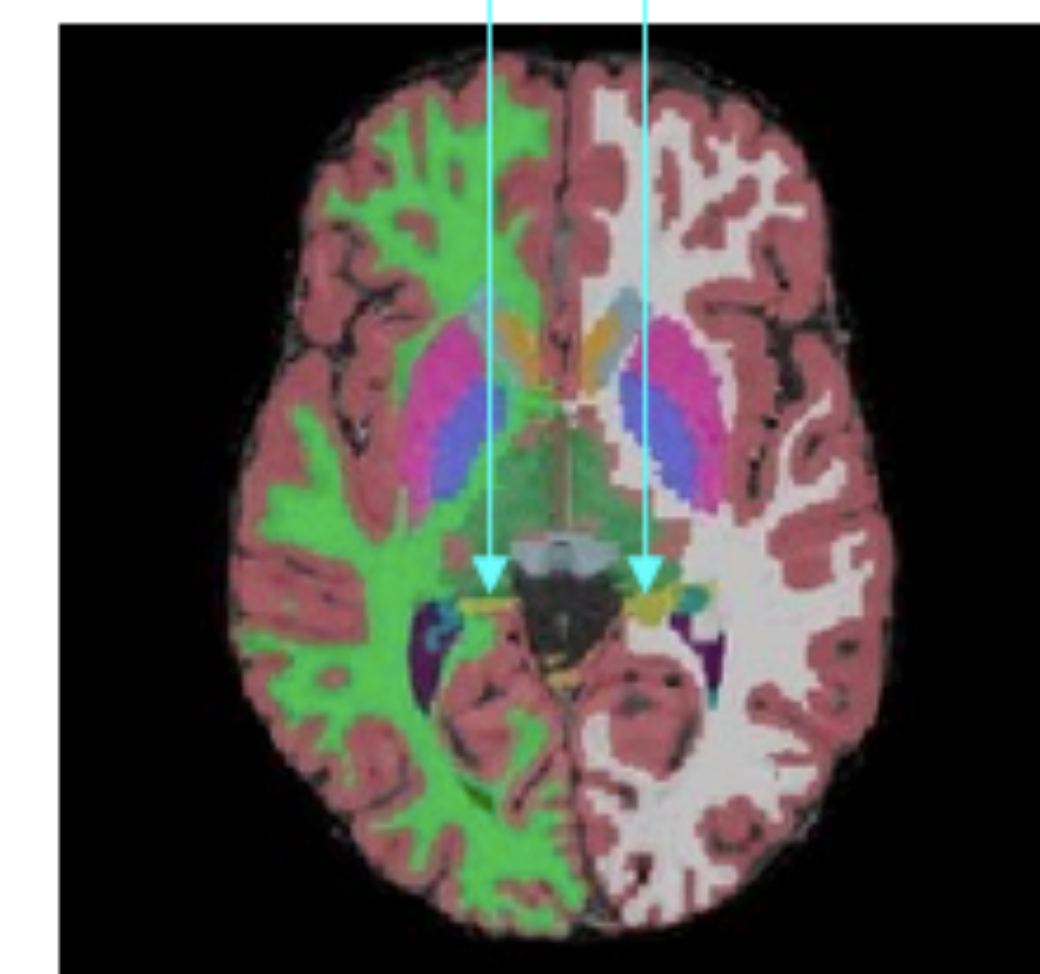
Empathic Concern

- Part of the Neuroscience Project
- Continuous variable based on 7 items
- Sample items:
 - “I often have tender, concerned feelings for people less fortunate than me.”
 - “Other people’s misfortunes do not usually disturb me a great deal.”
- Item rating from 1 = does not describe me well to 4 = describes me very well

Hippocampal Volume

- MRI data were collected on a 3 T scanner
- T1-weighted structural MRI images
- Processed through FreeSurfer
- Segmentation followed the Desikan-Killiany atlas (Desikan et al., 2006)
- Analyses focused on hippocampus gray matter volume

Subcortical segmentation denoting left & right hippocampi



Cortical parcellation indicating the hippocampus



Results

Maternal Affection & Empathic Concern (Hypotheses 1a):

- There was not a significant association between maternal affection and empathic concern (when adjusting for age), as shown in the figure below, $b = -0.04$, $F(1, 123) = 0.302$, $p = 0.583$.

