

**Psychological Compensation in Attention Deficit Hyperactivity Disorder – Application
of a Theoretical Framework**

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2. Zusammenfassung

Der Begriff Kompensation wird im Alltag, in der psychologischen Forschung und auch im Bereich der Aufmerksamkeitsdefizit-/Hyperaktivitätsstörung (ADHS) viel genutzt. Allerdings haben bisher wenige Studien Kompensation bei ADHS systematisch und theoriegeleitet untersucht. Auf Kompensation kann geschlossen werden, wenn ein Defizit (eine Diskrepanz zwischen vorhandener Fähigkeit und Anforderungen aus der Umwelt) durch mehr Anstrengung, die Nutzung latenter Fähigkeiten oder den Erwerb neuer Fähigkeiten ausgeglichen wird. Basierend auf der Anwendung eines theoretischen Rahmens (Bäckman & Dixon, 1992) auf ADHS habe ich in dieser Dissertation folgende Ziele: (1) Die Bewusstheit der eigenen Defizite bei Menschen mit ADHS zu überprüfen und (2) Kompensation in einer Gruppe mit ADHS, welche hohe Leistungen zeigt, zu untersuchen.

Die Ergebnisse der ersten Studie zeigten, dass Kinder mit ADHS sich im Vergleich zu Kindern mit ähnlich niedriger Schulleistung nicht überschätzten. In der zweiten Studie berichteten Studierenden mit ADHS höhere Leistungsmotivation im Vergleich zu Studierenden ohne ADHS. Außerdem deuteten die Ergebnisse an, dass Frauen mit ADHS kompensieren, indem sie kompensatorische Anstrengung und zwanghaftes Verhalten zeigen. Die dritte Studie zeigte, dass Studentinnen mit ADHS mögliche Defizite in einer Flankeraufgabe durch besondere Vorsicht kompensieren, die ebenfalls zwanghaftes Verhalten widerspiegeln könnte.

Die Studien werden im Kontext des theoretischen Rahmens diskutiert. Sie tragen zum Verständnis von Kompensation bei ADHS bei durch (1) die Überprüfung der Bewusstheit der eigenen Defizite bei Menschen mit ADHS, indem eine Gruppe ohne ADHS und mit schlechter Leistung berücksichtigt wird und (2) durch die Hinweise, dass besonders vorsichtiges Verhalten kompensatorisch wirkt und dazu führt, dass Frauen mit ADHS studieren können, erst später diagnostiziert werden und gute Leistungen in kognitiven Aufgaben, zum Beispiel der Flankeraufgabe, zeigen.

Einschränkungen sind, dass ich nicht alle Komponenten des theoretischen Rahmens in einer Studie getestet habe und dass wir keine Erwachsenen, die nicht studieren in die zweite und dritte Studie aufgenommen haben. Dies wäre nötig um zu testen ob Leistungsmotivation oder vorsichtiges Verhalten erklärt weshalb einige Erwachsene studieren und gute Leistungen in kognitiven Aufgaben erbringen und andere nicht.

3. Abstract

The term compensation is widely used in every-day language, in psychological research, and also discussed in the context of Attention Deficit Hyperactivity Disorder (ADHD). However, few studies have looked at psychological compensation in ADHD systematically and theory based. Compensation can be inferred if a deficit (i.e., a mismatch between skill and environmental demand) is counterbalanced by the investment of more effort, the utilization of latent or the acquisition of new skills. Based on the application of a theoretical framework (Bäckman & Dixon, 1992) to ADHD, I developed the following aims: (1) To reassess the awareness of deficits in ADHD and (2) to explore psychological compensation in a group with ADHD that accomplishes high achievement.

The results of Study 1 showed that children with ADHD did not overestimate their own skills compared to a group matched for academic achievement. In Study 2, college students with ADHD reported higher achievement motivation compared to college students without ADHD. Furthermore, results indicated that women with ADHD compensate by adopting compensatory effort and obsessive-compulsive behavior. Study 3 showed that female college students compensate for possible deficits in solving a flanker task by being overly cautious, which may reflect more obsessive-compulsive behavior.

The studies are discussed within the framework of psychological compensation. They add to the understanding of compensation in ADHD by (1) the reassessment of awareness of deficits in ADHD by including a group without ADHD but with low achievement, and by (2) suggesting that overly cautious behavior could be a form of psychological compensation in females with ADHD enabling them to enter college, leading to a late diagnosis and to good performance in cognitive tasks (i.e., flanker task).

Limitations are, that I did not test all components of the theoretical framework in one study and that I did not include adults with ADHD that did not enter college in Study 2 and 3 to test if achievement motivation or overly cautious behavior explains why some adults with ADHD

gain admittance to higher education and show good performance in cognitive tasks and others do not.

4. Introduction

There are several reports of compensatory behavior in Attention Deficit Hyperactivity Disorder (ADHD), assuming that psychological compensation might hide symptoms of ADHD or underlying deficits in executive functioning: “Girls [with ADHD] . . . work harder to compensate for or hide their symptoms in their effort to meet parent and/or teacher expectations” (Quinn, 2005, p. 580). “Symptoms of overt hyperactivity may be diminished [in adults with ADHD], for many patients have developed compensatory strategies” (Prince & Wilens, 2002, p. 167). “Smaller effect sizes . . . might be expected in adults [with ADHD] if they have partially compensated for their executive problems” (Nigg et al., 2005, p. 707). However, few of these reports are systematically or theory based.

4.1. ADHD

The symptoms of ADHD are inattention, hyperactivity and impulsivity. The symptoms have to be present before the age of 12 years and have to cause impairment in multiple settings like academic, occupational or social functioning to legitimate an ADHD diagnosis (International Classification of Diseases, 10th edition; World Health Organization, 2009; Diagnostic and Statistical Manual of Mental Disorders, 5th edition; American Psychiatric Association, 2013). The worldwide prevalence of ADHD is 5% in childhood (Huss, Hölling, Kurth, & Schlack, 2008; Polanczyk, De Lima, Horta, Biederman, & Rohde, 2007) and 2.5-5% in adulthood (de Zwaan et al., 2012; Simon, Czobor, Bálint, Mészáros, & Bitter, 2009). Childhood symptoms of ADHD persist into adulthood in 40-60% of cases (Davidson, 2008), but the manifestation changes. While inattention in children, for instance, is expressed in the difficulty to sustain attention in tasks or play activities, it changes into difficulties to stay focused during lectures, conversation or lengthy readings in adults. Whereas hyperactivity manifests as running and climbing in inappropriate situations in children, it is often limited to a feeling of restlessness in adults. Impulsivity is displayed in

children by interfering into others conversation, games or activities, whereas adults may intrude or take over what others are doing (American Psychiatric Association, 2013).

There has been a long and ongoing search for the core deficit causing the symptoms of ADHD that could be used as a diagnostic marker. However, the group of individuals with ADHD is extremely heterogeneous and the search for genetic polymorphisms (B. Franke, Neale, & Faraone, 2009), neurobiological (Hart, Radua, Nakao, Mataix-Cols, & Rubia, 2013), or psychological endophenotypes (Willcutt, Doyle, Nigg, Faraone, & Pennington, 2005) specifically associated with ADHD has been unsuccessful. One explanation for why it has been impossible to find the core deficit underlying ADHD is psychological compensation. A common deficit in neurobiological or psychological processes might be hidden by compensation, because the performance in tasks does not differ between individuals with ADHD. However, whereas participants without ADHD show activation in one area of the brain or rely on a psychological process like inhibition, participants with ADHD show activation in a compensatory area or rely on a compensatory process (Fassbender & Schweitzer, 2006; Nigg et al., 2005).

4.2. Theoretical Framework of Psychological Compensation

The term compensation is widely used in every-day language but also in psychological research. However, it is rarely the topic of conceptual and integrative analysis and often not supported by a theoretical background. To bridge this gap Bäckman and Dixon (1992) developed a theoretical framework to study psychological compensation. The theoretical framework is presented in Figure 1 and will be used later to analyze findings of compensation in ADHD. Bäckman and Dixon (1992) stated that there are three prerequisites of compensation. The first prerequisite is that there has to be a deficit or mismatch between the skill level and the environmental demand. The mismatch between skill level and the environmental demand and deficit are interchangeable within the framework. The mismatch could be caused by an intraindividual decline in skill level (e.g., cognitive skills when ageing)

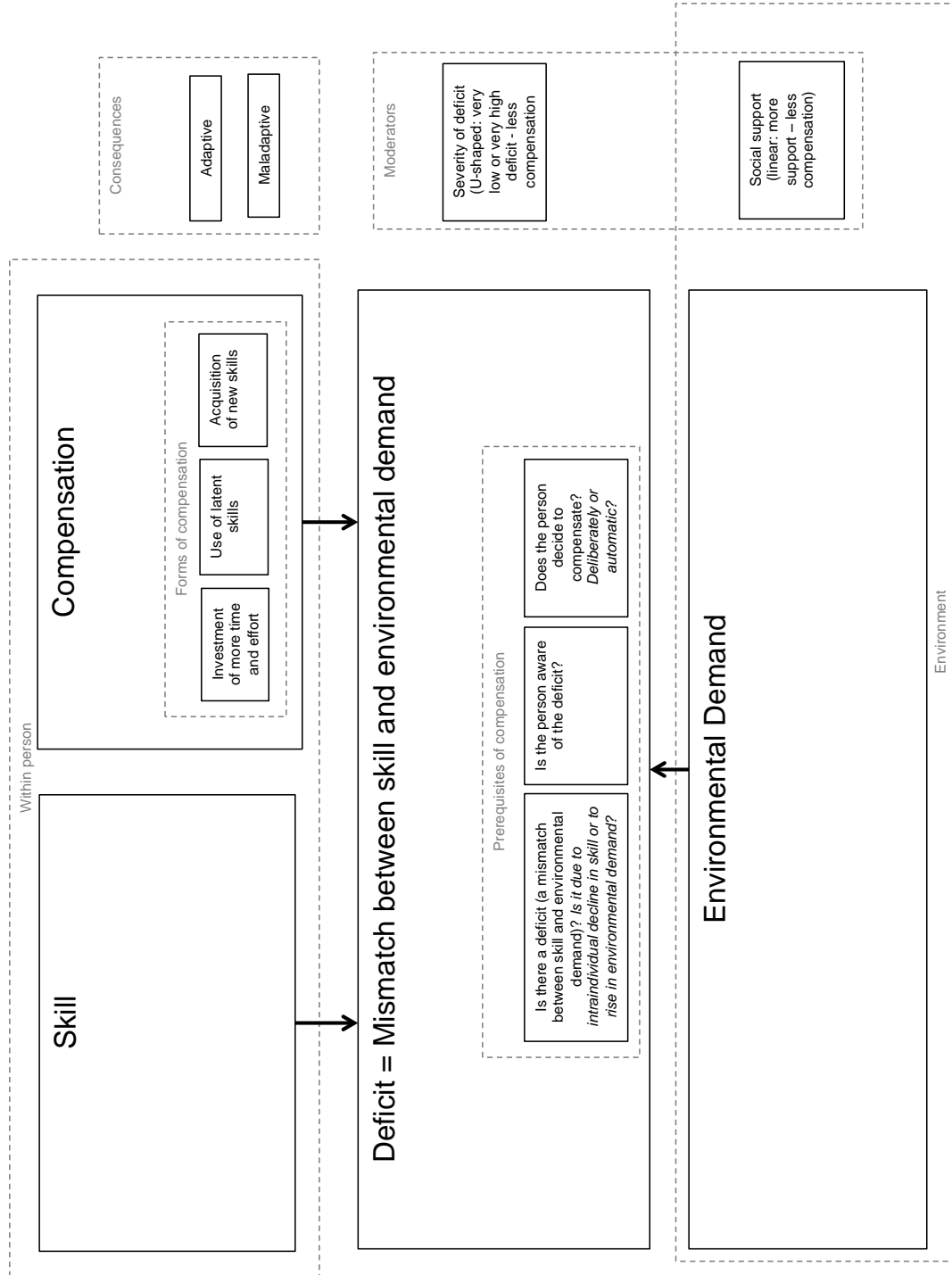


Figure 1. The theoretical framework of psychological compensation.

or by a raise of environmental demand (e.g., a child entering school). The second prerequisite is that the person is aware of the mismatch. The third prerequisite of psychological compensation is that the person decides to compensate. If the three prerequisites of compensation are fulfilled, the mismatch between skill and environmental demand is counterbalanced by either the investment of more time or effort (drawing on normal skills), or the utilization of latent (but normally inactive) skills, or the acquisition of new skills.

