

Maternal Attachment Moderates Effects of Substance Use on White-Matter Microstructure

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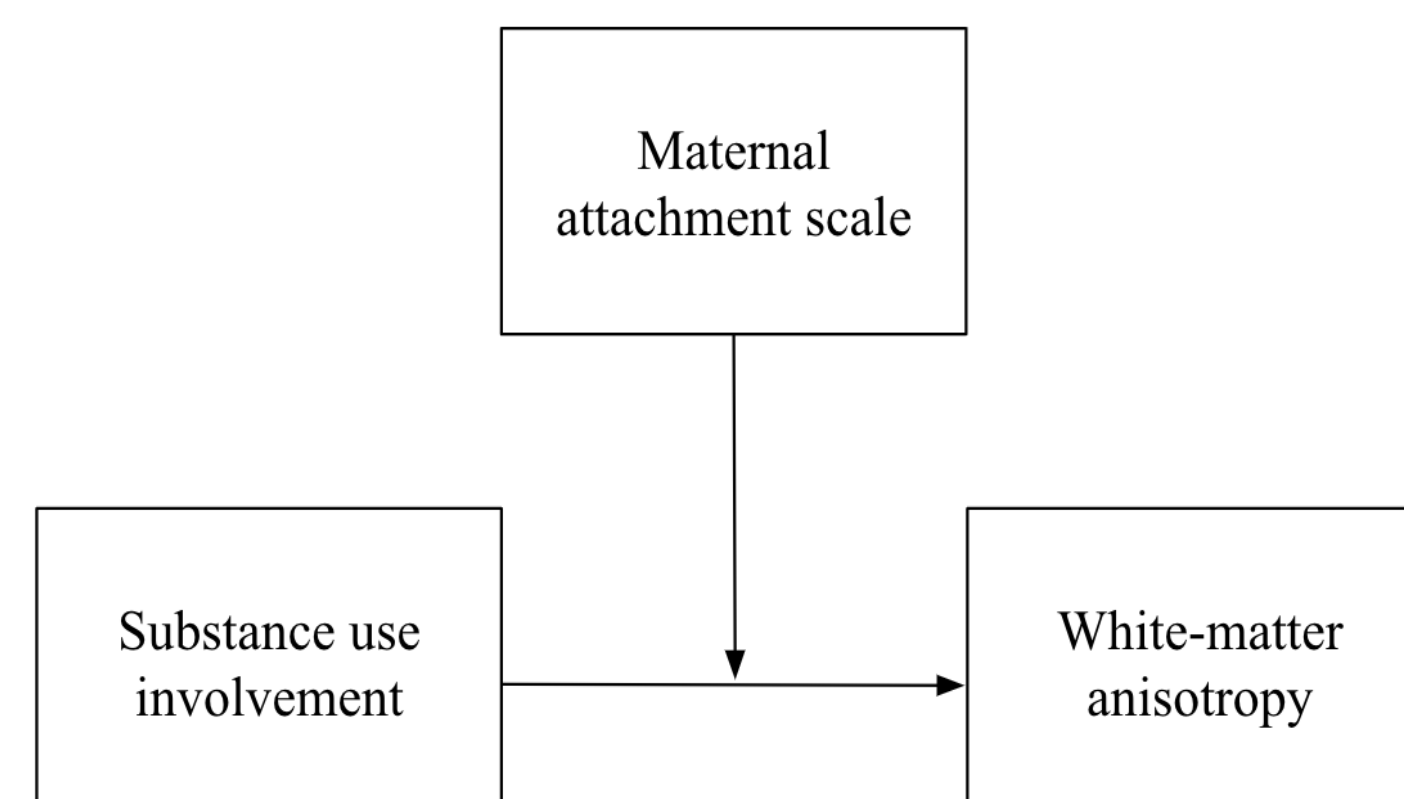
INTRODUCTION

- Substance use decreases brain white-matter volume, alters white-matter anisotropy, impairs self-regulation, and is involved in many psychiatric disorders^{1,2,6}.
- Similarly, poor parental attachment decreases self-regulation and contributes to risky behaviors, including substance use initiation and maintenance^{1,5}.
- The current study aims to clarify associations between substance use involvement (SUI), early adolescent attachment to mothers, and white-matter anisotropy in regions of interest (ROIs) linked to self-regulation and drug exposure in prospective longitudinal data^{2,6}.

METHODS

- **Overview:** Data were drawn from a longitudinal study. Participants ($n = 72$) were assessed at age 10-12, 12-14, 16, 18-19, and 22.
- **Youth Attachment to Parents Scale (YAPS):** 31-item scale assessing trust, communication, alienation, and attachment towards mothers⁵.
- **Drug Use Chart (DUC):** 42-item self-report of use across 10 major substance categories that fits a unidimensional model of SUI⁴.
- **Diffusion-weighted magnetic resonance imaging (dMRI):** Scans were used to compute measures including fractional anisotropy (FA) and crossing fiber anisotropy of primary (F1), secondary (F2), and tertiary (F3) fibers. A priori ROIs included the corpus callosum (genu/body/splenium), cingulum (left/right), uncinate fasciculus (UF L/R), and superior longitudinal fasciculus (SLF L/R)^{5,6}.
- **Statistical analysis:** Moderation analyses were conducted using the Process package within SPSS³.