Maternal Affection & Hippocampal Volume (Hypothesis 1b):

- There was not a significant association between maternal affection and child’s **right** hippocampus (when adjusting for age and total brain volume), $b = 67.54$, $F(1, 119) = 1.278$, $p = 0.261$.
- There was not a significant association between maternal affection and child’s **left** hippocampus (when adjusting for age and total brain volume), $b = 60.37$, $F(1, 119) = 1.148$, $p = 0.286$.

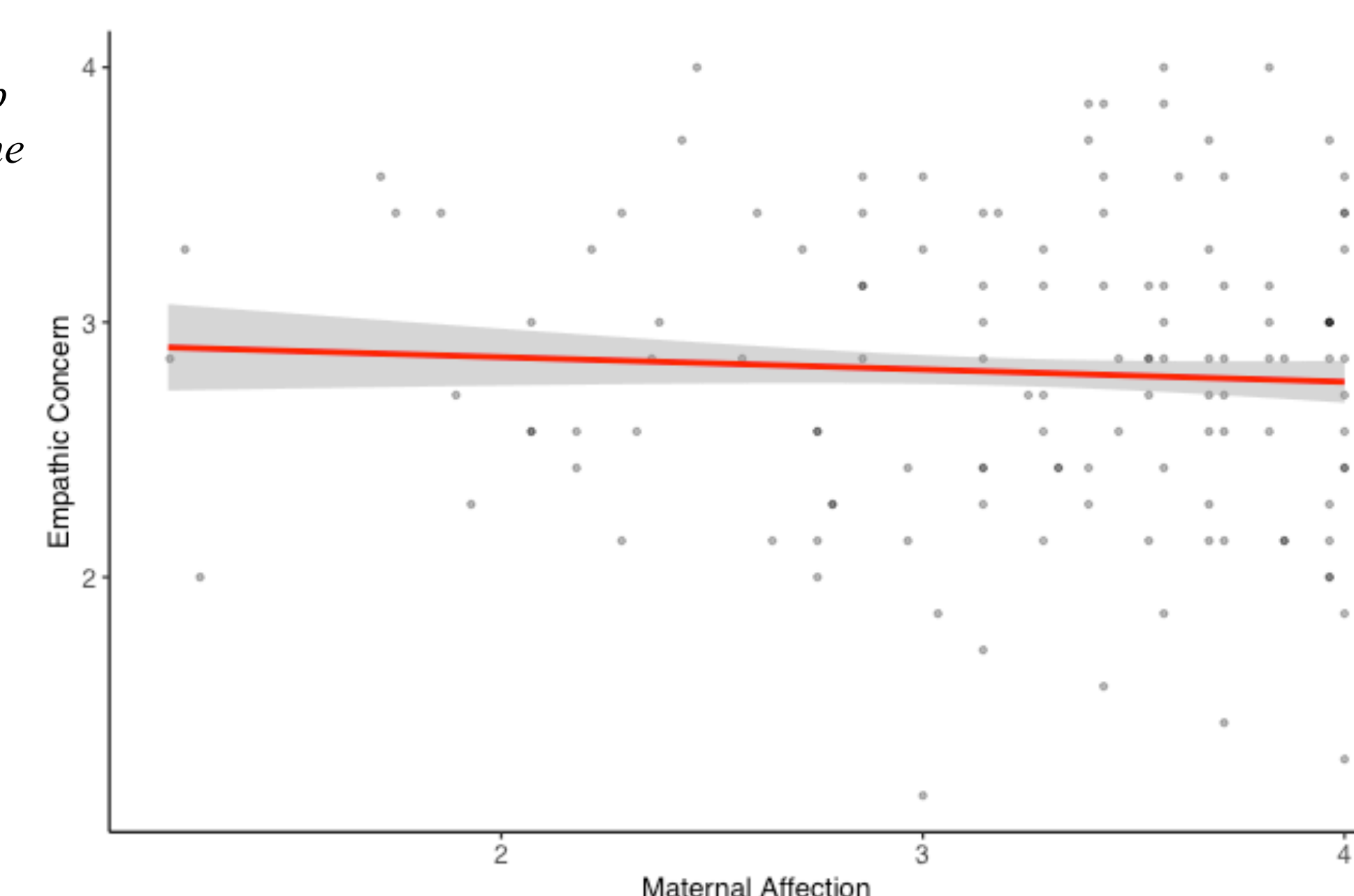
Hippocampal Volume & Empathic Concern (Hypothesis 1c):