Psychological compensation can be adaptive or maladaptive. This does not refer to whether the compensation leads to the reduction of the mismatch between skill and environmental demand but to other consequences the compensatory behavior might have (e.g., investment of more time and effort to study in children with learning disabilities leads to fewer friendships).

Bäckman and Dixon (1992) discussed two dimensions that modify the probability that compensatory behavior will occur. Compensatory behavior decreases as a function of increasing contextual support. Bäckman and Dixon (1992) stated that this is a moderator. It is important that psychological compensation as implemented in their framework only applies to within-person processes. Nevertheless, contextual support does not have to be a moderator, it could also be a part of the environmental demand. If the contextual support increases, the environmental demand decreases. The other moderator, severity of the deficit, is related to the magnitude of the mismatch between skill and environmental demand. The relationship between the severity of the deficit and the probability of compensation can be expressed as an inverted U-shaped function. A small deficit may not produce an awareness that a compensatory behavior might help. But, a pronounced deficit may be associated with a lack of resources to produce a compensatory behavior.

Bäckman and Dixon (1992) used the terms compensatory behavior, effort, process, strategy and mechanism. One could also differentiate psychological compensation by behavior, cognition and emotion as typical differentiation in psychology (Dolan, 2002). It is also important to try to distinguish psychological compensation from other terms, although

definitions often overlap. Two concepts that are similar to psychological compensation are cognitive control and adaptive behavior. Cognitive control is defined as the ability of the human cognitive system to configure itself for the performance of specific tasks (Botvinick, Braver, Barch, Carter, & Cohen, 2001). Adaptive behavior means optimally fitting the internal state to the environmental demand (Bäckman & Dixon, 1992). Therefore, psychological compensation is a special case of cognitive control and adaptive behavior implying a deficit or deviation from normality (Bäckman & Dixon, 1992). The term coping refers to the constantly changing efforts to manage daily hassles and stressful events (Lazarus & DeLongis, 1983) and not to a reaction to a specific deficit. Furthermore, coping refers to adaptive strategies whereas compensation can be adaptive or maladaptive.

4.3. Psychological Compensation in ADHD

I will apply the theoretical framework (Figure 1) to ADHD by exploring if the prerequisites of psychological compensation are fulfilled in ADHD, trying to find examples of the different forms of compensation in ADHD and discussing consequences and moderators.

First prerequisite: deficit. The first prerequisite of psychological compensation is the existence of a deficit, which represents a mismatch between skill level and environmental demands. The ADHD symptoms describe the inability to meet environmental demands like schoolwork or sitting still due to a lack in the skills attention, motor or inhibitory control (e.g., “Often fails to pay close attention . . . to details in schoolwork”, “Often leaves seat in situations when remaining seated is expected”; American Psychiatric Association, 2013). A clinical diagnosis as opposed to only symptoms of ADHD takes this even further. To receive a diagnosis of ADHD, the person does not only have to show ADHD symptoms but these have to reduce social, academic, or occupational functioning. Therefore, a clinical diagnosis of ADHD represents a mismatch with environmental demands of social interactions, academic, or occupational achievement. Hence, a deficit is implicit in individuals with ADHD

symptoms or ADHD diagnoses. Bäckman and Dixon (1992) distinguished between a deficit that is caused by intraindividual decline in skill and a deficit that is caused by a rise of environmental demand. Since ADHD is a neurodevelopmental disorder with an onset in early development (American Psychiatric Association, 2013; World Health Organization, 2009) the deficit is usually conceptualized as congenital and not as an intraindividual decline in the skills of attention, motor or inhibitory control. Therefore, deficits in ADHD have to be seen in the context of changing environmental demands. This fits with the hot public debate arguing that the rise in the prevalence of ADHD is due to changing demands by society such as sitting still for longer durations and fewer outside activities (Bacher, 2010). Furthermore, theoretical assumptions predicted (Sergeant, 2005; Söderlund, Sikström, Loftesnes, & Sonuga-Barke, 2010) and experimental findings showed (Sonuga-Barke, 2002) that deficits in children with ADHD as compared to children without ADHD are only apparent under certain conditions but disappear in other experimental conditions. A mismatch between the skills of attention, motor or inhibitory control and environmental demand is usually observed when the environmental expectations rise with the development of children (e.g., expectation to sit still at the age of six years, when entering school) or when entering a new phase of life (e.g., start of college, start of occupation, or having children).

A deficit in individuals with ADHD has been conceptualized at many different levels (Sonuga-Barke, 2003): At a neurobiological level (e.g., reduced activation in executive or reward circuits), at the level of cognitive processes (e.g., deficits in inhibition and delay aversion), at the level of symptoms (i.e., less attention, less impulse and motor control), and at the level of outcome (i.e., less academic or occupational achievement). This is important because psychological compensation will be found at the same level at which the deficit is conceptualized and can cause heterogeneity and hide deficits at the next level. For example a study using functional magnetic resonance imaging found that dysfunction of premotor systems (rostral supplementary motor area) during a go/no-go task was compensated for by

greater prefrontal activation in children with ADHD (Suskauer et al., 2008). Children with ADHD did not perform worse in the go/no-go task, therefore compensatory activation was hiding the deficit in executive function. Another example is that women invest more effort and time to compensate for their ADHD symptoms (Quinn, 2005). They show good academic achievement and therefore do not receive a diagnosis of ADHD.

Second prerequisite: awareness. The second prerequisite of psychological compensation is that the person is aware of the mismatch between skill level and environmental demand. After extensively studying the self-concept of children with ADHD, Hoza and colleagues (Hoza, Pelham, Dobbs, Owens, & Pillow, 2002; Hoza et al., 2004; Hoza, Johnston, Pillow, & Ascough, 2006; Hoza, Murray-Close, Arnold, Hinshaw, & Hechtman, 2010; Owens, Goldfine, Evangelista, Hoza, & Kaiser, 2007; Owens & Hoza, 2003) drew the conclusion that children with ADHD have a positive illusory bias and tend to overestimate their own skills. It can be hypothesized that children with ADHD inflate the estimate of their own skills to protect their self-esteem and therefore tend to overestimate most grossly in the domain of their greatest deficit (Evangelista, Owens, Golden, & Pelham, 2008). However, although a positive illusory bias might protect the self esteem of children, it has a detrimental effect on performance (Owens et al., 2007) and on the development of aggressive behavior (Hoza et al., 2010). An initial study in college students also found a positive illusory bias in students with ADHD but did not evaluate the effects on achievement (Prevatt et al., 2012). In summary, children and adults with ADHD seem to overestimate their own skills and therefore might not be aware of a mismatch between skill level and environmental demand.

Third prerequisite: decision. The third prerequisite of psychological compensation is that the person decides to compensate. There are very few studies that ask participants with ADHD if they compensate. When adults with ADHD were asked how they deal with stressful situations they reported to be more confrontative, escape-avoidant and use less strategic problem-solving but they reappraised stressful situations positively (Young, 2005). College

students with ADHD described using strategies such as working harder and longer than other students, using some type of social support, specific study, time management, and organizational skills, exercise, spirituality/religion, maintenance of a positive attitude, self-awareness, and therapy (Kaminski, Turnock, Rosén, & Laster, 2006). Hence, there are some reports of deliberate compensation in ADHD. However, in studies investigating psychological compensation at the level of neurobiology or cognitive processes it seems unlikely that participants are aware of the deficit and deliberately decide to compensate. A study found compensatory activation in parietal cortex, precuneus, and occipital lobe during a working memory task and interpreted this as increased use of visual strategies. This interpretation was supported by the reports of the participants (Schweitzer et al., 2000). Therefore, the awareness of deficits and the decision to compensate is only possible at the level of behavior. Bäckman and Dixon (1992) also attenuate the importance of their second (i.e., awareness of the deficit) and third (i.e., decision to compensate) prerequisite by discussing that in cases in which the deficit is congenital the compensation is often automatic and not deliberate. They named examples like autism, schizophrenia and learning disorders (Bäckman & Dixon, 1992) which like ADHD are neurodevelopmental disorders. Consequently, prerequisite two (i.e., awareness of the deficit) and three (i.e., decision to compensate) are only met when looking at deficits in behavior but not when looking at neurobiological or cognitive deficits in ADHD.

Forms of psychological compensation. Bäckman and Dixon (1992) distinguished between three different forms of psychological compensation: The investment of more time or effort (drawing on normal skills), the utilization of latent (but normally inactive) skills and the acquisition of new skills. There are examples for all three forms of psychological compensation in ADHD. For instance, adults with ADHD showed more activation in the parietal cortex during a go/no-go task compared to healthy adults but no differences in performance suggesting that they invested more effort (Dillo et al., 2010). College students reported to work harder and longer than other students (Kaminski et al., 2006). There are also

examples for the second form of psychological compensation in ADHD, the utilization of latent skill. Studies suggest that children and adults with ADHD use visual, spatial, and motor processing in an auditory working memory task to counteract a deficit in the use of verbal processing. This was indicated by activation in regions associated with visual processes (e.g., parietal, precuneus, and occipital lobe) instead of the right prefrontal regions that were activated in controls (Schweitzer et al., 2000; Schweitzer et al., 2004). Impairments in psychological processes like inhibition might be compensated for by good skills in other cognitive domains like working memory (Berlin, Bohlin, Nyberg, & Janols, 2004) or intelligence (Brown, 1998). Achievement motivation had a higher impact on performance in children with ADHD compared to children without ADHD and may lead to equal performance (Gut, Heckmann, Meyer, Schmid, & Grob, 2011). The third form of psychological compensation, the acquisition of new skills, is difficult to distinguish from therapeutic interventions. Compensatory strategies such as making lists, writing down reminders, using day planners to record assignments and activities are an important part of the therapy of ADHD (Nadeau, 2002).

