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IF-THEN PLANS BENEFIT EXECUTIVE FUNCTIONS IN CHILDREN WITH ADHD

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Children with ADHD encounter multiple academic and interpersonal problems presumably due to insufficient executive functions. In two studies we measured executive functions (i.e., shifting, resistance to distraction) and assessed whether children with ADHD can empower these functions by forming implementation intentions (i.e., if-then plans; Gollwitzer, 1999). Children with ADHD made fewer perseverative errors on a shifting task (Study 1) when instructed to make if-then plans. They also benefited from if-then plans in solving math problems that required both working memory and the inhibition of distractions (Study 2). Results concerning implications for research on if-then planning in children with ADHD are discussed.

1. For ease of exposition in this paper, the term ADHD is used constantly as an abbreviation for Attention-Deficit/Hyperactivity Disorder according to the DSM-IV combined subtype of ADHD and the ICD-10 category of Hyperkinetic Disorder.

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Inattentiveness, impulsivity, and hyperactivity are the core symptoms of Attention Deficit Hyperactivity Disorder (ADHD).[1] Children with ADHD are easily distracted by extraneous stimuli, have problems organizing activities, and lack inhibitory control. Prominent theories on ADHD suggest that ADHD-symptoms arise from deficits in executive functions because these deficits reliably differentiate children with ADHD from children without ADHD (Barkley, 1997). For instance, children with ADHD show worse performances compared to children without ADHD on tasks requiring planning, inhibition, task shifting, and working memory (Lijffijt, Kenemans, Verbaten, & van Engeland, 2005).

Executive functions are commonly grouped into three types: (a) inhibition, (b) shifting, and (c) working memory (Miyake, Friedman, Emerson, Witzki, & Howerter, 2000).

Inhibition involves the ability to inhibit dominant, automatic, or pre-potent responses. A typical inhibition task is the Stop Signal task (SST; Logan & Cowan, 1984), in which participants learn to discriminate between two different stimuli (i.e., X versus O) and in one-third of the trials an auditive stop signal is presented with a time delay after the presentation of the stimulus (e.g., 250 ms). In trials with a stop signal, participants are required to inhibit their response. Children with ADHD have difficulties to inhibit their response on stop trials and show a prolonged reaction time on Go trials as compared to children without ADHD and without any psychiatric diagnosis (Lijffijt et al., 2005).

Another type of executive function encompasses the shifting back and forth between multiple tasks or mental sets (Monsell, 1996). Also referred to as task switching, shifting has been identified as an executive function that may play a role in failures of cognitive control in patients with brain injuries and psychiatric disorders (Miyake et al., 2000). Children with ADHD also have difficulties performing tasks that require shifting between mental sets and therefore consistently exhibit poorer performances on the Wisconsin Card Sorting Test (WCST; e.g., Grant & Berg, 1948), a test that is widely used to measure the capability to switch flexibly between different task sets (meta-analysis by Romine et al., 2005).

Finally, there is a third aspect of executive functioning referred to as *working memory.* It is thought to (a) monitor incoming information as to its relevance, and (b) appropriately revise items held in short-term memory by replacing old information that is no longer relevant with new information (Morris & Jones, 1990). Thus, work-

ing memory is keeping track of information that is outdated. Working memory deficits have been widely and repeatedly documented in children with ADHD (Klingberg et al., 2005). Results suggest a weakened general working memory in children with ADHD (Martinussen, Hayden, Hogg-Johnson, & Tannock, 2005; Martinussen & Tannock, 2006) as well as more specific working memory deficits (e.g., rehearsal of verbal and spatial information; Karatekin, 2004).

IF-THEN PLANS AS A SELF-REGULATORY STRATEGY OF GOAL IMPLEMENTATION

The formation of if-then plans is a particularly effective strategy to enhance the self-regulation of goal striving and thus the attainment of self-set or assigned task goals. Accordingly, if-then plans have proven effective as regards the support of executive function tasks (Cohen, Bayer, Jaudas, & Gollwitzer, 2008; Miles & Proctor, 2008). If-then plans (i.e., implementation intentions; Gollwitzer, 1999) take the format of "If situation X is encountered, then I will perform Y" linking a critical situation (if-part) to a goal-directed response (then-part). It is important to recognize that implementation intentions differ from goal intentions. Goal intentions merely specify an expected future outcome and have the format of "I intend to achieve Z." Whereas mere goal intentions specify preferred finite states (i.e., the performance of a desired behavior or the attainment of a desired outcome) that an individual feels committed to attain, if-then plans define how a specified critical situation will be responded to when it is encountered. Accordingly, if-then plans are subordinate to goal intentions. If-then plans provide benefits beyond goal intentions: a meta-analysis by Gollwitzer and Sheeran (2006) involving more than 8,000 participants in 94 independent studies reported an effect size of $d = 0.65$. This medium-to-large effect size (Cohen, 1992) represents the additional facilitation of goal achievement through if-then plans compared to mere goal intentions. As goal intentions themselves commonly have a facilitating effect on behavior enactment by themselves (Webb & Sheeran, 2006), the size of this effect is remarkable.

The mental links created by if-then plans support goal attainment on the basis of psychological processes that relate to both the anticipated situation (if-part) and the goal-directed response (then-part). As forming an if-then plan implies the selection of a future situ-

ation, the mental representation of this situation becomes highly activated, and therefore more easily accessible. This heightened accessibility of the situation spelled out in the if-part was observed in several studies meaning that people more readily identify and notice the critical situation when they subsequently encounter it (e.g., Aarts, Dijksterhuis, & Midden, 1999; Parks-Stamm, Gollwitzer, & Oettingen, 2007). Additionally, this critical cue automatically triggers the intended response: it is enacted immediately, efficiently, and without conscious intent (e.g., Bayer, Achtziger, Gollwitzer, & Moskowitz, 2009; Brandstätter, Lengfelder, & Gollwitzer, 2001). Both mechanisms, the heightened accessibility of the cue and the automatic activation of the intended behavior, produce a perceptual and behavioral readiness that accounts for if-then plan effects on goal attainment (e.g., Webb & Sheeran, 2008).

IF-THEN PLAN EFFECTS ON EXECUTIVE FUNCTIONS

Studies revealed that if-then plans also support performance on task goals where challenges to executive functions are prevalent, namely shifting (i.e., task switching) and conflict management (i.e., spatial Simon task) paradigms (Cohen, Bayer, Jaudas, & Gollwitzer, 2008; Miles & Proctor, 2008). In task switching, executive control is necessary to avoid switching costs; in the Simon task, executive control is necessary to minimize the influence of spatial location on stimulus classification. If-then plans are effective for these types of tasks for two reasons: they heighten the activation of mental representations of critical stimuli, and they strongly link critical stimuli to the appropriate goal-directed response. Apparently, the strategic automaticity produced by if-then plans (i.e., switching from top-down control of action to bottom-up directed stimulus control) minimizes the demands of these tasks on executive functioning and thus improves performance. Moreover, studies showing that if-then plans promote goal realization particularly when difficult to attain goals are at stake suggest that if-then plans turn effortful goal striving into automated goal striving (Gollwitzer & Sheeran, 2006): In samples burdened by self-regulatory shortcomings (e.g., schizophrenic inpatients; Brandstätter et al., 2001), if-then plans turned out to be equally or even more effective in promoting performance on executive function tasks as in control samples without self-regulatory shortcomings.

IF-THEN PLAN EFFECTS ON EXECUTIVE PERFORMANCE IN CHILDREN WITH ADHD

Moreover, making if-then plans helped children with ADHD on a Go/NoGo task (Gawrilow & Gollwitzer, 2008; Paul et al., 2007). This task required participants to both classify stimuli that were presented on a computer screen by pressing a particular computer key, as well as inhibit classification in response to a NoGo signal. In two experiments, the authors randomly assigned children with ADHD to one of two groups: Children in the goal intention group formed a goal to inhibit a classification response for marked stimuli ("I will not press a key for pictures that have a sound"), whereas children in the implementation intention group, in addition to forming this goal intention, formed an if-then plan ("And if I hear a sound, then I will not press any key"). In the first study, the performance of children with and without ADHD was compared: Children without ADHD performed on a high level no matter whether they had formed mere goal intentions or implementation intentions. Children with ADHD, however, reached this high performance level only when they had furnished the inhibition goal with an if-then plan; mere goal intention ADHD participants showed a significantly lower performance level. The second study compared the performance of ADHD children with and without psychostimulant medication: a combination of if-then plans and medication resulted in the highest level of inhibition performance in children with ADHD. Again, replicating the findings of Study 1, children with ADHD showed a superior inhibition performance when having made an if-then plan as compared to merely forming a goal intention even without any medication (Gawrilow & Gollwitzer, 2008). Finally, a recent study showed that the beneficial effects of if-then plans in children with ADHD also pertain to delay of gratification, a performance that rests on effective motivation control (Gawrilow, Gollwitzer, & Oettingen, in press).