Figure 1. Conceptual model of the moderation effect of maternal attachment components (trust, communication, alienation, and total attachment) on associations between SUI and fractional, primary, secondary, and tertiary fiber anisotropy.



RESULTS

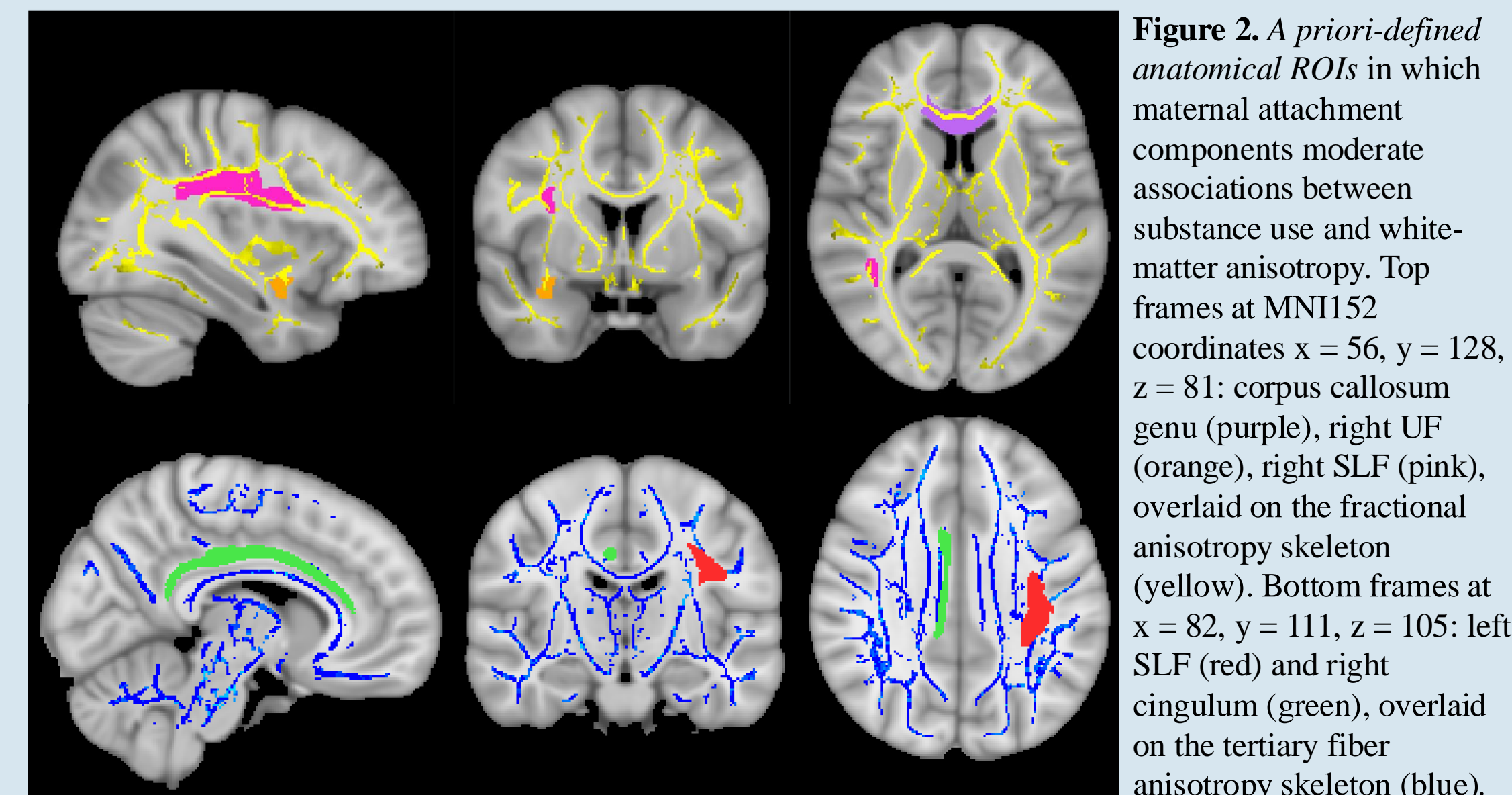
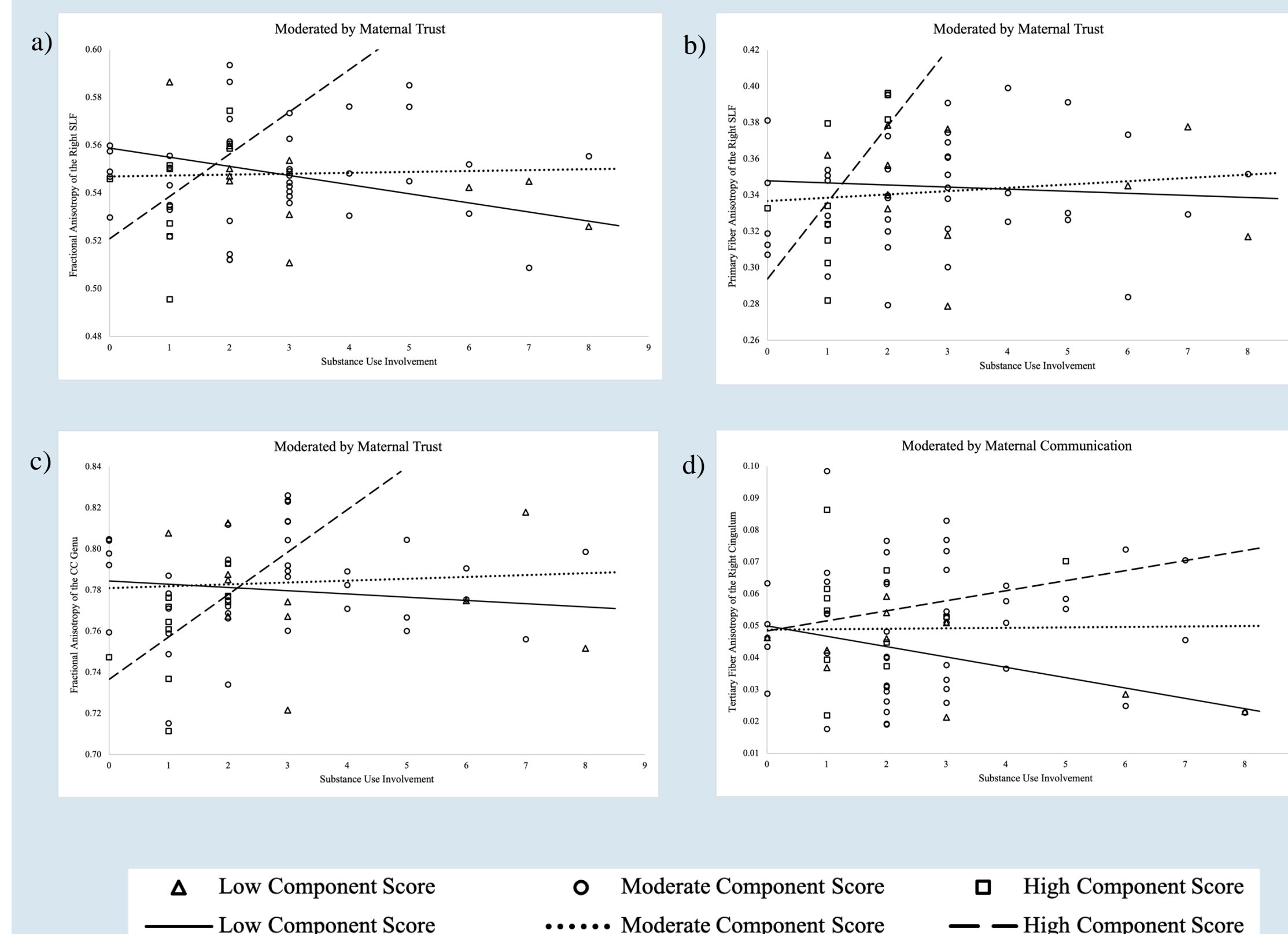