Consequences. Bäckman and Dixon (1992) noted that psychological compensation can be adaptive or maladaptive. This does not refer to whether compensation leads to the reduction of the mismatch between skill and environmental demand but to other consequences the compensatory behavior might have. This is difficult to investigate because psychological compensation can have an impact onto many other domains, and consequences in all of these have to be taken into account. However, distinguishing adaptive and maladaptive consequences of compensation is of vital importance. Psychological compensation can prevent diagnosis of ADHD because it allows individuals to meet environmental demands although they have low attention, motor, and impulse control. If psychological compensation is adaptive and does not have negative consequences, this is highly desirable and it would be unnecessary to diagnose or treat the individual. However, if psychological compensation is

maladaptive it can lead to an accumulation of other problems in addition to ADHD without decreasing inattention, hyperactivity and impulsivity. In this case psychological compensation prevents diagnosis, and thereby therapy and the chance to learn about adaptive compensation. For example some assume that adults with ADHD counteract short sleep duration (Semeijn et al., 2013) or deal with the frustration associated with attentional and organizational difficulties (Schweickert, Strober, & Moskowitz, 1997) by increasing food intake. If they do not get diagnosed with ADHD and learn better strategies to deal with attentional and organizational difficulties, this leads to obesity. Therefore, if psychological compensation hides ADHD and has maladaptive consequences, this underdiagnosis will lead to an accumulation of problems in addition to those already caused by the ADHD symptoms. First studies show that adults with ADHD use more maladaptive (i.e., confronting, escape-avoiding and less strategic problem-solving) than adaptive strategies (i.e., positive reappraisal; Young, 2005) to deal with stressful situations.

Moderators. If all three prerequisites of psychological compensation are fulfilled, there are two dimensions that modify the probability that compensatory behavior will occur: contextual support and severity of the deficit. Compensatory behavior decreases as a function of increasing contextual support. There are reports that parents of children with ADHD compensate to buffer the effect of ADHD on academic achievement (Fletcher & Wolfe, 2008). Furthermore, college students with ADHD report that they use social support to compensate for their deficits (Kaminski et al., 2006). Therefore, contextual support seems to be an important variable to be taken into account when investigating psychological compensation in ADHD. The second moderator, severity of the deficit, is related to the probability of compensation in an inverted U-shaped function. A small deficit may not produce an awareness that a compensatory behavior might help. But, a pronounced deficit may be associated with a lack of resources to produce a compensatory behavior. Therefore, to

study psychological compensation, ADHD symptoms should be assessed dimensionally and not only categorically as ADHD diagnoses.

4.4. Implications for Empirical Studies

Based on the application of the theoretical framework of psychological compensation on ADHD I discovered two shortcomings: (1) It is unclear whether the positive illusory bias (i.e., the unawareness of a mismatch between skill and environmental demand) is specific to ADHD or to low performance because these two have been confounded in studies until now, (2) Studies of psychological compensation have frequently included only individuals with ADHD that are not able to meet environmental demands. However, based on the assumptions by the theoretical framework, compensation is not present in this group. The assumptions underlying these two limitations of previous studies are displayed in Table 1.

Table 1.

Assumptions underlying the limitations of previous studies.

		Skill	
		ADHD (low skill in attention, motor and impulse control)	No ADHD (high skill in attention, motor and impulse control)
Degree to which environmental demands are met	Environmental demands not met (low achievement)	<p>1. Typical ADHD sample</p> <ul style="list-style-type: none"> - Should show positive illusory bias if it is specific for ADHD or low achievement -No psychological compensation 	<p>2. Low achievers without ADHD</p> <ul style="list-style-type: none"> -Should show positive illusory bias if it is specific for low achievement -No psychological compensation
	Environmental demands met (high achievement)	<p>3. High achievers with ADHD</p> <ul style="list-style-type: none"> -Should show positive illusory bias if it is specific for ADHD -Psychological compensation 	<p>4. Typical control sample</p> <ul style="list-style-type: none"> -No need for psychological compensation

ADHD and low achievement are often confounded. The typical ADHD sample displays low skills in attention, motor and impulse control and low achievement (Group 1 in Table 1, upper left). The typical control sample has high skills in attention, motor and impulse control and high achievement (Group 4 in Table 1, lower right). Hoza and colleagues assume that the positive illusory bias is specific for ADHD. They predict that it can be found in all children with ADHD independent of their achievement (Group 1 and 3, Table 1, left column). An alternative explanation is that the positive illusory bias is actually specific for low achievers and can be found in children with ADHD and low achievement (Group 1, Table 1) and children without ADHD and low achievement (Group 2, Table 1, upper right) but not in children with ADHD and high achievement (Group 3, Table 1, lower left). To find out whether the positive illusory bias is specific for ADHD or for low achievers it is important to include a group of children without ADHD but with low performance (Group 2, Table 1).

The second observation from the application of the theoretical framework on ADHD is that studies of psychological compensation in ADHD usually included only individuals with ADHD that are not able to meet environmental demands (Group 1, Table 1). However, compensation should counteract the mismatch between skill and environmental demand and therefore allow the individuals to meet environmental demands. Therefore, psychological compensation can only be found in individuals with low skills that are able to meet the environmental demand (Group 3, Table 1).

Based on the application of the theoretical framework of psychological compensation on ADHD, I had the following aims: first, to find out whether a positive illusory bias (i.e., the unawareness of the own deficit) is specific to ADHD or to low achievers (Study 1) and second, to explore psychological compensation in a group of individuals with ADHD in which compensation is likely because despite ADHD they are able to meet environmental demands (Study 2 and 3).

5. Empirical Studies

5.1. Study 1

Research question. Is a positive illusory bias (i.e., the unawareness of the own deficit) specific to ADHD or to low achievers?

Design. First, we compared children with ADHD symptoms to children without ADHD symptoms. Afterwards, we compared children with ADHD symptoms to children without ADHD symptoms and low academic achievement. The depended variables were difference scores between the self-concept of the children and academic achievement (i.e., teacher ratings and achievement tests) in reading, writing, and math.

Participants. The sample was drawn from a larger sample of 1675 children in the second grade participating in the project “ready for school” [Schulreifes Kind]. First, children with ADHD symptoms as according to teacher ratings ($n = 262$) were compared to children without ADHD symptoms ($n = 981$). Afterwards, children with ADHD symptoms ($n = 225$) were compared a group of children without ADHD symptoms matched for academic achievement ($n = 176$).

Results. Children with ADHD symptoms as according to teacher ratings overestimated their achievement more than children without ADHD symptoms. However, when children with ADHD symptoms were compared to a control group matched for academic achievement, no group differences were found.

5.2. Study 2

Research question. Does a subpopulation in which we assume to find psychological compensation – college students with ADHD – report compensatory behavior?

Design. The study followed a 2-between (Group: ADHD vs. no ADHD) \times 2-between (Gender: Female vs. Male) design. The dependent variables were psychological functioning, health related quality of life, dietary habits, and achievement motivation assessed with online questionnaires.

Participants. Seventy-seven college students with self-reported ADHD (49 women; M -age = 25.82, SD = 4.62) and 120 college students without ADHD (65 women; M -age = 25.17, SD = 5.41) participated in an online questionnaire survey.

Results. Students with ADHD showed impairment in health and dietary habits, with women with ADHD reporting even worse health compared to men with ADHD. The effects of gender on obsessive-compulsive behavior and compensatory effort were mediated by the timing of the diagnosis. Achievement motivation differed between students with and without ADHD. The ADHD group indicated less persistence, fearlessness, internality and self-control, but higher levels of dominance, flow, eagerness to learn, status orientation, competitiveness and goal setting.

Additional analyses. We used the grade from the last graduation (school or college degree) as an estimator for academic achievement. Men (ADHD: M = 2.53, SD = 0.71; Control: M = 2.24, SD = 0.62) received lower grades than women (ADHD: M = 2.41, SD = 0.67; Control: M = 2.24, SD = 0.64), $F(176) = 4.45, p < .05$. However, students with ADHD did not have lower grades than students without ADHD, $F(176) = 0.57, ns$. Some items from the Achievement Motivation Inventory could indicate how college students perceive their own achievement. The ratings of the item “I am convinced that I will achieve a lot in my occupation” showed that men with ADHD had higher convictions of their own achievement compared to controls (men with ADHD: M = 5.74, SD = 1.29; men without ADHD: M = 4.76, SD = 1.80; women without ADHD: M = 4.60, SD = 1.67). Women with ADHD showed the lowest ratings (women with ADHD: M = 4.04, SD = 1.91) and this pattern was supported by a significant interaction of Group and Gender, $F(193) = 8.91, p < .05$. Similar pattern of higher ratings by men with ADHD as compared to students without ADHD and women with ADHD were displayed in the items: “If I set myself a goal, I usually do better than other people”, “If decisions have to be made in a group, I usually contribute an essential part”, “I have never

had difficulties to understand complex logical relations". However, the other comparisons were not significant.

5.3. Study 3

Research question. Does a subpopulation in which we assume to find psychological compensation – female college students with ADHD – show compensatory behavior in a flanker task?

Design. The study followed a 2-between (Group: ADHD vs. no ADHD) \times 2-within (Flanker Conflict: incongruent vs. congruent) \times 2-within (Conflict Frequency: 20% vs. 80%) design. Dependent variables were reaction time, error rates and measures drawn from diffusion model analysis (i.e., nondecision time, boundary separation and drift rate) in a flanker task.

Participants. Fifteen female college students with ADHD (M -age = 30.20, SD = 5.93) and 24 without ADHD (M -age = 22.58, SD = 2.53) performed in a flanker task.

Results. Compared to a control group, the ADHD group displayed prolonged response times accompanied by fewer errors in a flanker task and a more focused attention. Results from diffusion model analyses revealed that members of the ADHD group showed deficits in nondecisional processes (i.e., higher nondecision time) and adaptation of information uptake (i.e., drift rate) to task demands. Furthermore, they leaned more towards accuracy than participants without ADHD (i.e., setting higher boundaries).