SELF-REGULATION STRATEGIES AND INTERVENTIONS IN CHILDREN WITH ADHD

Due to their deficits in various executive functions children with ADHD are highly distractable and thus have difficulties concentrat-

ing on goal-directed actions, especially in the classroom context. These difficulties in turn lead to impaired academic performance (Frazier, Youngstrom, Glutting, & Watkins, 2007). Therefore, interventions improving the executive functions in children with ADHD are essential for the treatment of ADHD in childhood (DuPaul & Stoner, 2003). So far, this has been attempted by self-management interventions, which typically include cognitive-behavioral strategies such as self-monitoring, self-reinforcement, and/or self-instruction. The influence of such interventions has been investigated regarding children's on-task behavior, academic productivity, academic accuracy, and disruptive behaviors (Harris, Reid, & Graham, 2004). A meta-analysis by Reid Trout, and Schartz (2005) found that interventions targeting self-monitoring strategies in children with ADHD indeed improved their performance on tasks that require executive control. Additionally, the teaching of self-reinforcement strategies seems to be promising in the treatment of ADHD as well, as this improves on-task behavior, academic accuracy, and peer interactions. For instance, Hinshaw, Henker, and Whalen (1984) reported a decrease in negative social interactions when children with ADHD received a reinforcement intervention (i.e., children obtained rewards for desired behavior) that was combined with a self-evaluation training (i.e., children obtained rewards for correct self-evaluations).

However, to date it is still difficult to find evidence that the acquired cognitive-behavioral strategies transfer to different contexts and that the observed improvements are sustained (Abikoff, 1991). This may be due to the rather general approach investigated in respective studies. With respect to self-monitoring, children with ADHD are asked to scrutinize and document their own behavior through specifying a target response and recording its performance; and with respect to self-reinforcement, children with ADHD are not only asked to monitor their behavior but also to evaluate and reinforce their own performance. Hinshaw, Klein, and Abikoff (2007) therefore note that current self-management interventions merely constitute meaningful and valuable extensions of traditional behavioral interventions (i.e., token economies and response-cost systems).

The present research takes a different perspective. Given that children with ADHD have deficits in executive functions, we want to explore whether offering these children a self-regulation tool can off-set these deficits. Accordingly, we measured the performance of

children with and without ADHD in a shifting task (i.e., modified WCST, Study 1) and in a resistance to distraction paradigm, which requires both inhibition and working memory (Study 2). As offering the self-regulation tool of forming if-then plans has already been shown to improve executive functions in college students (Cohen et al., 2008), we studied the effectiveness of forming if-then plans on executive functions performance in children with ADHD.

OVERVIEW OF THE PRESENT STUDIES

In Study 1, we used the modification of a classic shifting task (i.e., WCST) and compared common task instructions, mere goal intentions, and if-then plans in children with and without ADHD. We hypothesized that children with ADHD should do worse than children without ADHD in the control condition (i.e., make less perseverative errors in the modified WCST under the mere task instructions). This difference should not be alleviated when goal intentions to do well are formed; only when these goal intentions are furnished with implementation intentions children with ADHD should perform at a level that is no longer different to that of children without ADHD.

In Study 2, we measured performance of children with and without ADHD on a task assessing working memory that had to be taken under quite difficult conditions (i.e., incidental distractions were presented throughout the task). Here, we were interested in the effects of mere goal intentions versus two different types of implementation intentions all geared toward coping with the disruptive distractions: Children in the if-then plan conditions received a goal intention instruction to not get distracted plus either a distraction-inhibiting or a task-facilitating if-then plan (Gollwitzer & Schaal, 1998). We assumed that children with ADHD would show a weaker performance as compared to children without ADHD in a task that requires updating while dealing with distractions when mere goal intentions to not get distracted are formed. However, children with ADHD should be able to improve their performance by the assigned if-then plans to the high level of performance observed with children without ADHD.

The present studies extend previous research on the facilitative effects of if-then plans in children with ADHD: (1) We investigate if-then plan effects as they regard children's performance in differ-

ent executive functions: inhibition, shifting, and working memory. Therefore, both studies represent not only a replication but also an extension of previous studies observing the beneficial if-then plan effect on tasks assessing the executive function deficit of reduced inhibition (Gawrilow & Gollwitzer, 2008) and motivation control deficit of reduced delay of gratification (Gawrilow et al., in press). (2) Furthermore, Study 2 investigates the effect of different types of if-then plans (i.e., task-facilitating if-then plan, distraction-inhibiting if-then plan) on improving executive functions in children with ADHD.

We decided to invite only boys to take part in these studies, because ADHD is more prevalent in boys than in girls (Barkley, 1990). Participating children with ADHD were diagnosed with Hyperkinetic Disorder F90.0 (ICD-10; World Health Organization WHO, 1991) as their primary disorder by the head pediatrician of a local German pediatric outpatient clinic. Exclusion criterion was the medication with nonpsychostimulant medications (i.e., Atomoxetine). Furthermore, participants were not medicated with Methylphenidate (MPH) 48 hours before and at the time of investigation.[2] We decided to exclude medication with MPH from both studies because effects of MPH on performing the tasks at hand (i.e., WCST in Study 1, Tannock & Schachar, 1991; a resistance to distraction paradigm in Study 2) are not clear yet. With regard to ethnic background, all of the participating boys were Caucasian. The studies were approved by a local ethics committee and were compliant with the 1964 World Medical Association Declaration of Helsinki.

STUDY 1: MODULATION OF PERFORMANCE IN A MODIFIED WCST IN CHILDREN WITH ADHD

The WCST (Heaton, Chelune, Talley, Kay, & Curtiss, 1993) is a commonly used measure of executive functions that requires participants to match a series of response cards (i.e., depicting one, two, three, or four; circles, triangles, stars, or crosses; in red, blue, green,

2. It is important to note that the medication rate is lower in Germany compared to the United States: Recent studies revealed a stimulant medication rate of 4.8% among 6–12-year-old children in the United States (Zuvekas, Vitiello, & Norquist, 2006) and of 2.6% among 9–15-year-old children in Germany (Janhsen & Glaeske, 2003). Furthermore, in the present study we emphasized the participation of children who were not medicated with MPH.

or yellow color) concerning one of three stimulus characteristics (i.e., color, form, number) to four stimulus cards (Card 1: one red triangle, Card 2: two green stars, Card 3: three yellow crosses, Card 4: four blue circles) without being instructed how the cards should be matched. The only feedback given by the experimenter is whether a match is correct or incorrect. Each time the participant has sorted 10 cards in a row successfully the experimenter changes the sorting category without informing the participant.

Dependent measures of interest are the number of perseverative responses or errors, categories completed, and times that an individual lost a set. WCST variables reflect a number of executive functions, including inhibition, shifting, and working memory. The variable that is most strongly associated with shifting performance is WCST perseverative errors. WCST perseverative errors occur when a participant sticks to a lapsed rule (i.e., the number of times the participant keeps using a sorting rule that has become invalid). Such perseverative may be due either to the inability to give up on an old category in favor of a new one or the inability to see a new possibility. A factor analysis of the WCST has shown these perseverative errors to be the most useful outcome measure for assessing executive function deficits (Greve, Stickle, Love, Bianchini, & Stanford, 2005). It is well established that WCST performance is worse in children with ADHD compared to children without ADHD (Romine et al., 2004). Our first study was thus designed to assess the hypothesis that if-then plans can help to reduce perseverative errors in a modified WCST in children with ADHD.

METHOD

Participants. Boys with ADHD ($n = 43$, *M*-age: 9.58 years, $SD = 1.23$) and without ADHD ($n = 36$, *M*-age = 8.59 years, $SD = 0.47$) took part in this experiment. Nineteen children with ADHD received medication with MPH. However, 48 hours before and at the time of investigation none of the participating children were medicated with MPH. To assess nonverbal thinking as a baseline, all participating children had to solve one subtest (i.e., block design subtest) from the HAWIK-III (German version of the WISC-III; Tewes, Rossmann, & Schallberger, 1999). The block design test was chosen because of its high predictive and diagnostic value (Renner, 2002; Sattler, 1992). The participants with ADHD achieved a score of $M = 10.11$ points

(*SD* = 2.71) and participants without ADHD achieved a score of *M* = 9.91 points (*SD* = 2.96). These scores are equivalent to the average in the population of the respective age group (*M* = 10 points; Tewes et al., 1999); the difference between children with and without ADHD did not reach significance, $F(1,78) = 3.11$, $p = .13$.

