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Genes and Behavior in Preschool Children: The Relation between Dopamine Genotype and Latent Executive Control

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Dopamine and Executive Control
- Dopaminergic neurotransmission is implicated in the executive control of cognition and behavior.
- The prefrontal cortex is thought to modulate activity in other brain regions through “bias signals” boosting activation of task-relevant neural pathways, likely through the action of dopamine.

A latent variable approach has been shown to be particularly useful for examining the contributions of individual genes, individual dummy variables were used to create a latent Genetic Risk variable, in a Multiple Indicator Multiple Cause (MIMIC) model.

Dopaminergic neurotransmission is implicated in the executive control of cognition and behavior (Braver & Cohen, 2000).

A number of studies have found associations between executive control and dopamine-related candidate genes, likely because of variation in the availability of dopamine in the synapse and/or efficiency of dopaminergic neurotransmission (Casey, 2002; Roesch-Ely, 2005).

Furthermore, dopamine genotype has been found to relate to attention problems and attention deficit hyperactivity disorder (ADHD; Faraone, 2005).

A better understanding of how variation in dopamine genotype relates to children’s regulation of attention and behavior has significance for clinical practice and possible intervention.

Dopamine Gene Alleles associated with Risk

- This model also demonstrated good fit to the data, as evidenced by a non-significant chi-square test.
- As shown by the loadings of the individual genetic risk dummy variables on the Genetic Risk latent variable.
- The effect can be largely attributed to DRD2 and COMT, as model results do not change substantially when DRD4 and DAT are dropped.

Discussion

- This study also further demonstrates the utility of a latent variable approach in the study of preschool executive control.
- These results are consistent with differences in dopamine availability and efficiency of neurotransmission related to different dopamine alleles.
- Further work is necessary to test this relationship in a larger sample, and to examine the contributions of gene-environment and gene-gene interactions to executive control development.
- Given that executive control problems are implicated in ADHD (Nigg, 2005), these findings may shed light on how genetic risk contributes to behavioral problems.

Method

- 133 preschool children (mean age 4 years 1 month, range 2.5 to 6 years) were administered an executive control battery that included the following tasks: Delayed Alternation, Continuous Performance Task, DAS Digit Span, Delayed Response, Six Roses, Shape School, NEPSY Name, NEPSY Visual Attention, and Tower of Hanoi.

- Children were genotyped on the COMT, DAT, DRD2, and DRD4 polymorphisms of interest from cheek swabs obtained using a preschooler-friendly “liplopip” game (Espy, 2002).

- Children were assigned dummy codes of 0 or 1 for each gene, where 1 indicated the presence of the “risk allele”.

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Genes and Executive Control: Model 1

- This risk score was used to predict latent executive control.
- Age was also included as a covariate, to account for age differences in executive control.

Genes and Executive Control: Model 2

- To look at the contributions of individual genes, individual dummy variables were used to create a latent Genetic Risk variable, in a Multiple Indicator Multiple Cause (MIMIC) model.

References

- Additional studies are needed to further understand the relationship between dopamine and executive control in preschool children.

Acknowledgments