Additional analyses. After completing the flanker task, participants were asked how they perceived the task. Females with ADHD thought that the task was less fun, $t(36) = 2.37$, $p < .05$, and reported to be less motivated to solve the task as fast and accurately as possible, $t(36) = 2.18$, $p < .05$. Information about speed and accuracy was intermixed in one question leaving us no opportunity to find out whether females with ADHD thought it was more important to respond accurately. There were no group differences in the estimation of how

effort-demanding or difficult the task was and how important it was to perform well. None of the questions were related to any of the dependent variables from the flanker task

6. Discussion

For the discussion I will try to place our studies within the framework of psychological compensation (Bäckman & Dixon, 1992) to indicate at which points they can add to the understanding of psychological compensation in ADHD but also to reveal limitations of our current designs and draw conclusions for future studies. Figure 2 displays the presentation of our studies within the theoretical framework of psychological compensation. Our aims were: (1) to find out whether a positive illusory bias (i.e., the unawareness of the own deficit) is specific to ADHD or to low achievers (Study 1) and (2), to explore psychological compensation in a group of individuals with ADHD in which compensation is likely because despite ADHD they are able to meet environmental demands (Study 2 and 3).

6.1. Study 1

In Study 1 (in blue, Figure 2) we replicate that children with ADHD symptoms (i.e., low skill in attention, motor and impulse control) show a deficit in academic achievement compared to children without ADHD symptoms and therefore are not able to meet environmental demands of the second grade. We focus on the question if children with ADHD symptoms are aware of their own deficit (i.e., the second prerequisite of psychological compensation) and find, in line with past findings, that they overestimate their abilities more than children without ADHD symptoms. However, there are no differences when they are compared to a group without ADHD symptoms and similar levels of academic achievement. Therefore, we conclude that children with ADHD symptoms are aware of their own deficits and that a positive illusory bias might not be specific to ADHD but to low achievers. Psychological compensation, which is dependent on the awareness of a deficit, might only be possible in individuals with ADHD who show relatively good achievement. To explore

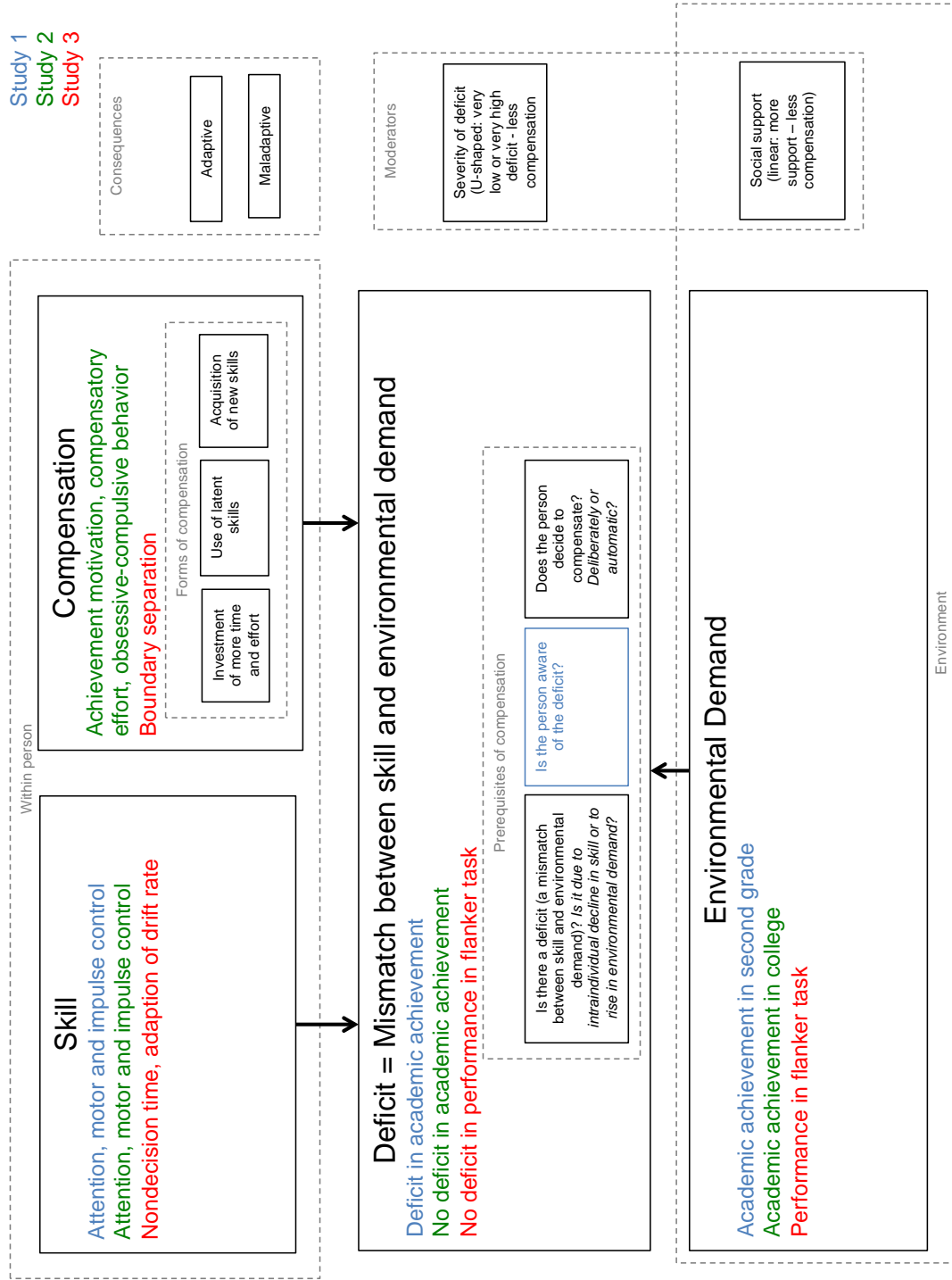


Figure 2. Presentation of our studies within the theoretical framework of psychological compensation.

possible compensatory behaviors, we decided to focus on a subgroup of individuals with ADHD that shows relatively good performance: college students with ADHD.

6.2. Study 2

We assume that college students with ADHD show low levels of skill with regard to attention, motor and inhibitory control (in green, Figure 2) as suggested by their diagnosis. Furthermore, we assume that they show high levels of academic achievement as suggested by the fact that they were able to enter college. This is also supported by the comparison of their last grade, which was similar to the grades of students without ADHD. Therefore, they are able to meet environmental demands of college and have to compensate in some way to do so despite their ADHD. We find higher levels of achievement motivation (i.e., dominance, flow, eagerness to learn, status orientation, competitiveness and goal setting) in the college students with ADHD compared to students without ADHD, which might be a hint of psychological compensation through motivation. Furthermore, female college students with ADHD received their diagnosis later than male students. In the context of compensation, this is interesting because effective compensatory behaviors might have hidden the deficits caused by ADHD symptoms until the onset of a rise in environmental demands at the start of college. We find that the effect of gender on compensatory effort and obsessive-compulsive behavior was mediated by the timing of the diagnosis. Certain achievement motivation like compensatory effort or traits such as obsessive-compulsive behavior may have allowed women with ADHD to hide their symptoms until they enter college. Our additional analyses indicate that female college students with ADHD did not overestimate their own achievements, however, men with ADHD did. Following the logic of the theoretical framework of psychological compensation, female college students with ADHD might show more compensation because they perceive a mismatch between their skills and the environmental demands. Maybe compensatory effort and obsessive-compulsive behavior can only be found in female college

students with ADHD because they are aware of their deficits, whereas male college students with ADHD are not. We decided to focus on female college students with ADHD in Study 3.

6.3. Study 3

To find out whether psychological compensation can be found not only in behavioral reports but also in performance in cognitive tasks, we asked female college students with and without ADHD to complete a flanker task. Female college students with ADHD performed differently but not worse than female college students without ADHD (in red, see Figure 2). They showed prolonged response times but made fewer errors. Our finding of higher nondecisional time and less adaptation of drift rate in female college students with ADHD compared to female college students without ADHD is in line with theories of ADHD (Sergeant, 2005). Therefore, we assume that the deficient nondecisional processes (i.e., higher nondecision time) and problems with sufficiently allocating effort (i.e., less adaptation of drift rate) are typical for the ADHD population. However, the finding of higher boundary separation is not in line with previous findings. Therefore, we assumed that high boundary separation could be a compensatory behavior leading to low error rates in the ADHD group. The assumption that female college students with ADHD are overly cautious not only in the task but also in every day life was supported by more obsessive-compulsive symptoms in the group with ADHD. Interestingly, participants who exhibited less information uptake in the congruent trials reported more obsessive-compulsive behavior, $r = -.33, p = .05$. We assume that the students with ADHD were cautious - showing more focused attention - which may lead to lower information uptake on congruent trials in which distractors are helpful for reacting fast and accurately. This behavior might be comparable to obsessive-compulsive behavior in everyday life. Our additional analyses can only indicate that female college students did have a realistic impression of their achievement in the flanker task.

6.4. General Discussion

We wanted to find out whether a positive illusory bias (i.e., the unawareness of the own deficit) is specific to ADHD or to low achievers (Study 1) and to explore compensation in a group of individuals with ADHD in which psychological compensation is likely because despite ADHD they are able to meet environmental demands (Study 2 and 3). The results of Study 1 show that a positive illusory bias (i.e., unawareness of the own deficit) is not specific to ADHD but to low achievers. Therefore, awareness of the own deficit and psychological compensation should be possible in individuals with ADHD and with high achievement. This is supported by our supplementary analyses that indicate that female college students with ADHD do not overestimate their own skills.

For Study 2 and 3 we decided to focus on the subgroup of individuals with ADHD that seems to be aware of their own deficit and is likely to show psychological compensation – college students with ADHD. Study 2 indicates that certain achievement motivations such as compensatory effort and obsessive-compulsive behavior might be cases of psychological compensation in female college students with ADHD. Study 3 shows that female college students compensate for possible deficits in solving a flanker task by being overly cautious, which may also reflect more obsessive-compulsive behavior. These results suggest that overly cautious behavior could be a form of psychological compensation in females with ADHD enabling them to enter college, leading to a late diagnosis and to good performance in cognitive tasks (i.e., flanker task).

Psychological compensation by cautious behavior. In Study 2 we found that compensatory effort and obsessive-compulsive behavior might be possible compensatory behaviors adopted by women with ADHD. It is important to note that obsessive-compulsive behavior as described in the Brief Symptom Inventory (G. H. Franke, 2000) does not refer to clinical symptoms like persistent thoughts, urges, or images or repetitive behaviors like hand washing (American Psychiatric Association, 2013). The Brief Symptom Inventory describes more common behaviors like controlling something over and over (G. H. Franke, 2000).

Compensatory effort as measured by the Achievement Motivation Inventory (Schuler & Prochaska, 2001) describes the effort of working even harder out of fear to fail (e.g., “If there is a risk that I will fail in a task, I invest extra effort”). Higher obsessive-compulsive behavior and compensatory effort might therefore reflect the investment of more effort and controlling over and over to prevent mistakes. Study 3 shows that female college students trade of speed for accuracy (i.e., higher boundary separation) and again are overly cautious to prevent mistakes.