Design. The study followed a 2-between (Group: children without ADHD, children with ADHD) X 3-between (Condition: mere task instruction, goal intention, goal intention plus if-then plan) design. The dependent variable was the percentage of perseverative errors measured in relation to total errors in the modified WCST.

Procedure. Children were assigned to an individual appointment with one of three female experimenters in our laboratory after they and their parents had given informed consent. Importantly, experimenters were blind to the hypothesis of the study.

Modified WCST. We adapted the WCST (Heaton et al., 1993) and the MCST (Modified Card Sorting Test; Nelson, 1976) to create our modified version of the WCST. As stimulus cards we used the cards according to the WCST manual (i.e., one red triangle, two green stars, three yellow stars, four blue circles); as response cards we used the subset of 24 nonambiguous cards (i.e., these response cards do not have more than one attribute in common with the stimulus card; Nelson, 1976) which we repeated three times. Deviating from the instructions of the original WCST, we told children beforehand which rules might apply during the task (sorting cards according to color, form, or number of symbols presented on the card). It was not possible to correct an answer after wrong matching of cards and there was no time limit for solving the task. To ensure that all children understood the procedure, the experimenter asked three short questions concerning the task.

Experimental Conditions. All participating children were randomly assigned to one of the following conditions: mere task instruction (16 children with ADHD, 13 children without ADHD), goal intention (15 children with ADHD, 12 children without ADHD), or if-then plan condition (12 children with ADHD, 11 children without ADHD). Participants in the mere task instruction condition were asked to memorize the sentence *"The cards from the stack need to be matched to the cards on the table!"* Participants in the goal intention condition were asked to set themselves the goal to match as many cards as possible *("I will match as many cards as possible according to*

the rule!"). Children in the if-then plan condition were in addition asked to make the plan *"Whenever my rule is wrong, then I will try another rule!"* The children had to repeat the respective sentences three times.

Interview. At the end of the experiment, the experimenter conducted a short interview with each participant. We measured task commitment to ensure the equivalence of our sample regarding this variable in the three different conditions (i.e., mere task instruction, goal intention, if-then plan) by asking the participants to answer four questions (i.e., "*I intended to do well on the task*"; "*It makes a difference for me to be good at this task;*" "*I would have been very disappointed if I had failed this task*" "*I had the intention to find correct rules*") using a six-point scale ranging from 0 (strongly disagree) to 5 (strongly agree). Finally, the children and their parents were thanked and debriefed.

RESULTS

Background Variables. There was no difference between conditions in performance of the block design test, $F(2,76) = .04$, *ns,* and age, $F(2,76) = .48$, *ns.* However, the age of the children differed between groups (with ADHD: $M = 9.58$, $SD = 1.23$, without ADHD: $M = 8.59$, $SD = 0.47$), $F(1,78) = 20.64$, $p < .001$, $\eta^2 = .21$. Accordingly, we used age but not performance on the block design test as a covariate in the analyses reported below.

Percentage of Perseverative Errors. A 2 (Group: children with ADHD, children without ADHD) X 3 (Condition: mere task instruction, goal intention, if-then plan) ANCOVA (with age as the covariate) on perseverative errors revealed a significant main effect of Group, $F(1,72) = 4.02$, $p < .001$, $\eta^2 = .16$, no significant main effect of Condition, $F(2,72) = 1.78$, ns, and no significant interaction between Group and Condition, $F(2,72) = .23$, ns (see Figure 1). Apparently, boys with ADHD showed overall more perseverative errors ($M = 60.93\%$, $SE = 2.28$) compared to boys without ADHD ($M = 53.47\%$, $SE = 2.51$); and the overall difference between the mere task instruction ($M = 61.32\%$, $SE = 2.61$), goal intention ($M = 56.56\%$, $SE = 2.43$), and if-then plan conditions ($M = 54.13\%$, $SE = 2.67$) did not reach significance.

Analyzing our specific hypotheses, however, we found the expected significant main effect of condition in children with ADHD,

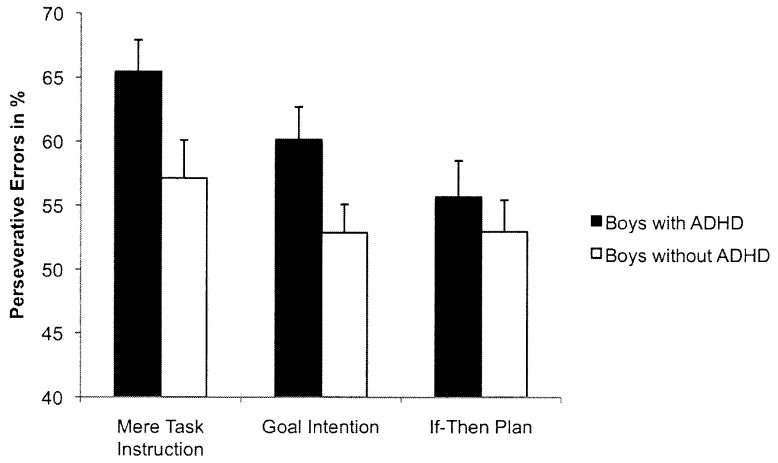

FIGURE 1. Means of perseverative errors (in %) in the modified WCST by Group and Condition (Study 1).

$F(2,39) = 3.44$, $p < .05$, $\eta^2 = .15$. Planned simple contrasts revealed that children in the if-then plan condition made fewer perseverative errors ($M = 55.67\%$, $SE = 2.83$) than children in the goal intention condition ($M = 60.16\%$, $SE = 2.55$, $p < .05$) as well as children in the mere task instruction condition ($M = 65.44\%$, $SE = 2.46$, $p < .05$). The latter two conditions did not differ significantly from each other.

In children without ADHD, on the other hand, mere task instructions suffice to produce satisfactory outcomes as there was no significant overall difference between the conditions, $F(2,32) = .23$, *ns*. Children without ADHD could not improve their performance in the if-then plan ($M = 52.96\%$, $SE = 2.45$) compared to the goal intention ($M = 52.88\%$, $SE = 2.21$), and the mere task instruction condition ($M = 57.21\%$, $SE = 2.98$).

Finally, when comparing perseverative errors between children with and without ADHD separately for each condition, significant differences emerged in the mere task instruction condition, $F(1,26) = 3.11$, $p < .05$, $\eta^2 = .11$ (children with ADHD: $M = 65.44\%$, $SE = 2.46$; children without ADHD: $M = 57.21\%$, $SE = 2.98$), and in the goal intention condition, $F(1,24) = 1.84$, $p < .05$, $\eta^2 = .10$ (children with ADHD: $M = 60.16\%$, $SE = 2.55$; children without ADHD: $M =$

52.88%, *SE* = 2.21), but not in the implementation intention condition, $F(1,20) = .31$, *ns* (children with ADHD: *M* = 55.67%, *SE* = 2.83; children without ADHD: *M* = 52.96%, *SE* = 2.45). Apparently, only forming if-then plans but not goal intentions made children with ADHD reduce their perseverative errors to the low levels observed in children without ADHD.

We tested this predicted pattern of performance by coding the mere task instruction group of children with ADHD as 1, the mere task instruction group of children without ADHD as -1, the goal intention group of children with ADHD as 1, the goal intention group of children without ADHD as -1, and the two implementation intention groups (i.e., children with and without ADHD) both as 0. This planned contrast turned out to be significant, $t(78) = 2.02$, $p < .05$.

Alternative Process Explanation. We checked whether the beneficial effect of implementation intentions for children with ADHD was due to an increase in task commitment. For this purpose, we summarized the four items to form one index assessing task commitment (Cronbach's $\alpha = .68$) and used this index as a covariate in a one-way ANCOVA for children with ADHD. As it turned out, the original $F(2,39) = 3.44$, $p < .05$, $\eta^2 = .15$, reported above changed to $F(2,38) = 3.49$, $p < .05$, $\eta^2 = .15$, and thus stayed significant. Moreover, there was also no difference of task commitment between children with ADHD (*M* = 3.45, *SD* = 0.25) and without ADHD (*M* = 3.69, *SD* = 0.27) in the if-then plan condition, $F(1,20) = 0.34$, *ns.*

These findings suggest that the beneficial effects of if-then plans for children with ADHD are not due to an increase in task commitment. This conclusion is also supported by the fact that the level of commitment did not significantly correlate with the main dependent variable of perseverative errors in children with and without ADHD, $r(72) = -.05$, *ns*.

SUMMARY AND DISCUSSION

Study 1 revealed that children with ADHD benefit from if-then planning in a modified WCST. Importantly, mere goal intentions were not significantly more supportive than a neutral instruction. Furthermore, the facilitating effect of if-then plans does not seem to be based on an increase in task commitment; this finding is in

line with other implementation intention studies (Webb & Sheeran, 2008).

