Project Proposal (v.1)

Title: The Taste of Regulation: Exploring Oral Sensitivity, Eating Behavior, and Parental Well-Being in Autism

Introduction: Children with autism spectrum disorder (ASD) frequently exhibit heightened oral sensory sensitivity, which can make every-day experiences like eating overwhelming or aversive (Nimbley, Golds, Sharpe, Gillespie-Smith, & Duffy, 2022; Zickgraf, Richard, Zucker, & Wallace, 2022). These oral sensitivities often contribute to selective eating behaviors, including food refusal based on taste, texture, or smell. Beyond eating challenges, sensory atypicalities in ASD have also been linked to broader difficulties with emotion regulation and behavior problems, suggesting a shared regulatory vulnerability (Sung, Lin, Chu, & Lin, 2024). Supporting this connection, neuroimaging studies in typical adults have identified gustatory-interoceptive integration in the mid-insula, a region also implicated in emotional processing (Avery et al., 2017). While some research has found associations between selective eating and internalizing symptoms such as anxiety and depression in autistic populations, findings have been mixed (Johnson et al., 2014; Page, Souders, Kral, Chao, & Pinto-Martin, 2022; Tanner et al., 2015).

Importantly, these child-level challenges unfold within family systems, where parental mental health plays a critical role. Parents of children with ASD often report elevated stress around mealtimes, which can become emotionally charged routines due to feeding difficulties (Crowe, Freeze, Provost, King, & Sanders, 2016). Moreover, parental emotional responses and feeding strategies are strong predictors of children's eating behavior, potentially reinforcing or buffering selective patterns (Zlomke, Rossetti, Murphy, Mallicoat, & Swingle, 2020).

Despite these established links between sensory sensitivity, eating behavior, emotion regulation, and caregiver stress, few studies have integrated these variables into a unified framework. This project seeks to **examine how oral sensory sensitivity contributes to emotion dysregulation in autistic children, both directly and indirectly via selective eating behavior.** We also investigate whether these relationships are shaped by contextual factors such as parental mental health.

Aims and Research Questions:

Aim 1: Is oral sensory sensitivity associated with greater emotion dysregulation in autistic children?

- Hypothesis: Higher levels of oral sensory sensitivity will predict greater emotion dysregulation, as measured by Child Behavior Checklist subscales.

Aim 2: Does selective eating statistically mediate the relationship between oral sensory sensitivity and emotion dysregulation?

- Hypothesis: Higher levels of oral sensory sensitivity will be associated with greater emotion dysregulation, and this association will be partially explained by selective eating behaviors.

- **NOTE:** While all measures are cross-sectional, mediation is tested based on theoretical precedence rather than temporal inference. A consistent association between oral sensory sensitivity and selective eating has already been established in the literature (Descrettes-Demey et al., 2023; Elsayed, Thompson, Conklin, & Watson, 2022).

Aim 3: Does parental mental health moderate the relationship between selective eating and emotion dysregulation?

- Hypothesis: Parental mental health (Adult Behavior Checklist) will moderate the relationship between selective eating and emotion dysregulation, such that the association is stronger when parental mental health challenges are higher.

Datasets:

- NDA Study #2804 (https://nda.nih.gov/edit_collection.html?id=2804)
- NDA Study #3005 (https://nda.nih.gov/edit_collection.html?id=3005)

Variables of Interest:

- Oral Sensory Sensitivity – Sensory Profile (SP), Oral Sensory Processing subscale
- Selective Eating Behavior – Child Eating Behavior Questionnaire (CEBQ)
- Emotion Dysregulation – Child Behavior Checklist (CBCL): Emotionally Reactive, Aggressive Behavior, Anxious/Depressed
- Parental Mental Health – Adult Behavior Checklist (ABCL)
- Covariates – Age, Sex, ASD severity (measured via the Social Responsiveness Scale, SRS)

Data Analysis Plan:

Aim 1: **Linear Regression**

To test whether distinct components of oral sensory sensitivity predict emotion dysregulation in autistic children:

- Emotion dysregulation will be measured using the CBCL **Emotionally Reactive**, **Anxious/Depressed**, and **Aggressive Behavior** subscales, analyzed as separate outcome variables.
- Covariates – Age, Sex, ASD severity (measured via the Social Responsiveness Scale, SRS)
- Oral sensory sensitivity dimensions (taste, smell, texture) will be derived through Principal Component Analysis (PCA) of SP Oral Processing items.