- There was not a significant association between the child’s **right** hippocampus and their level of empathic concern (when adjusting for age and total brain volume), $b = -0.00$, $F(1, 116) = 1.337$, $p = 0.250$.
- There was not a significant association between the child’s **left** hippocampus and their level of empathic concern (when adjusting for age and total brain volume), $b = -0.00$, $F(1, 116) = 1.443$, $p = 0.232$.

Gender Differences in the Effects of Maternal Affection on Empathic Concern (Hypothesis 2):

- The interaction between gender and maternal affection was not significantly associated with child’s empathic concern (when adjusting for age), $b = 0.135$, $F(1, 121) = 0.571$, $p = 0.451$.

*Since $p > 0.05$, this suggests an insignificant relationship between the abovementioned measures, suggesting that the results occur likely due to chance.



Discussion

In summary, a) there was no relationship between maternal affection and child’s empathic concern, b) maternal affection was not associated with child’s hippocampal volume in adulthood, c) hippocampal volume was not associated with their level of empathic concern and finally, there were no gender interactions in these analyses.

- Lack of significant results may be explained by the following factors:
 - Specifically focusing on hippocampal volume, assuming that it is the primary brain region involved in empathic concern. This limits the role that other brain regions may play in empathy.
 - Data collected for the Survey Project were participant self-reports which may be unreliable. Participants filled out a questionnaire later in adulthood, retrospectively reflecting on the levels of maternal affection they received in childhood.

Future directions include:

- Study the correlation between paternal affection and child’s empathic concern since this area lacks research vis-à-vis the relationship between maternal affection and empathic concern.
- Compare this relationship to that of maternal affection and child’s empathic concern in order to examine differences in the role that parental figures play in their child’s empathy development.
- Study the relationship between same sex parent-child interactions and child’s level of empathy since previous research suggests a positive correlation between the two measures.
- Investigate different brain regions involved in empathy, considering that the hippocampus isn’t the only brain region associated with empathy development and that the brain is a complex organ.

References

- ¹Zahn-Waxler, C., & Radke-Yarrow, M. (1990). The origins of empathic concern. *Motivation and Emotion*, 14(2), 107-130.
- ²Davis, Mark H. (1983). Measuring individual differences in empathy: Evidence for a multidimensional approach. *Journal of Personality and Social Psychology*, Vol 44(1), 113-126.
- ³Barnett, M., King, L., Howard, J., & Dino, G. (1980). Empathy in young children: Relation to parents' empathy, affection, and emphasis on the feelings of others. *Developmental Psychology*, 16(3), 243-244.
- ⁴Ainsworth, M. D. S., Blehar, M. C., Waters, E., & Wall, S. (1978). Patterns of attachment: A psychological study of the Strange Situation.
- ⁵Fabes, R., Eisenberg, N., & Miller, P. (1990). Maternal correlates of children’s vicarious emotional responsiveness. *Developmental Psychology*, 26(4), 639-648.
- ⁶Luby, J. L., Barch, D. M., Belden, A., Gaffrey, M. S., Tillman, R., Babb, C.,...Botteron, K. N. (2012). Maternal support in early childhood predicts larger hippocampal volumes at school age. *PNAS*, 109(8), 2854-2859.
- ⁷Immordino-Yang, M. H., Singh, V. (2013). Hippocampal contributions to the processing of social emotions. *Human Brain Mapping*, 34(4), 945-955.
- ⁸Rossi, A. S. (2001). *Caring and doing for others: Social responsibility in the domains of family, work, and community*. Chicago: University of Chicago Press.

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