Overall, children without ADHD made fewer perseverative errors and hence showed significantly better shifting performance compared to children with ADHD. One may wonder however why children without ADHD could not also significantly benefit from if-then plans. Implementation intentions reveal their goal attainment enhancing effects in particular when task difficulty is high; for easy tasks goal intentions suffice to produce satisfactory outcomes (Gollwitzer & Sheeran, 2006). Indeed, as the results in the control condition (i.e., mere task instruction) of the present study show, the WCST was comparatively easier for children without ADHD: Children without ADHD made fewer perseverative mistakes than children with ADHD.

An important limitation of our first study is that we did not apply sufficient control measures and cannot specify whether there are baseline differences between children with and without ADHD. Therefore, we assessed several additional control variables in Study 2 (e.g., behavioral problems; ADHD-symptoms; socioeconomic status, SES). Moreover, Study 2 was designed to compare children with and without ADHD using a working memory task, as we wanted to know whether executive functions demanded by tasks that challenge working memory also benefit from if-then planning. Furthermore, the goal and implementation intentions of Study 2 did not focus on performing the task at hand (as it was the case in Study 1) but on coping with the distractions that made performing the task more difficult. Finally, we explored whether different types of if-then plans might vary in their effectiveness. Specifically, we focused on plans to ignore the distractions (distraction-inhibiting plans) vs. to concentrate on the task at hand (task-facilitating plans; Gollwitzer & Schaal, 2008; Patterson & Mischel, 1976), as these plans have been observed to produce differential outcomes for certain individuals (e.g., high test anxious individuals benefit only from distraction-inhibiting plans; Parks-Stamm, Gollwitzer, & Oettingen, 2010).

STUDY 2: MODULATION OF RESISTANCE TO DISTRACTION PERFORMANCE IN CHILDREN WITH AND WITHOUT ADHD

In Study 2, boys with and without ADHD were asked to work on math problems that required them to continuously monitor infor-

mation while distracting excerpts from the movie Shrek (Warner et al., 2001) randomly disrupted them. Thus, children were confronted with a working memory task; this task had to be performed under both difficult (distraction) and easy (no distraction) conditions. Beforehand, one third of the children received a mere goal intention; whereas the remaining children additionally received one of two different if-then plans (task-facilitating or distraction-inhibiting if-then plan). We expected a weaker performance in boys with ADHD than in boys without ADHD, especially during phases with distraction compared to phases without distraction. Furthermore, we hypothesized that if-then plans are capable of improving this performance in boys with ADHD as for these children the task should be comparatively more difficult and if-then plans show their effects when task difficulty is high (Gollwitzer & Sheeran, 2006).

METHOD

Participants. Participants in this experimental study were 33 boys with ADHD (*M*-age: 10.33 years, *SD* = 1.12) who were diagnosed with Hyperkinetic Disorder as their primary disorder. In order to avoid practice effects, participants in this study were not the same as participants in Study 1. Four of the participants with ADHD were medicated with MPH. However, none of our participants received any kind of psychostimulant (i.e., MPH) or other medication 48 hours before and at the time of investigation. The comparison group consisted of 47 boys (*M*-age: 10.73 years, *SD* = 1.19; see Table 1).

In order to compare the ADHD and control groups in more detail we also assessed symptom severity. We asked the parents of all participating children to answer the CBCL (Child Behavior Check List) questionnaire (Arbeitsgruppe Deutsche Child Behavior Checklist, 1998) that measures different aspects of their children's behavior (e.g., social withdrawal, somatic disturbances, and anxiety/depression in the internalizing scale; anti-social and aggressive behavior in the externalizing scale; social problems, schizoid/obsessive compulsive behavior, attention problems; internalizing, and externalizing scales in the total CBCL) as well as the Conners Rating Scale (Conners, 2008; Steinhausen, 1993). The CBCL confirmed the diagnosis of the ADHD children showing significant differences between the ADHD group (*M* = 68.70, *SD* = 6.73) and the control

TABLE 1. Characteristics of the Sample (Study 2)

	Boys		
Variables	**With ADHD (n =33)**	**Without ADHD (n = 47)**	**Group differences p value**
Age in years			
Mean age (SD)	10.33 (1.12)	10.73 (1.19)	.135
Behavioral ratings (CBCL)			
Internalizing problems T value (SD)	64.40 (8.78)	54.17 (8.16)	< .001
Externalizing problems T value (SD)	65.26 (7.89)	51.97 (9.33)	< .001
Total T value (SD)	68.70 (6.73)	52.90 (8.84)	< .001
Behavioral ratings (Conners)			
ADHD scale	1.44 (0.63)	0.36 (0.29)	< .001
Calculative thinking (HAWIK-III)			
Mean (SD)	9.30 (2.50)	12.67 (3.33)	< .001
Highest education level (SES)			
≤10 years of school (Mothers), %	69.69	78.72	.048
≤10 years of school (Fathers), %	51.51	76.59	.004
Employment status (SES)			
Full-time or part-time (Mothers), %	66.66	55.31	.356
Full-time or part-time (Fathers), %	84.84	86.04	.786

Note. Employment status was reported according to the following options: 1 = full-time, 2 = part-time; 3 = unemployed/homemaker.

group (M = 52.90, SD = 8.84) concerning the total scale, $t(78) = 8.16$, $p < .001$, $d = 2.01$. Likewise, the ratings regarding the internalizing scale (ADHD group: M = 64.40, SD = 8.78; control group: M = 54.17, SD = 8.16; $t(78) = 5.02$, $p < .001$, $d = 1.21$) and the externalizing scale (ADHD group: M = 65.26, SD = 7.89; control group: M = 51.97, SD = 9.33; $t(78) = 6.29$, $p < .001$, $d = 1.53$) differed between ADHD and control children. In the same vein, differences in the hyperactivity/attention deficit scale of the Conners Rating Scale occurred between children with ADHD (M = 1.44, SD = 0.63) and without ADHD (M = 0.36, SD = 0.29).

As a baseline all participating children had to solve a subtest (i.e., calculative thinking) of the HAWIK-III (German version of the WISC-III; Tewes et al., 1999). The calculation subtest was chosen because the experimental task was math-related, and this subtest therefore provided baseline data on math abilities. Results revealed

that children with (M = 9.30, SD = 2.50) and without ADHD (M = 12.67, SD = 3.33) differed significantly concerning their math abilities, $t(78) = 4.84$, $p < .001$, $d = 1.14$.

We assessed the SES (Lampert & Kroll, 2006) of families by asking parents about their educational level (i.e., ≤ 10 years of school or > 10 years of school) and employment status (i.e., *1* = full-time, 2 = part-time, 3 = unemployed/homemaker). We did not form a SES index but treated both variables separately as recommended by Entwisle and Aston (1994). There were differences between children with and without ADHD concerning the educational level but not concerning the employment status (see Table 1).

Design. The experiment followed a 2-between (Group: with ADHD vs. without ADHD) X 3-between (Condition: goal intention vs. task-facilitating if-then plan vs. distraction-inhibiting if-then plan) X 2-within (Distraction: with vs. without) design. The main dependent variable was the mean time for answering the items (in s) regardless of whether the answer was correct or not, in phases with and without distractions.

Material. Two different screens, one stacked on top of the other, were used for presenting the stimulus material. The upper screen showed the math problems, while the lower screen displayed intermittent distractions. The math problems consisted of items adapted from the KLT (Attention Achievement Test; Dueker & Lienert, 1959). These items present two mathematical problems at the same time (e.g., 5 - 3 + 2 = ?, and 8 + 2 - 4 = ?), and the task is (a) to solve each equation, and then (b) to subtract the smaller from the larger sum.

Excerpts from the movie Shrek (Warner et al., 2001) were used as visual and auditory distractions. The excerpts were interspersed six times for 75 s, respectively. The six phases without distraction lasted between 30 and 120 s in order to prevent anticipation of the next distraction phase. Thus, the experiment contained six phases with distraction (i.e., 7.5 min), six phases without distraction (i.e., 7.5 min); they cumulatively lasted for 15 min.

Procedure. Children were assigned to an individual appointment with a female experimenter after they and their parents had given written informed consent.

Computerized Task. The experimenter instructed the children how to solve the math problems. The children hence learned that in every trial, two mathematical problems would appear on the upper

screen, that they had to solve both tasks, keep the respective results in mind, and subtract the smaller figure from the sum. The resulting figure had to be typed in. The participants were asked to answer several open questions to make sure that they understood the whole procedure. Subsequently, every child completed a familiarization trial on the computer. Children worked on as many problems as possible in 15 min and all children received the same math problems in the same order. Additionally, participants obtained written feedback on the screen for every single math problem they had worked on ("correct answer" or "wrong answer"). Children also learned that they would be distracted during task completion by excerpts from the movie Shrek appearing on the lower screen.

