

# Duration Discrimination Predicts Delay of Gratification in Children with and without ADHD

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## Theoretical Background and Objectives

Although the ability to delay gratification has been shown to be predictive for various aspects of daily life (e.g., better school grades, higher education, reduced drug consume; see Mischel et al., 2011), cognitive factors underlying individual differences are only poorly understood. Recently, it has been suggested that people who overestimate the duration of time intervals might also experience waiting times as more costly and, hence, have a reduced likelihood to delay gratification (Corvi et al., 2012; Wittman & Paulus, 2008). Children with Attention-Deficit/Hyperactivity Disorder (ADHD) both show impairments in temporal processing and consistently prefer smaller, immediate rewards over larger, delayed rewards (Sonuga-Barke, Bitsakou, & Thompson, 2010).

To our knowledge, as yet no study has directly tested for an association between a measure of temporal processing (i.e., duration discrimination) and a classical delay of gratification task.

## Methods

### Participants

One hundred twelve children aged 7-13 years ( $M = 10.13$  years,  $SD = 1.59$  years; 29 female; 51 with ADHD) took part in a larger study on Gene X Environment interactions in ADHD. Of these, 82 (42 with ADHD) completed both a duration discrimination task and a delay of gratification task.

### Procedure

**Duration Discrimination Task.** Children were presented with two unfilled intervals indicated by two brief tones each. The baseline interval lasted 400 ms, while the comparison interval was always longer and was adjusted up or down in steps of 10 ms securing an accuracy of 80%. The task stopped either after six reversals of direction or when the comparison interval exceeded 610 ms. The duration discrimination measure was calculated by averaging the mean four reversal points (see Sonuga-Barke et al., 2010 for a similar approach)

**Delay of Gratification Task.** Children were offered a choice between receiving one chocolate bar immediately or two chocolate bars after an unknown waiting time (max. 25 minutes). Children were told that they could opt for the immediate reward at anytime by ringing a bell (see Figure 1). Delay of gratification was defined as whether and for how long the child waited for the additional chocolate bar.



Figure 1

## Results

Children with ADHD did not differ from children without ADHD on either the duration discrimination task or the delay of gratification task. Thus, we further analyzed both groups together.

To investigate whether duration discrimination predicts delay of gratification performance we calculated a Cox regression with age as a covariate. The test of the full model with duration discrimination and age as predictors against a constant-only model was significant,  $X^2(2, N = 82) = 6.77, p = .03$ , and according to the Wald criterion, only duration discrimination predicted delay of gratification,  $X^2(1, N = 82) = 4.00, p < .05$ . Participants with a duration discrimination of one standard deviation below average had a 1.48 times higher chance to stop waiting and thus receive only one chocolate bar.

## Discussion and Conclusion

This is the first study that demonstrates an association between better temporal processing and prolonged waiting times in children. Contrary to our expectations, no differences were found between children with and without ADHD. However, children with ADHD might have deficits in temporal processing, reward sensitivity, behavioral inhibition, or sustained attention but not necessarily in all of them (de Zeeuw et al., 2012; Sonuga-Barke et al., 2010).

To clarify our results regarding ADHD, future studies need to include larger sample sizes. Moreover, latent variables approaches using multiple tasks for each construct might be helpful to elaborate on the association between temporal processing and delay of gratification.

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