Gender differences. We found hints of psychological compensation through higher achievement motivation (dominance, flow, eagerness to learn, status orientation, competitiveness and goal setting) in male and female college students with ADHD, but we also found specific compensatory behaviors in female college students (i.e., compensatory effort, obsessive-compulsive behavior and trading of speed for accuracy). Although girls show ADHD symptoms above a clinical cutoff 1.77 times more than boys, boys receive an ADHD diagnosis 4.38 times more than girls (Huss et al., 2008). The gender ratio becomes more equal in adults (Biederman et al., 1994; de Zwaan et al., 2012) because many women with ADHD symptoms receive their diagnosis of ADHD in adulthood (Simon et al., 2009). The late identification of females with ADHD might be due to girls showing lower rates of comorbid symptoms and externalizing behaviors (Gaub & Carlson, 1997) and are therefore not identified because they show less disruptive behavior (Biederman et al., 2005; Biederman, Faraone, Monuteaux, Bober, & Cadogen, 2004; McGee & Feehan, 1991). Our findings suggest that in addition to lower rates of externalizing behaviors, psychological compensation by cautious behavior might explain why women with ADHD receive their diagnoses later than men.

Implications for diagnosis and treatment. It is important to consider adaptive or maladaptive consequences of psychological compensation in ADHD. Overly cautious behavior seems to help women with ADHD to enter college, to deal with ADHD symptoms,

in a way that they do not get diagnosed until adulthood, and to perform well in a cognitive task. If there are only adaptive consequences this is desirable and the behavior should be trained in interventions. However, psychological compensation by overly cautious behavior could also have maladaptive consequences. If symptoms of obsessive-compulsive behavior become aggravated this could cause additional impairment in the quality of life over and above the ADHD symptoms. The same behavior could be helpful or maladaptive depending on the frequency of use. For example, minor obsessive-compulsive behavior or a generally higher caution to prevent mistakes could help college students with ADHD to reduce errors and therefore pass exams. However, if this behavior becomes too pronounced it could become a comorbid condition causing additional impairment. If the consequences are adaptive the compensatory behavior could be promising for future interventions. However, if the consequences are maladaptive it is important to consider compensatory behaviors when diagnosing ADHD because they could disguise deficits when using neuropsychological tasks in diagnostic procedures.

6.5. Limitations

After applying the theoretical framework to our studies, I would like to acknowledge some shortcomings of the studies presented in this synopsis. In Study 1 we did not ask children if they would decide to compensate and did not measure possible compensatory behaviors. However, since there was a mismatch between skill and environmental demand as indicated by a deficit in academic achievement, it is unlikely to find psychological compensation. If compensation did occur, it would counteract the deficit in academic achievement. In Study 2 and 3 we did not ask participants if they perceived a deficit (i.e., prerequisite 2 of compensation; Bäckman & Dixon, 1992) and if they decided to compensate (prerequisite 3). Therefore, we never tested all components of the theoretical framework in one study.

In Study 2 we did not measure the skill or outcome directly to evaluate the efficiency of possible compensatory behaviors. We assume that college students with ADHD show low attention, motor, and impulse control but did not use rating scales of ADHD symptoms. We also did not have a good measure of academic achievement in college. We asked for the last grade, however this might be highly influenced by the subject or area of Germany in which the grade was received.

To test if psychological compensation increases the ability to meet environmental demands, designs have to include participants with a low level of skill, which are not able to meet environmental demands (Group 1, Table 1) and individuals with a low level of skill that are able to meet the demands (Group 3, Table 1). Most studies only include individuals with ADHD that are not able to meet environmental demands (Group 1, Table 1) and therefore are unlikely to find psychological compensation. However, we only included individuals with ADHD that are able to meet the environmental demands (Group 1, Table 1) but cannot test if it is the compensatory behavior that enables them to do so. To test if achievement motivation, compensatory effort or obsessive-compulsive behaviors enable individuals to gain admittance to college, we would need to implement the same design in adults with ADHD that did not enter college.

In addition to the comparison of groups with high and low skills that do or do not meet the environmental demands, there are more designs that allow to differentiate the effect of skill from compensatory behavior. The first possibility is to experimentally manipulate the opportunity to use the compensatory behavior (e.g., no error feedback, no time to check results over and over again). The second possibility is to manipulate the environmental demand (e.g., ask participants to react as fast as possible in a flanker task without taking accuracy into account). If the environmental demand decreases and the mismatch between skill and environmental demand is reduced, the compensatory behavior should decrease. This could also be achieved by enhancing the level of contextual support. The third possibility is to

train the compensatory behavior to individuals that are not able to meet the environmental demand and to assess if the compensatory behavior helps them to meet the environmental demand (e.g., train participants who are not cautious to be cautious with error feedback, remind adults with ADHD to check for mistakes more than once). Finally, longitudinal designs could test for a natural change in environmental demand (e.g., beginning of school or college, comparison of weekdays and weekend) and test if compensatory behavior is adopted after the rise of the environmental demand.

6.6. Conclusion

In Study 1, we found that a positive illusory bias is not specific to ADHD but to low achievers. When the degree of awareness of the own deficit children with ADHD symptoms was compared to a control group matched for academic achievement, no group differences were found. In Study 2, we explored possible compensatory behaviors in college students with ADHD. College students with ADHD reported higher achievement motivation compared to college students without ADHD. Our results indicate that being overly cautious to prevent mistakes as indicated by higher compensatory effort, obsessive-compulsive behavior and trading of speed for accuracy could be a possible compensatory behavior in women with ADHD. It might add to the understanding of why women with ADHD receive their diagnoses later than men. The adaptive and maladaptive consequences of cautious behavior should be explored further. If consequences are adaptive, cautious behavior could be trained in interventions. However, if consequences are maladaptive, cautious behavior has to be taken into account when diagnosing ADHD. Future studies should test all components of the theoretical framework in one study. Furthermore, studies have to include adults that did not enter college to test if achievement motivation or overly cautious behavior explains why some adults with ADHD gain admittance to higher education and show good performance in cognitive tasks and others do not.

7. References

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8. Appendix

- Study 1.** Ehm, J.-H., Merkt, J., Gawrilow, C., & Hasselhorn, M. (in press). Selbstkonzept und Schulleistungen von Grundschulern mit ADHS-Symptomen. *Zeitschrift für Entwicklungspsychologie und Pädagogische Psychologie*.
- Study 2.** Merkt, J., & Gawrilow, C. (submitted). Health, Dietary Habits, and Achievement Motivation in College Students with Self-Reported ADHD Diagnosis. *Journal of Attention Disorders*.
- Study 3.** Merkt, J., Singmann, H., Bodenbug, S., Goossens-Merkt, H., Kappes, A., Wendt, M., & Gawrilow, C. (in press). Flanker Performance in Female College Students with ADHD – A Diffusion Model Analysis. *ADHD*.

Der Artikel „Ehm, J.-H., Merkt, J., Gawrilow, C., & Hasselhorn, M. (in press). Selbstkonzept und Schulleistungen von Grundschulern mit ADHS-Symptomen. *Zeitschrift für Entwicklungspsychologie und Pädagogische Psychologie*.“ wird aus urheberrechtlichen Gründen in der elektronischen Version der Dissertation nicht veröffentlicht.

The paper “Ehm, J.-H., Merkt, J., Gawrilow, C., & Hasselhorn, M. (in press). Selbstkonzept und Schulleistungen von Grundschulern mit ADHS-Symptomen [Self-concept and academic achievement of elementary school students with ADHD symptoms]. *Zeitschrift für Entwicklungspsychologie und Pädagogische Psychologie [German Journal of Developmental and Educational Psychology]*.” is not published in the electronic version of the doctoral thesis due to copyright reasons.

Der Artikel „Merkt, J., & Gawrilow, C. (submitted). Health, Dietary Habits, and Achievement Motivation in College Students with Self-Reported ADHD Diagnosis. *Journal of Attention Disorders*.“ wurde am 14.01.2014 in überarbeiteter Form zur Publikation angenommen. Auf den folgenden Seiten findet sich die erste eingereichte Fassung des Manuskriptes.

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Health, Dietary Habits, and Achievement Motivation in College Students with Self-Reported
ADHD Diagnosis

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Abstract

Objective

Although ADHD persists into adulthood, there is sparse research on health and motivation in college students with ADHD.

Method

Seventy-seven college students with self-reported ADHD (49 women; M -age = 25.82, SD = 4.62) and 120 college students without ADHD (65 women; M -age = 25.17, SD = 5.41) participated in an online survey assessing their health, dietary habits, and achievement motivation.

Results

Students with ADHD showed impairment in health and dietary habits, with women with ADHD reporting even worse health compared to men with ADHD. Some of the gender differences were mediated by the timing of the diagnosis. Achievement motivation differed between students with and without ADHD.

Conclusion

Although they represent a subpopulation college students with ADHD struggle with health related issues and women even more than men. Some of the differences might be due to underdiagnosis of girls in childhood. Differences in achievement motivation might indicate compensation mechanisms.

Keywords: college students, gender differences, health, dietary habits, motivation

Health, Dietary Habits, and Achievement Motivation in College Students with Self-Reported ADHD Diagnosis

Attention Deficit/Hyperactivity Disorder (ADHD) has predominantly been viewed as a childhood disorder and only in recent years research has started to focus on the characteristics of ADHD in adulthood (Rucklidge, Brown, Crawford, & Kaplan, 2007). Studies have revealed that in 40-60% of children with ADHD the disorder continues into adulthood (Davidson, 2008) and the prevalence of ADHD in adulthood is estimated to be between 2.5-4.7% in the population (de Zwaan et al., 2012; Fayyad et al., 2007; Kessler et al., 2006; Simon, Czobor, Bálint, Mészáros, & Bitter, 2009). Adults with ADHD show impairments in multiple domains, such as academic achievement, cognitive performance, and psychiatric well-being (Biederman, Faraone, Monuteaux, Bober, & Cadogen, 2004; Rucklidge et al., 2007). They are also at risk for impaired physical and psychological functioning (Klein et al., 2012; Ramos Olazagasti et al., 2013) and obesity (Cortese, Faraone, Bernardi, Wang, & Blanco, 2013).

College Students with ADHD

College students with ADHD who managed to graduate from high school and gain admittance to a postsecondary institution represent a subpopulation of individuals with ADHD (Merkt et al., 2013). They are expected to be less impaired compared to adults with ADHD from the general population: College students with ADHD have experienced more academic success, which may lead to a stronger belief in their abilities (Nelson & Gregg, 2012), they may have a less severe form of the disorder (Nelson & Gregg, 2012), they are likely to have higher ability levels, greater academic success during primary and secondary school, and better compensatory skills (Frazier, Youngstrom, Glutting, & Watkins, 2007). Therefore, college students with ADHD represent a subpopulation in adults with ADHD and findings in adults ADHD without college education cannot be transferred to college students.

Health. Adults ADHD has been related to many health problems like sexually transmitted disease, head injury, emergency department admissions (Ramos Olazagasti et al., 2013), overweight (Cortese et al., 2008), and a greater prevalence of psychiatric disorders (Kessler et al., 2006; Klein et al., 2012; Ramos Olazagasti et al., 2013). Adults with ADHD also reported diminished health related quality of life (Gjervan, Hjemdal, & Nordahl, 2012; Gjervan, Torgersen, Rasmussen, & Nordahl, 2012). Although impaired physical and psychological functioning and an impaired health related quality of life have been demonstrated repeatedly in adults with ADHD the findings in college students with ADHD are still sparse.