Experimental Conditions. The children were randomly assigned to one of the following conditions: goal intention, task-facilitating if-then plan, and distraction-inhibiting if-then plan. Participants in the goal intention condition were assigned the goal of not becoming distracted ("I won't get distracted!"). Children in the task-facilitating if-then plan condition additionally received the following plan "Whenever the movie starts, then I will work hard on my task!", whereas the children in the distraction-inhibiting if-then plan condition received in addition the plan "Whenever the movie starts, then I will ignore it!" The children had to repeat the respective goal intention or if-then plan three times.

Interview. Again, the experimenter conducted a short interview to ensure the equivalence of our sample concerning task commitment in the three different conditions (i.e., goal intention, task-facilitating if-then plan, distraction-inhibiting if-then plan). Participants were asked four questions at the end of the experiment (i.e., "I intended to do well on the task"; "It makes a difference for me to be good at this task"; "I would have been very disappointed if I failed this task"; "I had the intention to work concentrated on the task"), the answer scale ranged from 0 (strongly disagree) to 10 (strongly agree). Finally, the children and their parents were thanked and debriefed.

RESULTS

Background Variables. There were no differences between the conditions as regards participants' age, $F(2,75) = .81$, *ns*, symptoms (e.g., CBCL ratings, $F(2,75) = .02$, *ns*), scores in the calculative thinking test, $F(2,75) = .13$, *ns*, and SES of parents (i.e., highest education level

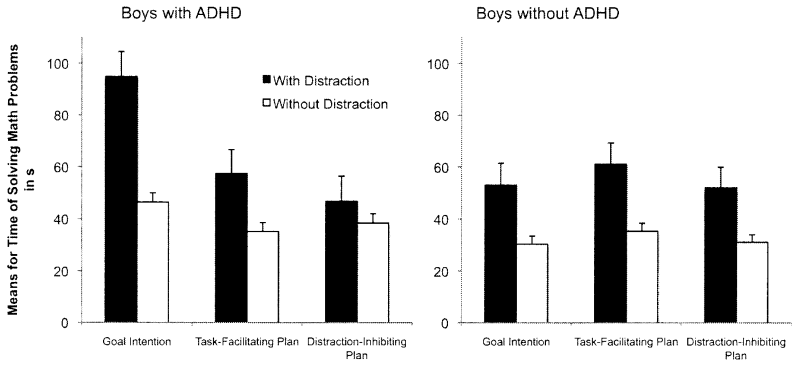

FIGURE 2. Means for time of solving math problems (in s) by Group, Condition, and Distraction (Study 2).

of mothers, $p = .79$, and fathers, $p = .96$; according to Mann-Whitney U tests).

Time to Solve Math Problems. As the children with ADHD were slightly younger than the children without ADHD and age had a significant influence on the dependent variable of interest, $F(1,69) = 15.07$, $p < .001$, we conducted the following analyses using age as a covariate. Furthermore, as one might argue that the speed-up effect of implementation intentions on mean time to solve the problems observed in the ADHD group might have costs in terms of a higher error rate we included the number of correctly solved math problems as a further covariate; there was no significant difference between conditions concerning this variable, $F(2,31) = 2.17$, $p = .13$. Table 2 displays adjusted and unadjusted means and variances for the dependent variable of mean time to solve math problems in the different Groups and Conditions with and without Distraction (Figure 2).

3. As it was possible that children start to work on an item (i.e., math problem) in a neutral phase (without distraction) and solve it in a critical phase (with distraction), or that children start to work on an item in a critical phase (with distraction) and solve it in a neutral phase (without distraction) we computed a ratio model for analyzing variables assessed during neutral and critical phases. Thus, every math problem was assigned to either a neutral or critical phase independent of time of presentation by the program and time of answer by the child. For every single item, we computed the ratio of critical phase. If the ratio of critical was at .5 or higher, we matched the item to critical items and if the ratio was lower or equal .49, we matched the item to neutral items.

TABLE 2. Adjusted and Unadjusted Means and Variability for Time of Solving Math Problems (in s) Using Age and Correct Solved Items as Covariates (Study 2)

	Unadjusted		Adjusted	
	M	*SD*	*M*	*SE*
Boys with ADHD with distraction				
Goal intention	116.44	80.05	94.91	9.54
Task-facilitating if-then plan	59.09	31.24	57.44	9.21
Distraction-inhibiting if-then plan	73.47	29.39	46.78	9.72
Boys with ADHD without distraction				
Goal intention	56.42	20.87	46.46	3.55
Task-facilitating if-then plan	37.26	17.35	35.21	3.43
Distraction-inhibiting if-then plan	49.68	21.55	38.44	3.62
Boys without ADHD with distraction				
Goal intention	35.96	19.63	53.04	8.38
Task-facilitating if-then plan	50.17	36.26	61.10	8.20
Distraction-inhibiting if-then plan	41.69	18.91	52.12	7.85
Boys without ADHD without distraction				
Goal intention	22.44	7.97	30.35	3.12
Task-facilitating if-then plan	29.95	16.69	35.38	3.05
Distraction-inhibiting if-then plan	26.52	8.96	31.11	2.92

A 2 between (Group: children with ADHD vs. children without ADHD) X 3 between (Condition: goal intention vs. task-facilitating if-then plan vs. distraction-inhibiting if-then plan) X 2 within (Distraction: with vs. without) factorial ANCOVA on time taken to solve math problems[3] (i.e., regardless of whether correctly or incorrectly solved) revealed a significant main effect of Group, $F(1,68) = 3.48$, $p < .05$, $\eta^2 = .21$, a significant main effect of Condition, $F(2,68) = 3.73$, $p < .05$, $\eta^2 = .10$, and a significant main effect of Distraction, $F(1,68) = 16.96$, $p < .001$, $\eta^2 = .21$. Boys with ADHD solved the math problems slower ($M = 52.80$ s, $SE = 3.81$) compared to boys without ADHD ($M = 44.11$ s, $SE = 3.26$); children overall benefited from a task-facilitating if-then plan ($M = 47.87$ s, $SE = 3.95$) and distraction-inhibiting if-then plan ($M = 41.56$ s, $SE = 3.87$) compared to a mere goal intention ($M = 54.47$ s, $SE = 3.92$); and boys overall solved the math problems slower under distraction ($M = 60.14$ s, $SE = 3.72$) compared to phases without distraction ($M = 35.36$ s, $SE = 1.34$).

Furthermore, the following interaction effects qualified these main effects: Group and Condition, $F(2,68) = 5.23$, $p < .05$, $\eta^2 = .13$, Condition and Distraction, $F(2,68) = 3.09$, $p < .05$, $\eta^2 = .11$, Group and Distraction, $F(1,68) = 3.92$, $p < .05$, $\eta^2 = .06$, and Group, Condition, and Distraction, $F(2,68) = 3.57$, $p < .05$, $\eta^2 = .11$. Apparently, boys with and without ADHD seemed to benefit differently from the different conditions depending on the presence of distractions. To elucidate the three-way interaction effect, we analyzed children with and without ADHD separately.

In boys with ADHD, a 3 between (Condition: goal intention vs. task-facilitating if-then plan vs. distraction-inhibiting if-then plan) X 2 within (Distraction: with vs. without) factorial ANCOVA on time taken to solve math problems revealed a significant main effect of Condition, $F(2,28) = 4.87$, $p < .05$, $\eta^2 = .26$, a significant main effect of Distraction, $F(1,28) = 8.27$, $p < .001$, $\eta^2 = .23$, and a significant interaction between Condition and Distraction, $F(2,28) = 3.72$, $p < .05$, $\eta^2 = .21$. In phases with distractions, boys with ADHD needed more time to solve the math problems when receiving a mere goal intention ($M = 94.91$ s, $SE = 9.54$) compared to a task-facilitating if-then plan ($M = 57.44$ s, $SE = 9.21$, $p < .05$, $d = 3.99$), or a distraction-inhibiting if-then plan ($M = 46.78$ s, $SE = 9.72$, $p < .001$, $d = 4.99$), overall $F(2,28) = 4.82$, $p < .05$. In phases where no distractions occurred, boys with ADHD also took more time to solve the math problems in the goal intention condition ($M = 46.46$ s, $SE = 3.55$) compared to the task-facilitating if-then plan ($M = 35.21$ s, $SE = 3.43$, $p < .05$, $d = 3.22$) and the distraction-inhibiting if-then plan ($M = 38.44$ s, $SE = 3.62$, $p < .05$, $d = 2.23$), overall $F(2,29) = 2.55$, $p < .05$. However, the difference in performance between phases with distraction and phases without distraction was significantly reduced in the two implementation intention conditions ($M = 22.23$ s, $SE = 5.78$; and $M = 8.34$ s, $SE = 6.1$) as compared to the goal intention condition ($M = 48.45$, $SE = 5.99$), all ps $< .05$, indicating a stronger distraction effect in the goal intention condition as compared to the two implementation intention conditions.

