



# Different patterns of association between the catechol-O-methyltransferase gene and executive attention in the Attention Network Test in young and old adults

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## Introduction

**Questions:** Does executive attention, as assessed by the Attention Network Test (ANT) vary by COMT genotype? Does this interact with adult age?

### Attention Network Test (ANT)

- Developed by Fan, McCandliss, Sommer, Raz and Posner, 2002
- Combines flanker and cued reaction time tasks
- Measures Executive, Orienting, and Alerting types of attention
  - **Executive attention:** Reaction time differences to Incongruent vs. Congruent arrows flanking the target arrow

### Catechol-O-methyltransferase (COMT)

- Involved in the breakdown of dopamine (DA) in the prefrontal cortex
- A substitution of Valine (Val) for Methionine (Met) at codon 158 is associated with individual differences in DA levels (Savitz, Solms and Ramesar, 2006)
  - **Val allele** greater DA degradation and less synaptic DA than **Met allele**

### COMT, Executive Attention, & Aging

- **Young adults** with the Val/Val genotype have *better* executive attention *in the ANT* than those with Met/Met genotype (Fosella et al., 2002)
- **Old adults** with the Val/Val genotype have *worse* executive attention in a *neuropsychological battery* than those with Met/Met genotype (Holtzer et al., 2010)
- This age difference may reflect:
  - old adults have lower DA levels than young (Bäckman et al., 2006), and
  - there is an inverted U-shaped function relating performance to DA (Nagel et al., 2008, Cools and D'Esposito, 2011))
- The present study is the first to use the ANT to examine the association of executive attention and COMT genotype in both old and young adults

## Participants

**Young adults:** n = 35, aged 20.17 ± 1.95 (19 female)

Val/Val n = 8, Met/Val n = 22, Met/Met n = 5

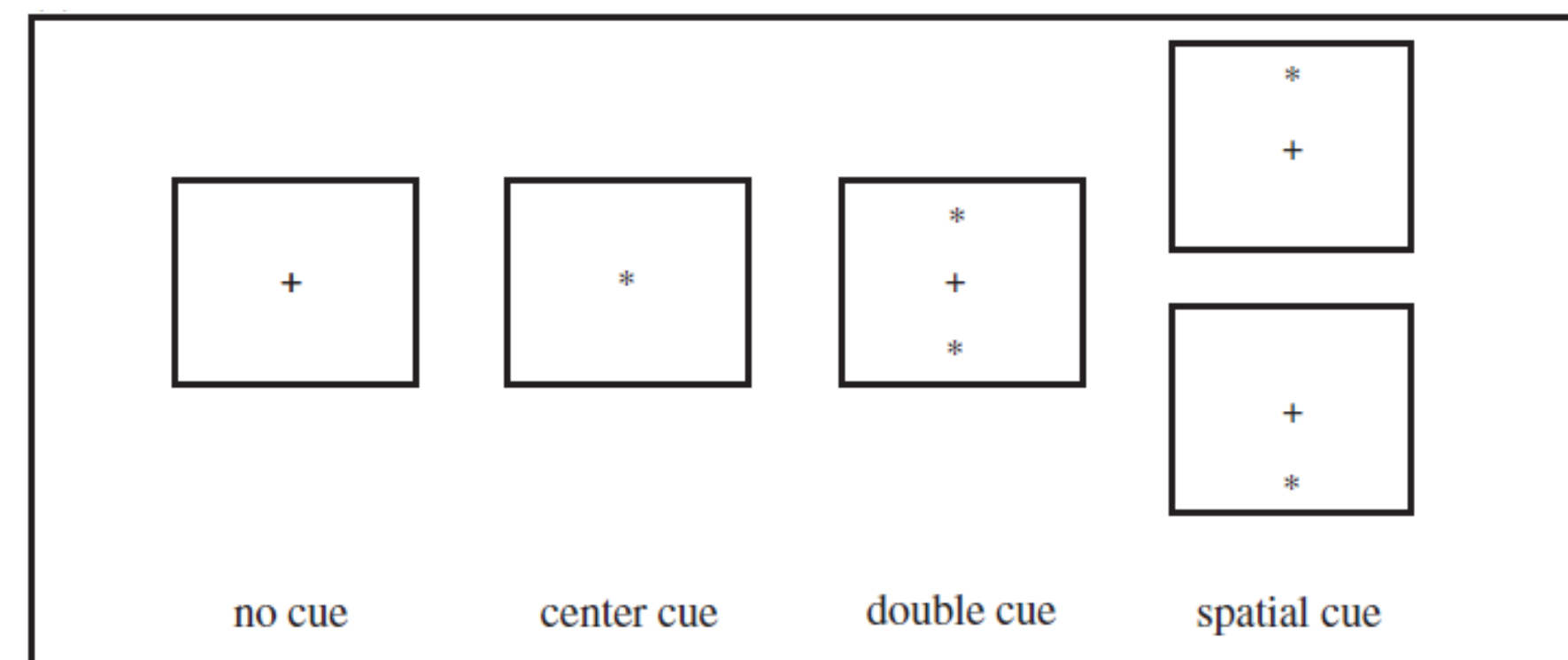
**Old adults:** n = 32, aged 73.06 ± 6.19 (18 female)