College students with self-reported ADHD displayed more noxious behaviors, like substance and alcohol use and smoking initiation (Blase et al., 2009). Furthermore, they showed impaired psychological functioning. On the Symptom Checklist–90–Revised (SCL-90-R; Derogatis, 1994) students with ADHD gave significantly higher ratings on somatization, obsessive compulsive disorder, interpersonal sensitivity, depression, anxiety, hostility, paranoid ideation, and psychoticism (Richards, Rosen, & Ramirez, 1999) and on the on the Global Severity Index of the Brief Symptom Inventory (BSI; Derogatis, 1993; Weyandt, Rice, Linterman, Mitzlaff, & Emert, 1998) they reported greater psychological distress compared to students without ADHD. To our knowledge the health related quality of life in college students with ADHD has not been explored yet.

Dietary Habits. Researchers found high rates of ADHD symptoms in obese populations and children and men with ADHD showed a higher Body Mass Index (BMI) than would be expected in the general population (Cortese et al., 2008; Cortese, Ramos Olazagasti, et al., 2013). There was a greater likelihood of overweight and obesity in adults with ADHD symptoms (Pagoto et al., 2008). However, an epidemiological study showed that the relation of ADHD diagnosis and obesity in adulthood disappeared when controlling for mood or anxiety disorders (Cortese, Faraone, Bernardi, Wang, & Blanco, 2013). Nevertheless, the

number of ADHD symptoms before the age of 18 was associated with obesity in adulthood even after controlling for comorbid disorders in women but not in men (Cortese, Faraone, et al., 2013). We are not aware of any studies investigating overweight or dietary habits in college students with ADHD.

Achievement Motivation. Impaired academic achievement in children and in college students with ADHD has repeatedly been demonstrated (Frazier et al., 2007; Weyandt & DuPaul, 2008). Achievement goals can predict academic performance independent of cognitive ability (Harackiewicz, Barron, Tauer, & Elliot, 2002). However, research on achievement motivation in ADHD is sparse. Findings so far suggest that children with ADHD show a maladaptive attributional style. Children with ADHD set themselves performance goals that will make them look smart rather than learning goals choosing tasks from which they will learn something (Dunn & Shapiro, 1999). Although only a small number of female participants with ADHD was included in the study, the girls showed the most inconsistent goal orientation switching from performance goals to learning goals after failure (Dunn & Shapiro, 1999). Adolescents with ADHD aimed at avoiding failure rather than achieving success (Milich & Okazaki, 1991; Olivier & Steenkamp, 2004). There was a stronger association between achievement motivation and academic performance in children with ADHD than in children without ADHD (Gut, Heckmann, Meyer, Schmid, & Grob, 2011). Although achievement motivation is so vital for academic performance in ADHD to our knowledge achievement motivation in college students with ADHD has not been previously examined. It could be possible that college students with ADHD show a high achievement motivation which helps them to achieve greater academic success during primary and secondary school (Frazier et al., 2007).

Gender Differences

Findings about gender differences in ADHD are very heterogeneous. Meta-analyses on gender differences in children have repeatedly reported lower levels of hyperactivity and

less externalizing behavior in girls with ADHD (Gaub & Carlson, 1997; Gershon, 2002). Furthermore, some showed greater intellectual impairment (Gaub & Carlson, 1997) and more internalizing behavior in girls (Gershon, 2002). Some of these differences were accounted for by moderator variables such as referral source (i.e., clinic vs. community), with non-referred samples of girls showing less impairment than boys with ADHD (Gaub & Carlson, 1997). Among clinic-referred populations, girls and boys with ADHD showed similar levels of impairment (Gaub & Carlson, 1997).

Although findings about gender differences in childhood are still not clear, there is even less research in gender differences in adult ADHD (Rucklidge et al., 2007). Some studies found no gender differences (Biederman et al., 2004; Rucklidge et al., 2007) but others did (Biederman et al., 1994). If gender differences in adults occurred there was a trend in showing greater impairment in women. For example, higher rates of major depression, anxiety disorders, and conduct disorder, and more evidence of school failure, and cognitive impairment in females as compared to males with ADHD (Biederman et al., 1994). Research in gender differences in college students with ADHD is limited since most studies did not include females or only a very small number of females. A review about ADHD in college students did not find gender differences (Weyandt & DuPaul, 2008). On the basis of the heterogeneous findings we aimed to include enough female college students with ADHD to explore gender differences.

Referral bias as cause for gender differences. It is discussed whether the gender differences in adults with ADHD are true reflections of the phenotype or may represent diagnostic artifacts or a referral bias (Biederman et al., 2004). Boys received an ADHD diagnosis 4.38 times as often as girls. However, when taking symptoms above a clinical cutoff as criterion boys were affected only 1.77 times as often as girls (Huss, Hölling, Kurth, & Schlack, 2008). An explanation for the unequal gender ratio in clinical compared to epidemiological samples is, that girls show lower rates of comorbid symptoms and

externalizing behaviors (Gaub & Carlson, 1997). Especially in school boys with ADHD showed more rule-breaking (Abikoff et al., 2002) and teachers, but not parents reported more problems in boys (Derks, Hudziak, & Boomsma, 2007). Thus, it seems that girls with ADHD are often not identified because they show less disruptive behavior (Biederman et al., 2005, 2004; McGee & Feehan, 1991). However, many women with ADHD seek psychiatric help as adults and receive their diagnosis of ADHD in adulthood (Simon et al., 2009), which leads to equal prevalence rates of ADHD in males and females in adulthood (Biederman et al., 1994; de Zwaan et al., 2012).

The timing of the diagnosis has vivid implications. Adults that did not receive their diagnosis in childhood but in adulthood reported more depression and anxiety, a more external locus of control, lower self-esteem, and a maladaptive attributional style (Rucklidge et al., 2007; Rucklidge & Kaplan, 1997). Rucklidge and colleagues (2007) suggested that “unidentified ADHD can lead to misattributions of blame and subsequently to more psychosocial problems”. Therefore, it is possible that unidentified ADHD in childhood leads to more impairment later in life. On the basis of the literature we wanted to explore if gender differences in ADHD were mediated by the timing of the diagnosis.

Present Study

We conducted an online study using questionnaires to assess psychological functioning, health related quality of life, dietary habits, and achievement motivation in college students with and without self-reported ADHD diagnosis. We had the following research questions: First, do college students with and without self-reported ADHD diagnosis differ in psychological functioning, health related quality of life, dietary habits, and achievement motivation? On the basis of the current literature we hypothesized that college students with ADHD show worse psychological functioning, less health related quality of life and more maladaptive dietary habits leading to a higher BMI. Furthermore, we assume that college students with ADHD show a higher achievement motivation. Our second research

question was: Are there gender differences that are specific for ADHD? We assumed that female college students with ADHD show even greater impairment in health compared to male students. On the basis of the literature we did not have a hypothesis regarding gender differences in achievement motivation. Our third research question was: Are gender differences in college students with ADHD mediated by the time when they received their ADHD diagnosis? We assume that women received their diagnosis later than men and that this is related to higher impairment.

Method

Participants

Seventy-seven college students with self-reported ADHD (49 women; age: $M = 25.82$, $SD = 4.62$) and 120 college students without ADHD (65 women; age: $M = 25.17$, $SD = 5.41$) participated.

Screening of cognitive abilities. Students completed five subtests of the Wechsler Adult Intelligence Scale, WAIS (Aster, Neubauer, & Horn, 2006) the picture completion, the arithmetics, the vocabulary, the similarities and the matrix-reasoning subtest. We chose these subtests as an estimate for the full IQ because we were able to present them online. A MANOVA by Group \times Gender revealed neither significant main effects nor interactions.

Socioeconomic status (SES). To make sure that college students with and without did not differ in SES, we assessed the SES of participants by asking questions regarding the educational level, occupation status, and monthly income (Table 1). In a demographic questionnaire, participants had to indicate their educational level (1 = nine years of education, 2 = ten years of education, 3 = twelve to thirteen years of education, and 4 = university degree), occupation status (1 = unemployed, 2 = low-wage employment, 3 = part-time employment, and 4 = full-time employment), and monthly income (1 = up to approximately 1.500 €; 2 = up to approximately 2.500 €; 3 = up to approximately 4.000 €; and 4 = approximately more than 4.000 €). We used the mean of educational level, occupation status,

and monthly income as an index for SES. An ANOVA by Group \times Gender for SES did not reveal significant main effects nor any interactions.

ADHD diagnosis. For the assessment of an ADHD-diagnosis we simply asked participants if they had received a clinical diagnosis of ADHD asking “Did you receive a diagnosis of ADD/ADHD?”. Men with ADHD were diagnosed on average 6.82 years ($SD = 6.59$) before the participation in the study. Women with ADHD were diagnosed on average 3.22 years ($SD = 4.66$) ago. Diagnoses were given by psychiatrists (57.3 %), medical practitioners (16.0 %), neurologists (13.3 %), pediatricians (8.0 %), and therapists (5.3 %). Fifty-one participants (36 women) in the ADHD group reported to take medication.

Design

The study followed a 2-between (Group: ADHD vs. Control) \times 2-between (Gender: Female vs. Male) design. Dependent variables were psychological functioning, health related quality of life, dietary habits, and achievement motivation assessed with questionnaires.

Procedure

We conducted a web-based survey because of the benefits of drawing larger, more diverse samples and accessing difficult-to-reach populations (Gosling, Vazire, Srivastava, & John, 2000), which is important since gender differences in college students with ADHD can often not be explored due to a lack of female participants (Weyandt & DuPaul, 2008). We posted links for the survey in ADHD and psychology forums on a German social networking website for college students with approximately 15 million members (StudiVZ, <http://www.studivz.net>). We posted links in forums for college students with ADHD, for female college students with ADHD, for females with ADHD and students of psychology and also asked students to share the link. The link directed interested students to the online survey conducted with Unipark (Globalpark Enterprise Feedback Suite 6.0, 2008). Computer IP addresses were tracked to allow only one entry from the same computer and enable participants to take breaks as often as they wanted. Answering the questions of the survey

took participants between 40 and 197 minutes ($M = 86.11$, $SD = 27.04$). An ANOVA did not reveal differences in time to complete the survey for Group or Gender. Participants were asked to fill out the following questionnaires.

Psychological functioning. Since studies in college students have repeatedly reported poorer psychological functioning in college students with ADHD we chose to use the BSI (Franke, 2000), which provides an overview of self-reported clinically relevant psychological symptoms in adolescents and adults. The BSI is the short version of the SCL-R-90 (Derogatis, 1994), which measures the same dimensions. The BSI requires only 8-10 minutes to complete and consists of 53 items covering nine symptom dimensions: somatization, obsession-compulsion, interpersonal sensitivity, depression, anxiety, hostility, phobic anxiety, paranoid ideation and psychoticism; and three global indices of distress: Global Severity Index (GSI), Positive Symptom Distress Index, and Positive Symptom Total. The global indices measure current or past level of symptomatology, intensity of symptoms, and number of reported symptoms, respectively. The BSI has internal consistencies from $\alpha = .63$ to $\alpha = .85$ and retest-reliabilities from $r = .73$ to $r = .92$.