- Linear regression models will test each sensory modality separately to assess its relationship with each CBCL outcome, while controlling for covariates (Age, Sex, IQ, ASD Severity).

Primary Models (for each CBCL subscale):

- CBCL_subscale ~ Taste + Covariates (Age, Sex, IQ, ASD Severity)
- CBCL_subscale ~ Smell + Covariates (Age, Sex, IQ, ASD Severity)
- CBCL_subscale ~ Texture + Covariates (Age, Sex, IQ, ASD Severity)
- This approach allows us to determine whether specific oral sensitivities (e.g., taste vs. texture) differentially predict emotion dysregulation domains (e.g., aggression vs. anxiety), consistent with findings from prior ASD research (e.g., Sung et al., 2024).

Post-Model Analyses:

- To balance false positive risk while preserving exploratory power, we will apply Benjamini-Hochberg false discovery rate (FDR) correction across the three CBCL subscales (Emotionally Reactive, Anxious/Depressed, Aggressive Behavior) within each sensory modality (i.e., separately for taste, texture, and smell models). This approach controls for multiple comparisons while allowing us to examine modality-specific patterns.

Aim 2: **Mediation Analysis**

To examine whether selective eating behaviors statistically mediate the association between oral sensory sensitivity and emotion dysregulation.

- Emotion dysregulation will be measured using the CBCL **Emotionally Reactive**, **Anxious/Depressed**, and **Aggressive Behavior** subscales, analyzed as separate outcome variables.
- Covariates – Age, Sex, ASD severity (measured via the Social Responsiveness Scale, SRS)
- Oral sensory sensitivity dimensions (taste, smell, texture) will be derived through Principal Component Analysis (PCA) of SP Oral Processing items.
- Mediation will be tested using bootstrapped indirect effects, estimating whether oral sensory sensitivity (taste, smell, texture) predicts dysregulation through selective eating behavior (CEBQ), while controlling for covariates (Age, Sex, IQ, ASD Severity).
    - Indirect effects will be tested using **nonparametric bootstrapping with 5,000 resamples**, and statistical significance will be evaluated using **bias-corrected 95% confidence intervals**.
    - **NOTE:** While the data are cross-sectional, mediation is grounded in theoretical precedence and supported by prior research linking oral sensitivity and selective eating (Descrettes-Demey et al., 2023; Elsayed, Thompson, Conklin, & Watson, 2022).

Proposed Models:

Model #	Sensory Modality	Sensory Predictor (X)	Mediator (M)	Outcome (Y)	Covariates
1	Taste	Taste Sensitivity	Selective Eating (CEBQ)	Emotionally Reactive (CBCL)	Age, Sex, IQ, ASD Severity
2	Taste	Taste Sensitivity	Selective Eating (CEBQ)	Anxious/Depressed (CBCL)	Age, Sex, IQ, ASD Severity
3	Taste	Taste Sensitivity	Selective Eating (CEBQ)	Aggressive Behavior (CBCL)	Age, Sex, IQ, ASD Severity
4	Texture	Texture Sensitivity	Selective Eating (CEBQ)	Emotionally Reactive (CBCL)	Age, Sex, IQ, ASD Severity
5	Texture	Texture Sensitivity	Selective Eating (CEBQ)	Anxious/Depressed (CBCL)	Age, Sex, IQ, ASD Severity
6	Texture	Texture Sensitivity	Selective Eating (CEBQ)	Aggressive Behavior (CBCL)	Age, Sex, IQ, ASD Severity
7	Smell	Smell Sensitivity	Selective Eating (CEBQ)	Emotionally Reactive (CBCL)	Age, Sex, IQ, ASD Severity
8	Smell	Smell Sensitivity	Selective Eating (CEBQ)	Anxious/Depressed (CBCL)	Age, Sex, IQ, ASD Severity
9	Smell	Smell Sensitivity	Selective Eating (CEBQ)	Aggressive Behavior (CBCL)	Age, Sex, IQ, ASD Severity