Figure 2. A priori-defined anatomical ROIs in which maternal attachment components moderate associations between substance use and white-matter anisotropy. Top frames at MNI152 coordinates $x = 56, y = 128, z = 81$: corpus callosum genu (purple), right UF (orange), right SLF (pink), overlaid on the fractional anisotropy skeleton (yellow). Bottom frames at $x = 82, y = 111, z = 105$: left SLF (red) and right cingulum (green), overlaid on the tertiary fiber anisotropy skeleton (blue).



Figures 3a, b, c, d. Interactions between SUI and maternal attachment components on FA in the right SLF (a), F1 in the right SLF (b), FA in the corpus callosum genu (c), and F3 in the right cingulum (d). Conditional effects at low (<16th percentile), moderate (16th – 84th percentiles), and high (>84th percentile) attachment in mothers.

CONCLUSION

- At low levels of maternal trust, greater SUI was associated with lower FA in the right UF. At high levels of maternal trust, greater SUI was associated with higher FA in the corpus callosum genu and right SLF, higher F1 in the right SLF, and lower F3 in the left SLF.
- At low levels of maternal communication, greater SUI was associated with lower F3 in the right cingulum. At high levels of maternal communication, greater SUI was associated with higher F2 in the right cingulum.
- Trust and communication are critical elements of familial relationships that may ameliorate SUI-induced white-matter differences. These findings can inform family-based treatments that reinforce trust and communication.
- The SUI index in the current study is a sum of the categories in which drug use has been endorsed, and it does not account for frequency or quantity of use. Whereas these components fluctuate considerably over time and are difficult to standardize, the sum score reduces bias for sample-specific effects and boosts generalizability.
- Future studies may examine substance use trajectories via structural equations modeling to illuminate more nuanced associations between SUI and white-matter microstructure.

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