Health related quality of life. We used the SF-36-Health Survey (Bullinger & Kirchberger, 1993) to research health related quality of life. The SF-36 assessing the following aspects: Physical functioning, physical role functioning, bodily pain, general health perceptions, vitality, social role functioning, emotional role functioning, and mental health. The SF-36 consists of 36 items and takes 10 min to complete. The SF-36 has internal consistencies from $r = .57$ to $r = .94$.

Dietary habits. We assessed dietary habits with the Questionnaire for the Assessment of Eating Behavior (Fragebogen zur Erfassung des Essverhaltens, FEV; Pudel & Westenhöfer, 1989), which is the German version of the Three Factor Eating Questionnaire (TFEQ; Stunkard & Messick, 1985). The FEV consists of 51 items assessing eating behavior and requires 15 min to complete and includes three scales: cognitive restraint of eating,

disinhibition, and hunger. The FEV has internal consistencies from $r = .75$ to $r = .87$ and split-half-reliabilities from $r = .74$ to $r = .86$. Furthermore we used the Eating Behavior Test (Essverhalten-Test, EVT; Böhm, 1998), which consists of 20 items and takes 15 min to complete. All items are summed up to one scale assessing risk for bulimia on the basis of the ICD 10 criteria for bulimia. The EVT has an internal consistency of $\alpha = .96$. We also asked participants for their weight and height to compute their BMI.

Achievement motivation. We used the achievement motivation inventory to assess several aspects of achievement motivation (Leistungsmotivationsinventar, LMI; Schuler & Prochaska, 2001). The LMI was developed as a comprehensive measure of achievement motivation by including previous definitions of achievement motivation. It requires about 35 min to fill out the LMI questionnaire and it incorporates the following 170 items in 17 scales: Persistence, Dominance, Engagement, Confidence in Success, Flexibility, Flow, Fearlessness, Internality, Compensatory Effort, Pride in Productivity, Eagerness to Learn, Preference for Difficult Tasks, Independence, Self-Control, Status Orientation, Competitiveness and Goal Setting. These scales have been shown to load on 3 second-order factors (Byrne et al., 2004): self-assurance, ambition, and self-control. The LMI has internal consistencies from $\alpha = .68$ to $\alpha = .86$ for the scales and $\alpha = .98$ for the total value. The retest-reliabilities for the scales range from $r = .66$ to $r = .82$ for the scales and $r = .86$ for the total value.

Results

First, we conducted MANOVAS by Group (ADHD vs. Control) and Gender (Female vs. Male) for the domains psychological functioning, health related quality of life, dietary habits, and achievement motivation. Second, to explore the results in more detail we performed ANOVAs by Group \times Gender on all scales, but only report significant findings in the text. Means and standard deviations and results for all MANOVAs and ANOVAs are displayed in Table 2. To answer our first research question of group differences between college students with and without self-reported ADHD diagnosis we focused on the Group

main effect. To answer our second research question of gender differences that are specific for ADHD we focused on the interactions of Group and Gender. To answer our third research question regarding the relation of gender differences in ADHD to timing of diagnosis we performed multiple mediation analysis. We used the PROCESS macro for SPSS by Hayes (Preacher & Hayes, 2004). We used a 95% confidence interval with 5000 resamples (Preacher & Hayes, 2008). We conducted regressions for all scales that showed significant interaction of Group and Gender and for all scales that showed significant correlation with the timing of the diagnosis. We only included participants with ADHD and used Gender as predictor. We then checked whether the effect was mediated by the timing of the diagnosis. We report results for all three research questions for each domain (i.e. psychological functioning, health related quality of life, dietary habits and achievement motivation) separately.

Psychological Functioning

The MANOVA of Group \times Gender for psychological functioning (i.e. all scales of the BSI) revealed significant main effects for Group and Gender, as well as a significant interaction. College students with ADHD reported more impairment on all scales of the BSI. Analyses revealed significant interactions between Group \times Gender for obsessive-compulsive behavior, interpersonal sensitivity, depression, anxiety, hostility and psychoticism, which were caused by the high impairment in women with ADHD compared to woman without ADHD in these constructs. Men with and without ADHD did not differ in these constructs. Only the effect of Gender on obsessive-compulsive behavior was mediated by the timing of the diagnosis. Gender predicted timing of the diagnosis, $t(73) = -2.75, p < .05$, and obsessive-compulsive behavior, $t(73) = 2.17, p < .05$. The bias corrected bootstrap 95% indicated that timing of the diagnosis mediated the relation of gender and obsessive-compulsive behavior, $B = .538, CI = .004-1.561$. In addition the direct effect of gender on obsessive-compulsive behavior disappeared, when controlling for timing of the diagnosis, $t(72) = 1.66, ns$, thus suggesting a full mediation.

Health Related Quality of Life

The MANOVA of Group \times Gender for health related quality of life (i.e. all scales of the SF-36) revealed significant main effects for Group and Gender, as well as a significant interaction. College students with ADHD reported worse general health perception, social and emotional role functioning as well as worse mental health. Significant interactions for Group \times Gender appeared for general health perceptions, social role functioning and mental health. Women with ADHD showed even more impairment in these domains. None of the relations were mediated by the timing of the diagnosis.

Dietary Habits and BMI

The MANOVA of Group \times Gender for dietary habits (i.e. all scales of the FEV and the EVT) revealed significant main effects for Group and Gender, as well as a marginally significant interaction. College students with ADHD showed more cognitive restraint of eating, more hunger and a higher risk of bulimia. The only significant interaction Group \times Gender appeared for risk of bulimia and was driven by the women with ADHD showing high risk. Linear regressions showed that the relation was not mediated by the timing of the diagnosis.

We also performed a ANOVA of Group \times Gender for BMI, which showed a significant main effect for Gender $F(1, 191) = 4.85, p = .029$, with men (BMI: $M = 23.93, SD = 3.41$) having a higher BMI than women (BMI: $M = 22.83, SD = 4.56$). There was no significant effect of Group, $F(1, 191) = 2.66, ns$, and no significant interaction, $F(1, 191) = 1.34, ns$. Men with ADHD had a higher BMI (BMI: $M = 25.07, SD = 4.09$) compared to men without ADHD (BMI: $M = 23.35, SD = 2.88$), to women with ADHD (BMI: $M = 23.00, SD = 4.74$), and to women without ADHD (BMI: $M = 22.71, SD = 4.46$).

Achievement Motivation

The MANOVA of Group \times Gender for achievement motivation revealed significant main effects for Group and Gender, as well as a marginally significant interaction. The

ADHD group indicated less persistence, fearlessness, internality and self-control, but higher levels of dominance, flow, eagerness to learn, status orientation, competitiveness and goal setting. Significant interactions of Group and Gender appeared for engagement and confidence in success. Women with ADHD showed higher levels of engagement compared to the other groups. Men with ADHD reported the most confidence to succeed, college students without ADHD were somewhat in the middle and women with ADHD indicated the lowest confidence to succeed. Compensatory effort was correlated to the timing of the diagnosis, $r = -.25, p < .05$. Gender predicted timing of the diagnosis, $t(73) = -2.75, p < .05$, and compensatory effort, $t(73) = 2.22, p < .05$. The bias corrected bootstrap 95% indicated that timing of the diagnosis mediated the relation of gender and compensatory effort, $B = 1.517$, $CI = .002-4.742$. In addition the direct effect of gender on compensatory effort disappeared, $t(72) = 1.63, ns.$, when controlling for timing of the diagnosis, thus suggesting a full mediation

Discussion

The aims of this study were first, to compare college students with and without self-reported ADHD diagnosis in aspects of psychological functioning, health related quality of life, dietary habits, and achievement motivation; second, to explore gender differences that are specific for ADHD; and third, to find out whether gender differences are mediated by the timing of the diagnosis.

Group Differences

College students with ADHD report impaired psychological functioning on all scales of the BSI and impaired health related quality of life in some scales of the SF-36 compared to college students without ADHD. The results are in line with current findings of impaired psychological functioning in college students with self-reported ADHD (Richards et al., 1999; Weyandt et al., 1998). We extend findings of impaired health related quality of life in adults with ADHD (Gjervan, Hjemdal, et al., 2012; Gjervan, Torgersen, et al., 2012) showing that

impaired health related quality of life can also be found in college students with ADHD. Furthermore, we find risky dietary habits in college students with ADHD in some scales of the FEV and in the EVT. Even though they represent a subpopulation of individuals with ADHD they, like other adults with ADHD (Cortese, Faraone, et al., 2013), are at risk regarding their dietary habits. Thus, college students with ADHD report impairment in different health domains, as for instance psychological functioning, health related quality of life and dietary habits. Although college students represent a subpopulation of adults with ADHD, and they might be impaired less compared to adults that did not enter higher education (Frazier et al., 2007), their symptoms lead to deficits above and beyond academic difficulties.

We also find differences in achievement motivation. Lower persistence and self-control in college students with ADHD are expected because impaired self-control is an important characteristic of ADHD (i.e., Gawrilow, Gollwitzer, & Oettingen, 2011). However, college students with ADHD in our sample also display higher dominance, flow, eagerness to learn, status orientation, competitiveness, and goal setting. Although these results warrant replication it would be interesting to explain how these effects come about. For instance, there are studies suggesting that a high motivation can help individuals with impairments to enter and succeed in higher education as college students with learning disabilities were found to have a higher need for achievement compared to students without learning disabilities (Hall, Spruill, & Webster, 2002). Additionally, findings suggest that achievement motivation shows a higher relation to actual performance in children with ADHD than in children without ADHD; and that a high motivation or specific volitional strategies of goal setting can help children with ADHD to perform on the same level of children without ADHD (Gawrilow & Gollwitzer, 2008; Gut et al., 2011). Perhaps the motivational dispositions reported by our sample of college students with ADHD helped them to achieve an academic performance in school that allowed it to enter higher education despite of their ADHD. The strategy of goal

setting or other adequate motivational strategies (i.e., dominance, flow, eagerness to learn, status orientation, competitiveness) may help them to cope with deficits caused by their ADHD symptoms.