In boys without ADHD, a 3 between (Condition: goal intention vs. task-facilitating if-then plan vs. distraction-inhibiting if-then plan) X 2 within (Distraction: with vs. without) factorial ANCOVA on time taken to solve math problems revealed only a significant main effect of Distraction, $F(1,38) = 23.05$, $p < .001$, $\eta^2 = .38$. The main effect of Condition was not significant, $F(2,38) = 1.82$, $p = .18$, and the interaction between Condition and Distraction was not significant

either, $F(2,38) = .75$, *ns*. Apparently, in phases with distraction boys without ADHD could not accelerate their already very fast mean solving time in the goal intention condition ($M = 53.04$ s, $SE = 8.38$) by adding task-facilitating if-then plans ($M = 61.10$ s, $SE = 8.20$) or distraction-inhibiting if-then plans ($M = 52.12$ s, $SE = 7.85$), all *p*s > .05; the same was true for phases without distraction (goal intention: $M = 30.35$ s, $SE = 3.12$; task-facilitating if-then plan: $M = 35.38$ s, $SE = 3.05$; distraction-inhibiting if-then plan: $M = 31.11$ s, $SE = 2.92$), all *p*s > .05. Moreover, the difference in performance between phases with distraction and phases without distraction stayed the same throughout all of the intention conditions (goal intention: $M = 22.69$ s, $SE = 5.26$; task-facilitating if-then plan: $M = 25.72$ s, $SE = 5.15$; distraction-inhibiting if-then plan: $M = 21.01$ s, $SE = 4.93$), all *p*s > . 05.

Finally, when comparing the time needed to solve the math problems in phases with distractions between children with and without ADHD separately for each condition, significant differences only emerged in the goal intention condition, $F(1,21) = 2.18$, $p < .05$, $\eta^2 = .28$, but not in the if-then plan conditions, all *p*s > .05. The same pattern of results was found for phases where no distractions occurred; significant differences were only observed in the goal intention condition, $F(1,21) = 10.27$, $p < .001$, $\eta^2 = .32$, but not in the if-then plan conditions, all *p*s > .05. Thus, forming if-then plans made children with ADHD perform at a level that was no longer significantly different from that of children without ADHD.

Alternative Process Explanation. We summarized the four items to form one index assessing task commitment (Cronbach's $\alpha = .59$). A 2 (Group: children with ADHD vs. children without ADHD) X 3 (Condition: goal intention vs. task-facilitating if-then plan vs. distraction-inhibiting if-then plan) X 2 (Distraction: with vs. without) repeated measurement ANCOVA (age as covariate) on task commitment revealed no significant main effect of Condition, $F(2,69) = 0.16$, *ns*, and no significant interaction effect of Condition and Group, $F(2,69) = 0.88$, *ns*. Thus, children with and without ADHD receiving either a goal intention ($M = 7.17$, $SE = 0.24$), task-facilitating if-then plan ($M = 7.09$, $SE = 0.24$), or distraction-inhibiting if-then plan ($M = 6.98$, $SE = 0.24$) all reported a similarly high task commitment. However, the main effect of Group was significant, $F(1,69) = 3.67$, $p < .05$, $\eta^2 = .05$, indicating that children with ADHD stated a higher

task commitment (M = 7.35, SE = 0.21) compared to children without ADHD (M = 6.81, SE = 0.18).

Finally, conducting a 2 (Group: with ADHD, without ADHD) X 3 (Condition: goal intention, task-facilitating if-then plan, distraction-inhibiting if-then plan) X 2 (Distraction: with, without) repeated measurement ANCOVA on time to solve math problems with the covariates age, correctly solved math problems, and task commitment did not change the pattern of results reported above. This suggests that the observed changes of children with ADHD caused by if-then plans are not due to an increase in task commitment. This conclusion is also supported by the fact that level of commitment did not significantly correlate with mean time spent working on math problems, $r(73) = .16$, *ns*; it even correlated negatively with amount of correctly solved math problems, $r(73) = -.27$, $p < .05$.

SUMMARY AND DISCUSSION

Boys with ADHD who furnished the goal to not get distracted with an if-then plan solved the math problems faster than boys in the ADHD group with a mere goal intention. This beneficial effect of implementation intentions was true for task-facilitating and distraction-inhibiting if-then plans alike. This finding indicates that children with ADHD can effectively increase their performance on a task that requires working memory and the inhibition of distractions by making if-then plans although they are challenged behaviorally and cognitively (e.g., as indicated by the CBCL). A special point of interest is the fact that the time needed to solve math problems in children with ADHD did not only improve during phases with distraction, but also during phases without distraction. This effect is plausible, as participants using if-then plans are known to solve tasks that burden self-regulatory resources in a very efficient way (e.g., Brandstätter et al., 2001). As a consequence, controlling distractions by the help of implementation intentions should need less resources (Webb & Sheeran, 2004), and thus more of the cognitive capacities required by the math calculations should be available in subsequent phases without distractions.

The finding that children without ADHD could not profit further from the different if-then plans are in line with implementation intention theory's postulate that if-then plans work particularly well when the "going gets tough" (Gollwitzer, Gawrilow, & Oettingen,

2010). The boys without ADHD evidenced superior mathematical abilities compared to boys with ADHD in the calculative thinking subtest of the WISC. Apparently, children without ADHD were not in need of a self-regulation strategy to effectively deal with the task at hand; this is also evident in their superior performance on the math problems to be solved in phases with and without distraction.

GENERAL DISCUSSION

Following our predictions, in Study 1 children with ADHD perseverated more in comparison to children without ADHD and reduced their perseverative errors in a modified version of the WCST by using if-then plans. In Study 2, children with ADHD showed a weaker performance as compared to children without ADHD in a working memory task; however, children with ADHD could again improve their performance by using if-then plans. In Study 1, the if-then plan was directed toward the cognitive procedures that are implicated in shifting, whereas in Study 2 the if-then plans were directed towards facilitating the conditions under which the working memory task had to be performed. No matter whether the procedures of performing the task (i.e., shifting in Study 1) or the circumstances in which the task had to be performed were addressed (i.e., distractions in Study 2), if-then plans managed to show facilitating effects on task performance in children with ADHD. Moreover, in Study 2, children with ADHD benefited from both task-facilitating and distraction-inhibiting plans.

It is important to note that we found a significant Group and Condition interaction in Study 2 but not in Study 1. Apparently, forming implementation intentions in both Studies 1 and 2 did only completely abolish the performance disadvantage observed for children with ADHD in Study 2 but not in Study 1. This discrepancy might be due to one or more of the following reasons: First, the targeted executive functions are different between the two studies; in Study 1 it was shifting whereas in Study 2 it was working memory. It seems possible that by its very nature the latter is more easily supported by if-then planning than the former. Second, the implementation intentions used in Study 2 were not focused on facilitating the task at hand (i.e., solving math problems) but rather on impairing the negative influence of the adverse situational context (i.e., incidental

distractions) in which the focal task had to be performed. It seems possible that the latter strategy is generally more effective than the former. Finally, comparing the age of participants in Studies 1 and 2 and in previous studies on the effectiveness of if-then plans to support executive functions in children with ADHD, it turns out that the children with ADHD participating in Study 1 were of a particularly young age (i.e., 8.5 years on average). It seems possible that at this young age executive functions have not developed to such a degree that they can be supported by self-regulation strategies, or that cognitive development has not yet advanced to a stage that allows the effective use of the self-regulation strategy of if-then planning (e.g., Cepeda, Kramer, & Gonzales de Sather, 2001).

IMPLICATIONS FOR SELF-REGULATION INTERVENTIONS IN CHILDREN WITH ADHD

"The primary goal of treatment for ADHD is to enable a student to develop adequate levels of self-control" (DuPaul & Stoner, 2003; p. 164). Thus, the present findings offer suggestions for research on self-regulation interventions in children with ADHD. Children with ADHD perseverate less when using if-then plans (i.e., Study 1). This is of particular importance as shifting between tasks seems difficult for children with ADHD but is required frequently in the everyday life of schoolchildren. Moreover, children with ADHD resist distractions more effectively by using if-then plans (i.e., Study 2) and the ability to resist distractions is permanently challenged within the school context in children with ADHD (DuPaul & Stoner, 2003). As the distractions were interspersed incidentally in Study 2, this study is assumed to thoroughly reflect the difficulties children with ADHD face in school.