Val/Val n = 12, Met/Val n = 17, Met/Met n = 3

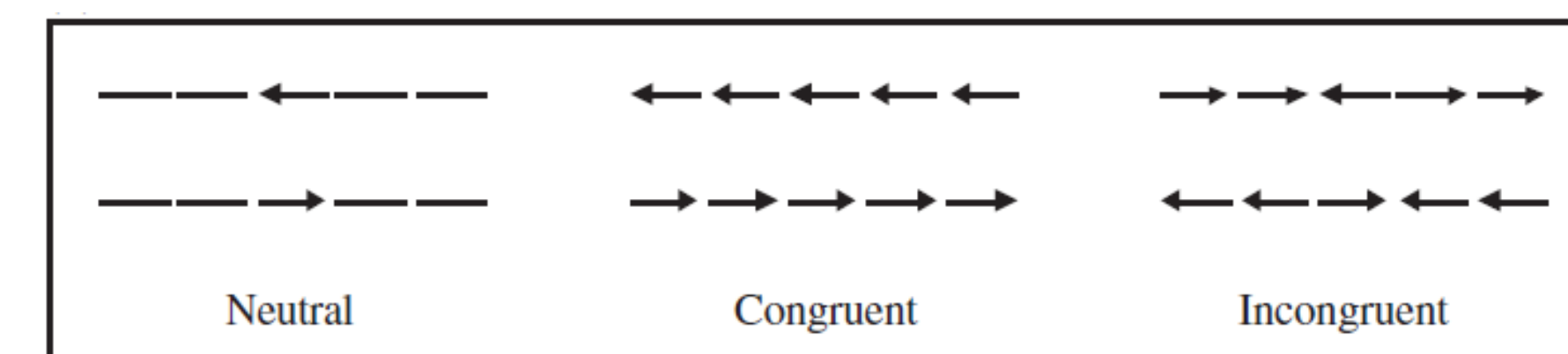
## Method

- All participants completed one session of the Attention Network Test
  - 1 practice block with feedback
  - 96 trials/block
  - 3 test blocks with no feedback and random inter-stimulus intervals
  - A subset of participants (n = 38) completed 4 ANT sessions (12 blocks)
- Genetic information was collected via a saliva sample
  - The catechol-O-methyltransferase (COMT) gene was analyzed for a substitution of Valine (Val) for Methionine (Met) at codon 158
    - This produced a genotype of either Met/Met, Val/Met or Val/Val COMT
  - Genetics were analyzed at the Research Center for Genetic Medicine at Children's National Medical Center in Washington, DC