Aim 3: **Moderation Analysis**

To test whether parental mental health moderates the association between selective eating and emotion dysregulation.

- Parental mental health will be assessed using the Adult Behavior Checklist (ABCL)
- Moderation will be tested for each combination of sensory modality and CBCL subscale
- A significant **CEBQ × ABCL** interaction will indicate moderation.
- Interaction effects will be probed using simple slopes analysis and visualized using interaction plots.

Model #	Sensory Modality	Moderator (W)	Predictor (X)	Outcome (Y)	Interaction Term	Covariates

1	Taste	Parental Mental Health (ABCL)	Selective Eating (CEBQ)	Emotionally Reactive (CBCL)	CEBQ × ABCL	Age, Sex, IQ, ASD Severity, Taste
2	Taste	Parental Mental Health (ABCL)	Selective Eating (CEBQ)	Anxious/ Depressed (CBCL)	CEBQ × ABCL	Age, Sex, IQ, ASD Severity, Taste
3	Taste	Parental Mental Health (ABCL)	Selective Eating (CEBQ)	Aggressive Behavior (CBCL)	CEBQ × ABCL	Age, Sex, IQ, ASD Severity, Taste
4	Texture	Parental Mental Health (ABCL)	Selective Eating (CEBQ)	Emotionally Reactive (CBCL)	CEBQ × ABCL	Age, Sex, IQ, ASD Severity, Texture
5	Texture	Parental Mental Health (ABCL)	Selective Eating (CEBQ)	Anxious/ Depressed (CBCL)	CEBQ × ABCL	Age, Sex, IQ, ASD Severity, Texture
6	Texture	Parental Mental Health (ABCL)	Selective Eating (CEBQ)	Aggressive Behavior (CBCL)	CEBQ × ABCL	Age, Sex, IQ, ASD Severity, Texture
7	Smell	Parental Mental Health (ABCL)	Selective Eating (CEBQ)	Emotionally Reactive (CBCL)	CEBQ × ABCL	Age, Sex, IQ, ASD Severity, Smell
8	Smell	Parental Mental Health (ABCL)	Selective Eating (CEBQ)	Anxious/ Depressed (CBCL)	CEBQ × ABCL	Age, Sex, IQ, ASD Severity, Smell
9	Smell	Parental Mental Health (ABCL)	Selective Eating (CEBQ)	Aggressive Behavior (CBCL)	CEBQ × ABCL	Age, Sex, IQ, ASD Severity, Smell

Replication and Extension: To assess the robustness and generalizability of findings, primary analyses will be replicated using a larger dataset (#2804) containing the same measures (SP, CEBQ, CBCL, ABCL).

Expected Contributions: This project builds on established research linking oral sensory sensitivity to selective eating in children with ASD by replicating this association across two independent, well-characterized datasets. While this relationship is well-documented, the downstream effects of selective eating on emotional functioning remain less clear. By modeling

emotion dysregulation as an outcome and incorporating selective eating as a mediator, this study extends previous work to clarify possible mechanistic pathways linking sensory sensitivity to emotional outcomes. Further, by testing parental mental health as a moderator, the project acknowledges the role of family context in shaping behavioral and emotional development, a factor often overlooked in existing models. Finally, the use of item-level analysis and principal component analysis (PCA) to disentangle taste, texture, and smell-related oral sensitivities represents a methodological innovation that improves specificity and interpretability. Together, these contributions advance our understanding of how sensory traits interact with child and caregiver factors to influence emotion regulation in autism.

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