Previous research on cognitive-behavioral interventions in children with ADHD revealed that self-monitoring, self-reinforcement, and self-evaluation trainings often fail to ameliorate behavioral and academic problems of children with ADHD because of two reasons: Strategies that children learn in these trainings often do not evidence a temporally stable influence, and the effectiveness of the acquired strategies is frequently restricted to the context in which the children first learned to apply these strategies. Therefore, teaching children with ADHD to form if-then plans might be an effective way to facilitate the everyday life of children with ADHD.

Interventions that effectively teach the formation of if-then plans as a metacognitive strategy have recently been developed (i.e., Mental Contrasting with Implementation Intentions; see Oettingen & Gollwitzer, 2010). The beneficial effects of such interventions were found to persist over extended periods of time (e.g., Stadler, Oettingen, & Gollwitzer, 2009, 2010) and entail all kinds of everyday life challenges (Achtziger, Martiny, Oettingen, & Gollwitzer, in press). Accordingly, further studies on children with ADHD might want to investigate the temporal stability and contextual generality of the beneficial effects of if-then planning over extended periods of time and across different applied settings (e.g., in the classroom, at home).

IMPLICATIONS FOR IMPLEMENTATION INTENTION RESEARCH

The present studies contribute much to implementation intention research: First, these studies provide further support for findings regarding the effect of implementation intentions on performance in tasks that tax executive functions (Cohen et al., 2008). Whenever executive functions are challenged by a task at hand, if-then plans can be used to restructure the task by specifying critical stimuli and appropriate responses in advance, thus facilitating successful task performance. Second, the studies showed again that populations suffering from self-regulation deficits benefit much from if-then plans (Gawrilow & Gollwitzer, 2008; Paul et al., 2007). Clinical groups analyzed so far (e.g., patients with frontal lesions) are all known to have self-regulatory deficits and thus benefit from forming implementation intentions as this self-regulation strategy apparently compensates for executive dysfunctions. Third, the present studies replicate and extend existing research on the effectiveness of if-then plans in children with ADHD: Whereas prior studies focused on performance in an inhibition task (Gawrilow & Gollwitzer, 2008) and a delay of gratification paradigm (Gawrilow et al., in press), the present studies analyzed shifting as well as working memory and indicated that if-then plans again have a beneficial effect in children with ADHD.

LIMITATIONS

Our research certainly has several limitations. First and foremost, only boys took part in both studies owing to the heightened prevalence of ADHD in boys as compared to girls. It seems challenging albeit compelling to recruit a larger matched sample of girls and boys with and without ADHD. A second limitation is that although we assessed baseline data using subtests from intelligence test batteries (i.e., block design in Study 1, calculative thinking in Study 2), we cannot make firm conclusions about the intelligence as well as the attention span of our participants. Thus, further research might want to include intelligence and objective attention span tests. This is of interest because intelligence and working memory seem to be highly correlated (Oberauer, Schulze, Wilhelm, & Suess, 2005). Furthermore, shifting, and even more so inhibition and working memory, seem to be related to a person's attention span (Friedman et al., 2007).

A final limitation concerns the task-specific information given in different instructions of both studies. Specifically, the sentences used in the intention conditions in Study 1 (i.e., *"I will match as many cards as possible according to the rule"* as a goal intention and *"Whenever my rule is wrong, then I will try another rule"* as an implementation intention) and in Study 2 (i.e., *"I won't get distracted"* as a goal intention vs. *"Whenever the movie starts, then I will work hard on my task"* and *"Whenever the movie starts, then I will ignore it"* as implementation intentions) seem to differ regarding the amount of strategy information that is given with respect to performing the task at hand. Past research on implementation intentions has dealt with this problem by enriching the goal intention with the more detailed information provided in the if-then plan (e.g., Bayer & Gollwitzer, 2007) or by striping the if-then plan of the more detailed strategy information (e.g., Henderson, Gollwitzer, & Oettingen, 2007). No matter which approach was taken, implementation intentions led to superior goal attainment as compared to goal intentions due to their if-then format.

REFERENCES

Aarts, H., Dijksterhuis, A., & Midden, C. (1999). To plan or not to plan? Goal achievement or interrupting the performance of mundane behaviors. *European Journal of Social Psychology, 29*, 971-979.

Abikoff, H. (1991). Cognitive training in ADHD children: Less to it than meets the eye. *Journal of Learning Disabilities, 24,* 205-209.

Achtziger, A., Martiny, S. E., Oettingen, G., & Gollwitzer, P. M. (in press). Metacognitive processes in the self-regulation of goal pursuit. In P. Briñol & K. DeMarree (Eds.), *Social meta-cognition.* Philadelphia: Psychology Press.

Arbeitsgruppe Deutsche Child Behavior Checklist (1998). Elternfragebogen ueber das Verhalten von Kindern und Jugendlichen; deutsche Bearbeitung der Child Behavior Checklist (CBCL/4-18). Einfuehrung und Anleitung zur Handauswertung. 2. Aufl mit deutschen Normen, bearbeitet von Doepfner M, Plueck J, Boelte S, Lenz K, Melchers P, Heim K. Koeln, Arbeitsgruppe Kinder-, Jugend- und Familiendiagnostik (KJFD).

Barkley, R. A. (1990). *ADHD: A handbook for diagnosis and treatment.* New York: Guilford.

Barkley, R. A. (1997). *ADHD and the nature of self-control*. New York: Guilford.

Bayer, U. C., Achtziger, A., Gollwitzer, P. M., & Moskowitz, G. (2009). Responding to subliminal cues: Do if-then plans facilitate action preparation and initiation without conscious intent? *Social Cognition, 27*, 183-201

Bayer, C., & Gollwitzer, P. M. (2007). Boosting scholastic test scores by willpower: The role of implementation intentions. *Self and Identity, 6,* 1-19.

Brandstätter, V., Lengfelder, A., & Gollwitzer, P. M. (2001). Implementation intentions and efficient action initiation. *Journal of Personality and Social Psychology, 81,* 946–960.

Cepeda, N. J., Kramer, A. F., & Gonzalez de Sather, J. C. (2001). Changes in executive control across the life span: Examination of task-switching performance. *Developmental Psychology, 37*, 715–730.

Cohen, J. (1992). A power primer. *Psychological Bulletin, 112,* 155-159.

Cohen, A.-L., Bayer, U. C., Jaudas, A., & Gollwitzer, P. M. (2008). Self-regulatory strategy and executive control: Implementation intentions modulate task switching and Simon task performance. *Psychological Research, 72,* 12-26.

Conners, K. (2008). *Conners 3rd edition (Conners 3).* Toronto, Canada: Multi-Health Systems.

Dueker, H., & Lienert, G. A. (1959). *Konzentrations-Leistungs-Test. Handanweisung*. Goettingen: Hogrefe.

DuPaul, G. J., & Stoner, G. (2003). *ADHD in the schools: Assessment and intervention strategies* (2nd ed.). New York: Guilford.

Entwisle, D. R., & Aston, N. M. (1994). Some practical guidelines for measuring youth's race/ethnicity and socioeconomic status. *Child Development, 65,* 1521-1540.

Frazier, T. W., Youngstrom, E. A., Glutting, J. J., & Watkins, M. W. (2007). ADHD and achievement: Meta-analysis of the child, adolescent, and adult literatures and a concomitant study with college students. *Journal of Learning Disabilities, 40,* 49-65.

Friedman, N. P., Haberstick, B. C., Willcutt, E. G., Miyake, A., Young, S. E., Corley, R. P., & Hewitt, J. K. (2007). Greater attention problems during childhood

predict poorer executive functioning in late adolescence. *Psychological Science, 18*, 893-900.

Gawrilow, C., & Gollwitzer, P. M. (2008). Implementation intentions facilitate response inhibition in children with ADHD. *Cognitive Therapy and Research, 32,* 261-280.

Gawrilow, C., Gollwitzer, P. M., & Oettingen, G. (in press). If-then plans benefit delay of gratification in children with ADHD. *Cognitive Therapy and Research.*

Gollwitzer, P. M. (1999). Implementation intentions: Strong effects of simple plans. *American Psychologist, 54*, 493-503.

Gollwitzer, P. M., Gawrilow, C., & Oettingen, G. (2010). The power of planning: Self-control by effective goal-striving. In R. R. Hassin, K. N. Ochsner, & Y. Trope (Eds.), *Self control in society, mind, and brain* (pp. 279-296). New York: Oxford University Press.

Gollwitzer, P. M., & Schaal, B. (1998). Metacognition in action: The importance of implementation intentions. *Personality and Social Psychology Review, 2*, 124-136.

Gollwitzer, P. M., & Sheeran, P. (2006). Implementation intentions and goal achievement: A meta-analysis of effects and processes. *Advances of Experimental Social Psychology, 38*, 69-119.

Grant, D. A., & Berg, E. (1948). A behavioral analysis of degree of reinforcement and ease of shifting to new responses in a Weigl-type card-sorting problem. *Journal of Experimental Psychology, 38,* 404-411.