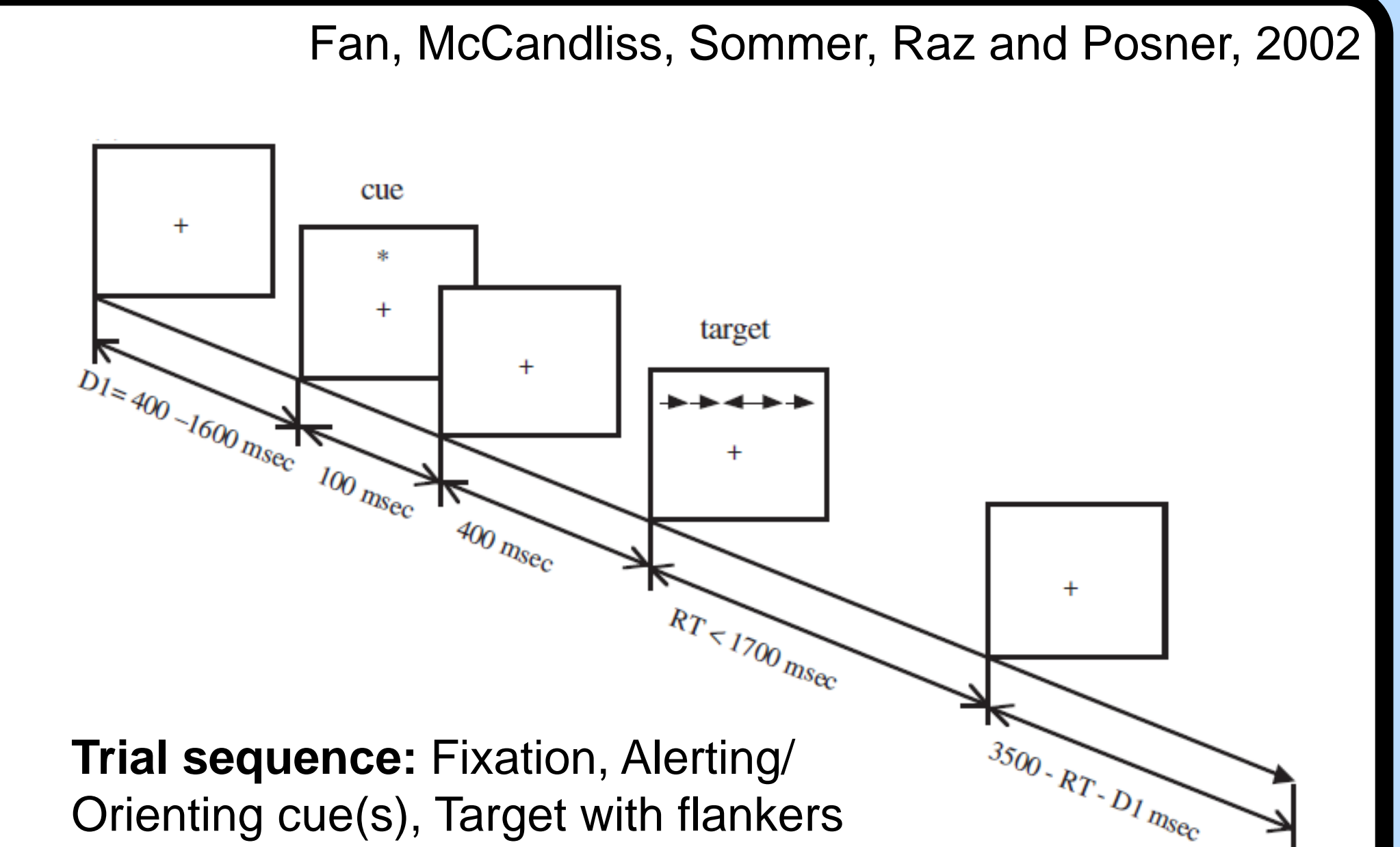
## Attention Network Test



**Cue type:** Just fixation, Alerting Cues, Orienting cues

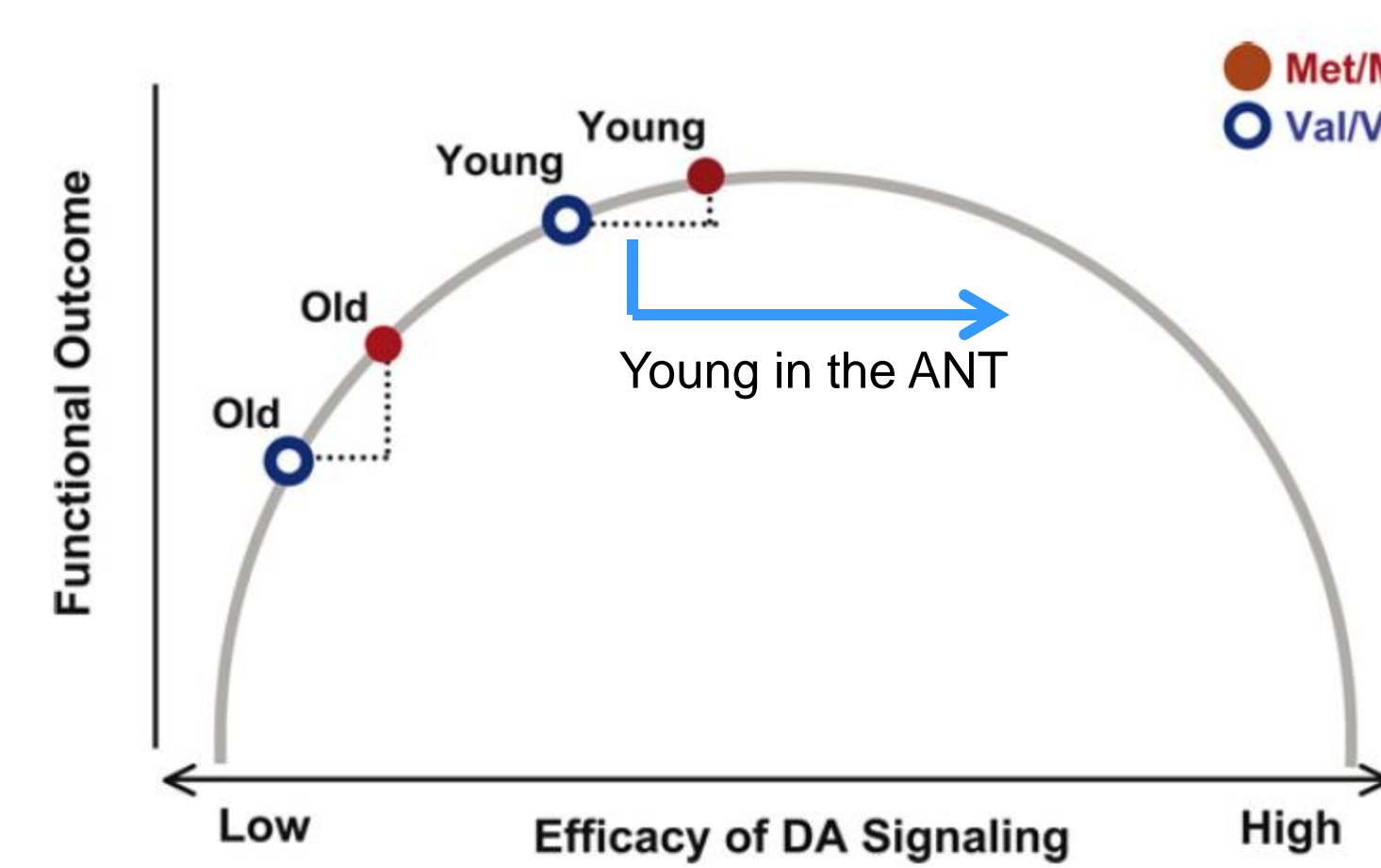


**Flanker type:** Neutral, Congruent, Incongruent



**Trial sequence:** Fixation, Alerting/Orienting cue(s), Target with flankers

## Dopamine Curves



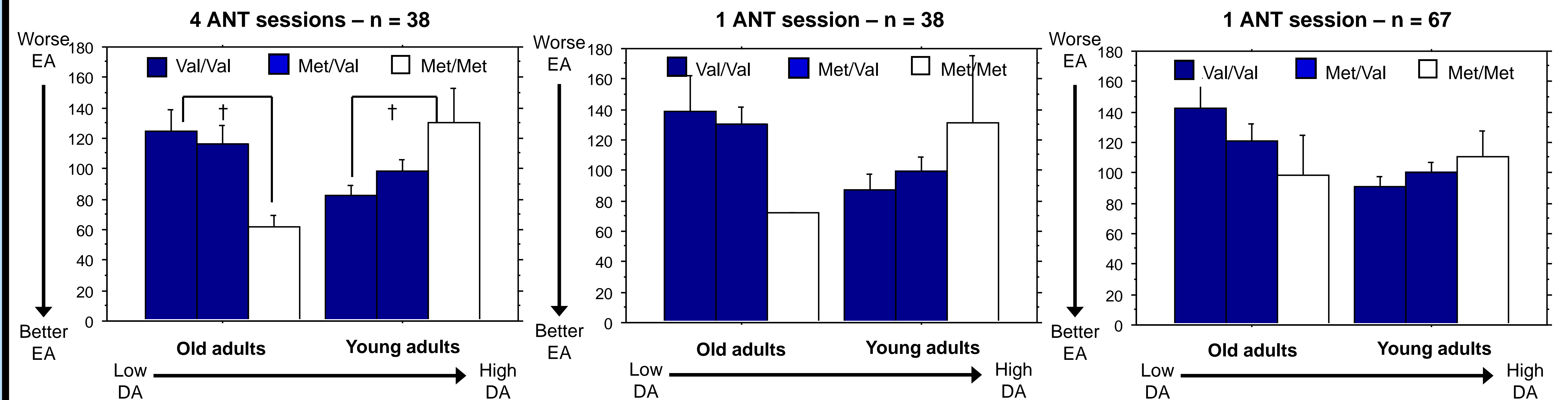
Inverted U-shaped function linking the efficacy of frontal DA signaling in early versus late adulthood to performance. Nagel et al., 2008, *Frontiers in Human Neuroscience*

## Discussion

- The association between COMT genotype and Executive Attention is different for young vs. old adults
- Successful performance on the executive attention component of the ANT may require an intermediate level of dopamine (inverted U-shaped function)
  - The Met/Met genotype (more DA) may be advantageous for older adults who experience age-related DA decline, but not for younger adults
- Obtaining performance from several sessions of the ANT may improve the ability to detect such age x genotype interactions
- Future research should investigate how COMT may interact with or be modulated by other genes related to DA levels, such as BDNF, and how these relationships may be associated with executive attention

## Results

Data show executive attention in the ANT task = RT to the target flanked by incongruent flankers – RT to the target flanked by congruent flankers



- This analysis contains 38 people who completed 4 sessions of the ANT with varying additional factors
- Significant interaction of COMT x Age,  $p = .018$
- No main effects of COMT ( $p = .792$ ) or Age ( $p = .819$ )

- Given our results, we analyzed the first ANT session where no other factors varied across individuals
- Marginal interaction of COMT x Age,  $p = .086$
- No main effects of COMT ( $p = .653$ ) or Age ( $p = .852$ )

- Because of the marginal effect seen in one ANT session with 38 participants, we increased our participant numbers to increase power
- No significant interaction of COMT x Age ( $p = .223$ ) or main effects of COMT ( $p = .148$ ) or Age ( $p = .804$ )