

## The Use of Consequences and Managed Behavior in ADHD

by Sam Goldstein, PhD, with Soleil Gregg, MA

**CONSEQUENCES**—rewards and punishments—have demonstrated benefits in the behavior management of ADHD. Recent meta-analyses of behavioral interventions have consistently demonstrated strong, positive effects on the behavior of children with ADHD. In this column, we review a number of recent studies examining the impact of rewards and punishments on the behavior of children with ADHD.

Beginning in the 1960s, systematic efforts to use contingency management techniques for children with ADHD relied on manual or electronic devices to provide contingent feedback for behavior. The second generation of studies utilizing behavior management sought to improve children's behavior by utilizing contingent social praise, modeling, tokens, and home-based reinforcement systems. As research in this area progressed, the initial tendency to focus on a single dimension of behavior progressed to treating broader classes of behavior. The primary focus has been on the use of positive reinforcement to increase task-related attention and completion of tasks at school and in the home.

Effective management of consequences not only increases motivation but also the likelihood that the child will appreciate what he or she is being required to do. These interventions for ADHD have demonstrated consistent effectiveness, even in the absence of accompanying psychiatric medication, and have been found to generalize from one setting to another. Researchers have examined the effects of reward size, timing, the impact incentives may have on reducing intrinsic interest, and the use of strategies such as response cost.

► **Groom MJ, Scerif G, Liddle PF, Batty MJ, Liddle EB, Roberts KL, Cahill JD, Liotti M, &**

**Hollis C. (2010). Effects of motivation and medication on electrophysiological markers of response inhibition in children with attention-deficit/hyperactivity disorder. *Biological Psychiatry, 67(7), 624-631.***

The authors studied the behavioral and neurophysiologic effects of motivational incentives on 28 children (aged nine to fifteen years) with combined-type ADHD and 28 control children without ADHD as they performed a go/no-go task under three conditions—reward, response-cost, and baseline. The children with ADHD were tested both on and off their usual dose of methylphenidate; the control children were never medicated. Analyses of N2 and P3 amplitudes showed effects from diagnosis (controls > ADHD unmedicated), medication (on > off), and motivation (reward and/or response cost > baseline). Motivational incentives increased amplitudes in children with ADHD towards the baseline of the control group. The authors concluded that motivational incentives have similar effects in children with and without ADHD but have additive effects in conjunction with stimulant medication, which appears to enhance attention resources during response inhibition.

► **Luman M, Oosterlaan J, Knol DL, & Sergeant JA. (2008). Decision-making in ADHD: Sensitive to frequency but blind to the magnitude of penalty? *Journal of Child Psychology and Psychiatry, 49(7), 712-722.***

The authors investigated decision-making and reinforcement sensitivity in 23 children with ADHD and 20 healthy controls using a gambling task in which penalties increased in either frequency or

magnitude. Children had to choose among alternatives involving small rewards and small penalties (advantageous), large rewards and increasing penalties, and small rewards and increasing penalties (both disadvantageous). Heart rate and skin conductance were monitored to see if impaired decisionmaking was accompanied by different autonomic responses. Compared to the control group, children with ADHD displayed a smaller preference for the advantageous alternative when penalties increased in size, but they performed like controls when penalties increased in frequency. The ADHD group also showed increased heart rate compared to controls following large rewards and greater skin conductance for the advantageous over disadvantageous condition, while controls showed the opposite pattern. The authors suggested that a maladaptive response during decisionmaking may cause children with ADHD to be sensitive to the frequency but blind to the magnitude of the penalty.

► **Masunami T, Okazaki S, & Maekawa H. (2009). Decision-making patterns and sensitivity to reward and punishment in children with attention-deficit hyperactivity disorder. *International Journal of Psychophysiology, 72(3), 283-288.***

The authors studied decision-making strategies in 14 children with ADHD and 11 healthy control children (aged seven to fourteen years)

as they performed a gambling task under three conditions: rewards, punishments, and no rewards or punishments. T-patterns and skin conductance responses were analyzed for the different task conditions. Researchers found that children with ADHD displayed fewer T-patterns with punishments and more T-patterns with rewards than the control children, while T-patterns without rewards and punishments did not differ between groups. Moreover, children

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with ADHD failed to show differences in skin conductance responses between reward and punishment conditions, in contrast to the control children, who showed larger responses to punishment. The authors concluded that impaired decisionmaking strategies in children with ADHD are related to abnormal sensitivity to rewards and punishments.

► **Paloyelis Y, Asherson P, & Kuntsi J. (2009). Are ADHD symptoms associated with delay aversion or choice impulsivity? A general population study. *Journal of the American Academy of Child and Adolescent Psychiatry, 48(8), 837-846.***

The authors examined the association of ADHD symptoms with choice impulsivity and delay aversion in 1,062 unmedicated children (aged seven to ten years, 49 percent female) who were rated by parents and teachers for symptoms of ADHD. Children performed tasks offering small, immediate rewards or larger, delayed rewards under two conditions— with and without a post-reward delay. Inattention ratings were found to predict a preference for smaller, immediate rewards under both task conditions, for both genders. Delay aversion was related to inattention in boys, while hyperactivity-impulsivity symptoms were negatively associated with choice impulsivity in girls in the post-reward delay condition; no significant association with hyperactivity-impulsivity symptoms was seen in boys. The authors pointed out that theirs is the first study associating inattention symptoms of ADHD with choice impulsivity and delay aversion.

► **Scheres A, Tontsch C, Thoeny AL, & Kaczkurkin A. (2010). Temporal reward discounting in attention-deficit/hyperactivity disorder: The contribution of symptom domains, reward magnitude, and session length. *Biological Psychiatry, 67(7), 641-648.***

The authors studied temporal reward discounting, or the decrease in perceived reward value as the reward is delayed, in 25 children and adolescents with ADHD-combined type, 20 with ADHD-inattentive type, and 37 matched control children without ADHD (aged six to seventeen). Children performed three tasks in which reward size and time before reward were varied. Steep temporal reward discounting was observed in children with combined-type ADHD but not inattentive-type ADHD, independent of reward size and delay, and was associated with symptoms of hyperactivity-impulsivity, especially when reward size was small. The authors suggested that steep temporal reward discounting in ADHD is related to the hyperactivity-impulsivity dimension and the tradeoff between reward size and delay, with contribution from all factors. ●



## What Have We Learned?

- Incentives and contingencies (for example, rewards and response-cost) can improve the performance of children with ADHD on cognitive tasks, even in the absence of medication.
- Contingencies and medication can have additive effects when used in combination.
- Children with ADHD appear more responsive to immediate and/or frequent rewards and punishments than to larger, delayed incentives.
- Impaired decisionmaking in children with ADHD may be linked to a maladaptive physiological response to rewards and punishments.
- Inattention symptoms as well as hyperactivity-impulsivity symptoms may influence sensitivity to contingencies in children with ADHD.