Greve, K. W., Stickle, T. R., Love, J. M., Bianchini, K. J., & Stanford, M. S. (2005). Latent structure of the Wisconsin card sorting test: A confirmatory factor analytic study. *Archives of Clinical Neuropsychology, 20*, 355-364.

Harris, K. R., Reid, R., & Graham, S. (2004). Self-regulation among students with LD and ADHD. In B. Wong (Ed.), *Learning about learning disabilities* (3rd ed., pp. 167-195). Orlando, FL: Academic Press.

Heaton, R. K., Chelune, G. J., Talley, J. L., Kay, G. G., & Curtiss, G. (1993). *Wisconsin card sorting test manual: Revised and expanded*. Odessa, FL: Psychological Assessment Resources.

Henderson, M. D., Gollwitzer, P. M., & Oettingen, G. (2007). Implementation intentions and disengagement from a failing course of action. *Journal of Behavioral Decision Making, 20,* 81-102.

Hinshaw, S. P., Henker, B., & Whalen, C. K. (1984). Self-control in hyperactive boys in anger-inducing situations: Effects of cognitive-behavioral training and of methylphenidate. *Journal of Abnormal Child Psychology, 12*, 55-77.

Hinshaw, S. P., Klein, R., & Abikoff, H. (2007). Childhood attention-deficit hyperactivity disorder: Nonpharmacological treatments and their combination with medication. In P. E. Nathan & J. Gorman (Eds.), *A guide to treatments that work* (3rd ed., pp. 3-27). New York: Oxford University Press.

Janhsen, K., & Glaeske, G. (2003). Arzneimittel-Versorgung von Kindern mit hyperkinetischen Störungen [Prescriptions for children with ADHD]. Bremen: zph-info.

Karatekin, C. (2004). A test of the integrity of the components of Baddeley's model of working memory in ADHD. *Journal of Child Psychology and Psychiatry, 45,* 912-926.

Klingberg, T., Fernell, E., Olesen, P. J., Johnson, M., Gustafsson, P., Dahlstroem, K. et al. (2005). Computerized training of working memory in children with

ADHD: A randomized, controlled trial. *Journal of the American Academy of Child and Adolescent Psychiatry*, *44*, 177-186.

Lampert, T., & Kroll, L. E. (2006). Messung des soziooekonomischen Status in sozial- epidemiologischen Studien. In Richter, M. (Ed.) *Gesundheitliche Ungleichheit: Grundlagen, Probleme, Perspektiven.* Wiesbaden: Verlag fuer Sozialwissenschaften.

Lijffijt, M., Kenemans, J., Verbaten, M. N., & van Engeland, H. (2005). A meta-analytic review of stopping performance in ADHD: Deficient inhibitory motor control? *Journal of Abnormal Psychology, 114,* 216-222.

Logan, G. D., & Cowan, W. B. (1984). On the ability to inhibit thought and action: A theory of an act of control. *Psychological Review*, *91*, 295-327.

Martinussen, R., Hayden, J., Hogg-Johnson, S., & Tannock, R. (2005). A meta-analysis of working memory impairments in children with ADHD. *Journal of the American Academy of Child and Adolescent Psychiatry, 44*, 377-384.

Martinussen, R., & Tannock, R. (2006). Working memory impairments in children with ADHD with and without comorbid language learning disorders. *Journal of Clinical and Experimental Neuropsychology, 28,* 1073-1094.

Miles, J. D., & Proctor, R. W. (2008). Improving performance through implementation intentions: Are preexisting response biases replaced? *Psychonomic Bulletin & Review, 15,* 1105-1110.

Miyake, A., Friedman, N., Emerson, M. J., Witzki, A. H., & Howerter, A. (2000). The unity and diversity of executive functions and their contributions to complex "frontal lobe" tasks: A latent variable analysis. *Cognitive Psychology, 41,* 49-100.

Monsell, S. (1996). Control of mental processes. In V. Bruce (Ed.*), Unsolved mysteries of the mind: Tutorial essays in cognition* (pp. 93-148). Oxford, England: Erlbaum (UK) Taylor & Francis.

Morris, N., & Jones, D. M. (1990). Memory updating in working memory: The role of the central executive. *British Journal of Psychology, 81,* 111-121.

Nelson, H. E. (1976). A modified card sorting test sensitive to frontal lobe defects. *Cortex, 12*, 313-324.

Oberauer, K., Schulze, R., Wilhelm, O., & Suess, H.-M. (2005). Working memory and intelligence—their correlation and their relation: Comment on Ackerman, Beier, and Boyle (2005). *Psychological Bulletin, 131,* 61-65.

Oettingen, G., & Gollwitzer, P. M. (2010). Strategies of setting and implementing goals: Mental contrasting and implementation intentions. In J. E. Maddux & J. P. Tangney (Eds.), *Social psychological foundations of clinical psychology*. New York: Guilford.

Paul, I., Gawrilow, C., Zech, F., Gollwitzer, P. M., Rockstroh, B., Odenthal, G., Kratzer, W., & Wienbruch, C. (2007). If-then planning modulates the P300 in children with ADHD. *NeuroReport*, *18,* 653-657.

Parks-Stamm, E., Gollwitzer, P. M., & Oettingen, G. (2007). Action control by implementation intentions: Effective cue detection and efficient response initiation. *Social Cognition, 25*, 248-266.

Parks-Stamm, E. J., Gollwitzer, P. M., & Oettingen, G. (2010). Implementation intentions and test anxiety: Shielding academic performance from distraction. *Learning and Individual Differences, 20*, 30-33.

Patterson, C. J., & Mischel, W. (1976). Effects of temptation-inhibiting and task-facilitating plans on self-control. *Journal of Personality and Social Psychology, 33*, 209-217.

Reid, R., Trout, A. L., & Schartz, M. (2005). Self-regulation interventions for children with ADHD. *Exceptional Children*, *71*, 361-378.

Renner, G. (2002). Kritische Werte und Konfidenzintervalle zur Interpretation von HAWIK-III IQ-Skalen, Index-Werten und Subtests. *Zeitschrift fuer Differentielle und Diagnostische Psychologie 23*, 353-358.

Romine, C. B., Lee, D., Wolfe, M. E., Homack, S., George, C., Riccio, & Cynthia A. (2004). Wisconsin card sorting test with children: A meta-analytic study of sensitivity and specificity. *Archives of Clinical Neuropsychology, 19,* 1027-1041.

Sattler, J. M. (1992). *Assessment of children: Revised and updated* (3rd ed.). San Diego: Jerome M. Sattler.

Stadler, G., Oettingen, G., & Gollwitzer, P. M. (2009). Physical activity in women. Effects of a self-regulation intervention. *American Journal of Preventive Medicine, 36*, 29-34.

Stadler, G., Oettingen, G., & Gollwitzer, P. M. (2010). Intervention effects of information and self-regulation on eating fruits and vegetables over two years. *Health Psychology, 29,* 274-283.

Steinhausen, H. C. (1993). *Psychische Stoerungen bei Kindern und Jugendlichen*. Muenchen: Urban & Schwarzenberg.

Tannock, R., & Schachar, R. (1991). Methylphenidate and cognitive perseverative in hyperactive children. *Journal of Child Psychology and Psychiatry, 33,* 1217-1228.

Tewes, U., Rossmann, P., & Schallberger, U. (1999). *HAWIK-III: Manual*. Bern: Huber.

Warner, A., Katzenberg, J., Williams, J. H. (Producers), & Adamson, A., Jenson, V. (Directors) (2001). *Shrek* [Motion picture]. United States: Turner.

Webb, T. L., & Sheeran, P. (2004). Identifying good opportunities to act: Implementations and cue discrimination. *European Journal of Social Psychology, 34*, 407-419.

Webb, T. L., & Sheeran, P. (2006). Does changing behavioral intentions engender change? A meta-analysis of the experimental evidence. *Psychological Bulletin, 132*, 249-268.

Webb, T. L., & Sheeran, P. (2008). Mechanisms of implementation intention effects: The role of goal intentions, self-efficacy, and accessibility of plan components. *The British Journal of Social Psychology, 47*, 373-395.

Willcutt, E. G., Doyle, A. E., Nigg, J. T., Faraone, S. V., & Pennington, B. F. (2005). Validity of the executive function theory of ADHD: A meta-analytic review. *Biological Psychiatry, 57,* 1336-1346.

World Health Organization (1991). *Internationale Klassifikation psychischer Stoerungen – ICD-10.* Bern: Huber.

Zuvekas, S. H., Vitiello, B., & Norquist, G. S. (2006). Recent trends in stimulant medication use among U.S. children. *American Journal of Psychiatry, 163*, 579-585.