Gender Differences in ADHD

Regarding psychological functioning and health related quality of life women with ADHD report more impairment as compared to men with ADHD. However, it has been proposed that gender differences – especially more impairment in women – can only be found in clinical samples and not in population based samples because many females with ADHD do not receive a diagnosis unless they exhibit a strong impairment (i.e., more ADHD symptoms, more comorbid psychiatric problems, worse health; Derks et al., 2007). Our sample only includes cases with a clinical diagnosis of ADHD and our finding of worse health in female college students with ADHD as compared to male college students might be caused by a referral bias. Maybe women with ADHD with higher psychological functioning and better health related quality of life did not seek or receive a diagnosis of ADHD. A second explanation is that, males and females do not differ in impairment in childhood but females are not diagnosed and therefore not treated until adulthood (Biederman et al., 2004) which leads to an accumulation of comorbid symptoms and health problems in females with ADHD in adulthood (Rucklidge et al., 2007). To test this explanation we checked if gender differences were mediated by the timing of the diagnosis (see Timing of the Diagnosis). These two explanations are not exclusive but could be interrelated, both attributing to worse health in women with ADHD as compared to men.

Regarding dietary habits both male and females with ADHD report impairments but with different outcome. Whereas men with ADHD had a heightened BMI, women with ADHD were at risk for bulimia. Therefore, both male and female college students like other adults with ADHD appear to be eating too much presumably due to their impulsivity (Cortese et al., 2008), however whereas men put on weight, women seem to try to take counteractive

measures leading to bulimia. This is in line with findings of a greater likelihood of overweight and obesity in adults with ADHD symptoms (Pagoto et al., 2008). However, others suggest that ADHD symptoms are only related to obesity in adulthood in women but not in men (Cortese, Faraone, et al., 2013). Maybe women with ADHD and a high education are more aware of their overeating and therefore take counteractive measures that are not perused by all women with ADHD. We also find differences in achievement motivation in male and female college students with ADHD. Whereas women with ADHD report more engagement, men with ADHD are more confident to succeed. Since this is the first finding of achievement motivation in adults with ADHD it is difficult to say if this specific for college students with ADHD or for adults with ADHD in general.

Timing of the Diagnosis

Since gender differences might be caused by referral bias leading to an underdiagnosis of girls with ADHD (Biederman et al., 2005) we wanted to explore if timing of the diagnosis mediated the relation between gender and outcome in the ADHD group. The women in our study were diagnosed on average 3.6 years later than the male participants. It is possible that the late diagnosis lead to the assembly of more health related problems in the women. We found full mediations for obsessive-compulsive behavior and compensatory effort. This suggests that male and female college students with ADHD do not differ in obsessive-compulsive behavior and compensatory effort *per se* but that differences are driven by the fact that women receive their diagnosis later than men. Obsessive-compulsive behavior and compensatory effort seem to be specific behaviors or strategies that are adopted when individuals with ADHD do not receive their diagnosis early in life. Interestingly, a recent study found higher levels in obsessive-compulsive behavior in a sample of female college students with ADHD that also show a cautious strategy of trading speed of for accuracy in a flanker task and therefore produce less errors compared to female students without ADHD (Merkt et al., 2013). Furthermore, academically less successful students with ADHD spend

more time using coping mechanisms and that this is maladaptive because they have fewer time to study (Kaminski, Turnock, Rosén, & Laster, 2006). It seems likely that women with ADHD that were not diagnosed and therefore not treated in childhood adopt more maladaptive coping strategies like being overly-cautious almost obsessive-compulsive and invest more compensatory effort.

A second possible explanation is that more obsessive-compulsive behavior and compensatory effort lead to the late diagnosis. Maybe being overly cautious to prevent any errors and showing certain obsessive-compulsive behaviors like controlling assignments before handing them in, leads to comparably high performance and therefore girls with this behavior are not sent to get a diagnosis. Only when demands get higher as for instance when entering the university the ADHD symptomology cannot be compensated by strategies like overly cautious behavior anymore and women come to seek help in psychiatric settings.

However, many of the gender differences (i.e., interpersonal sensitivity, depression, anxiety, hostility, psychoticism, general health perceptions, social role functioning, mental health, bulimia, engagement and confidence in success) were not mediated by the timing of the diagnosis. Therefore, we cannot draw the conclusion that women show worse health only because they received the diagnosis later and were not treated before. Maybe even as adults women have to show higher impairment to receive a diagnosis of ADHD.

Implications

College students with ADHD do not only suffer from impaired academic achievement and psychological functioning (Weyandt & DuPaul, 2008) but they are also impaired in other health related domains like health related quality of life and dietary habits and these should be targeted in interventions too. Furthermore, it seems important to note that although ADHD is more frequent in boys in childhood, female college students with ADHD show high health related impairment and might need interventions that are adapted to their specific needs.

We discuss whether a higher achievement motivation or overly cautious behavior could be a compensation mechanism in college students with ADHD. However, because academic achievement is not tested with standardized measures in Germany (as, for example, the Grade Point Average) and it is difficult to compare between students studying different subjects. Hence, we cannot test if the compensation mechanisms that we assume really mediate the relationship between ADHD and achievement. Future research might want to use standardized test to study the effect of achievement motivation and overly cautious behavior on achievement college students with ADHD.

If they prove to be helpful for individuals with ADHD compensation strategies can be taught in interventions. This has been brought forward before (Newark & Stieglitz, 2010). However, we still lack knowledge of which compensation strategies are used by individuals with ADHD, how these were adopted and which of these are adaptive and which are maladaptive. The same strategy could be helpful or maladaptive depending on the frequency of use. For example, a high rate of obsessive-compulsive behavior or a generally higher caution could help college students with ADHD to make fewer errors and therefore pass exams. However, if this behavior becomes too pronounced it could become a comorbid condition causing even further impairment in quality of life over and above the ADHD symptoms. If girls with ADHD are underdiagnosed when adopting specific compensation mechanisms like being overly cautious this should be taken into account when diagnosing ADHD in girls.

Limitations

An important limitation of this study is, that we only assessed the participants' self-reported diagnosis of ADHD. However, psychosocial functioning of students with self-reported ADHD is very similar to functioning in students with confirmed diagnosis (Richards et al., 1999). Furthermore, all our results are in line and not contradictory with previous findings. Another limitation concerns the dependent variables: We only used online

questionnaires. However, comparisons of online and paper-and-pencil methods of data collections have revealed that results are comparable for questionnaires (Gosling et al., 2000; Weigold, Weigold, & Russell, 2013), achievement tests (Preckel & Thiemann, 2003) and even experiments (McGraw, Tew, & Williams, 2000). Online administration might even be beneficial when it comes to health behavior, because bias of sensitive topics is reduced (Ramo, Hall, & Prochaska, 2011). Due to time constraints we did not use a questionnaire to assess ADHD symptoms and therefore have no continuous measure of ADHD. We cannot test if females with ADHD display lower level of ADHD symptoms and how this is related to impairment in health or motivation. To really test the influence of the timing of the diagnosis it would be valuable to include men and women with ADHD that have been diagnosed in childhood and in adulthood.

Conclusion

Students with ADHD showed impairment in health and dietary habits, with women with ADHD reporting even worse health compared to men with ADHD. Achievement motivation differed between students with and without ADHD and might indicate compensation mechanisms in the population of college students with ADHD. The effect of gender on obsessive-compulsive behavior and compensatory effort was fully mediated by the timing of the diagnosis. It seems important to prevent underdiagnosis in girls with ADHD, to further explore which compensation strategies are used by individuals with ADHD and which of these are adaptive and which are maladaptive. Results could be used to develop effective interventions for adults with ADHD.

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Table 1
Characteristics of the Sample by Group and Gender

<i>Variables</i>	<i>ADHD</i>		<i>Control</i>	
	<i>Female n = 49</i>	<i>Male n = 28</i>	<i>Female n = 65</i>	<i>Male n = 55</i>
Age in years	25.14 (4.00)	25.54 (5.65)	25.97 (6.37)	24.22 (3.83)
WAIS IQ				
Picture Completion	17.69 (3.73)	18.39 (3.75)	18.00 (3.61)	18.61 (3.61)
Arithmetics	12.04 (2.38)	11.89 (2.38)	12.24 (2.85)	11.31 (3.62)
Vocabulary	45.73 (7.45)	50.93 (5.58)	46.54 (8.05)	47.42 (9.56)
Similarities	20.75 (3.74)	23.00 (2.26)	20.24 (4.16)	21.28 (5.05)
Matrix-Reasoning	17.51 (2.85)	18.43 (2.53)	17.12 (3.16)	17.54 (3.30)
SES				
Educational level				
Nine years	0.0 %	0.0 %	0.0 %	3.6 %
Ten years	10.2 %	3.6 %	4.6 %	12.7 %
Twelve to thirteen years	75.5 %	89.3 %	83.1 %	78.2 %
University degree	14.3 %	7.1 %	12.3 %	5.5 %
Occupation status				
Unemployed	53.1 %	64.3%	40.0%	47.3 %
Low-wage employment	12.2 %	14.3 %	27.7 %	10.9 %
Part-time employment	12.2 %	7.1 %	18.5 %	9.1 %
Full-time employment	22.4 %	14.3 %	13.8 %	32.7 %
Income:				
< 1.500 €	87.0 %	80.0 %	89.7 %	65.5 %
< 2.500 €	13.0 %	0.0 %	10.3 %	24.1 %
< 4.000 €	0.0 %	0.0 %	0.0 %	3.4 %
> 4.000 €	0.0 %	20.0 %	0.0 %	6.9 %
Years since the confirmation of the diagnosis	3.22 (4.66)	6.82 (6.59)	-	-

Note. WAIS = Wechsler Adult Intelligence Scale German Version (Aster, Neubauer, & Horn, 2006)

Table 2
Means and Standard Deviations and Results of MANOVAS and ANOVAS for all Dependent Variables

Group	Mean (standard deviation)				MANOVAS and ANOVAS										
	ADHD		Control		Group (ADHD vs. Control)		Gender (Female vs. Male)		Group × Gender						
	Female n = 49	Male n = 28	All n = 77	Female n = 65	Male n = 55	All n = 120	df	F	p	df	F	p			
Health related quality of life							8,186	2.48	.014	8,186	2.58	.000	8,186	16.47	.011
Physical functioning	89.18 (12.39)	93.93 (7.74)	90.91 (11.11)	90.46 (14.33)	91.73 (16.02)	91.04 (15.08)	1,193	0.05	.822	1,193	2.16	.143	1,193	0.72	.396
Physical role functioning	72.70 (32.54)	75.89 (35.01)	73.86 (33.27)	76.92 (32.19)	79.09 (34.53)	77.92 (33.16)	1,193	0.55	.459	1,193	0.29	.592	1,193	0.01	.919
Bodily pain	50.12 (15.21)	21.86 (23.32)	39.84 (22.95)	48.85 (14.18)	28.24 (23.98)	39.40 (21.81)	1,193	0.80	.371	1,193	73.73	.000	1,193	1.81	.180
General health perceptions	51.10 (20.54)	55.39 (12.25)	52.66 (18.00)	63.24 (21.54)	56.38 (10.64)	60.10 (17.68)	1,193	6.17	.014	1,193	0.24	.627	1,193	4.46	.036
Vitality	40.97 (22.05)	46.07 (12.27)	42.82 (19.15)	46.12 (18.39)	47.36 (11.54)	46.69 (15.58)	1,193	1.59	.209	1,193	1.54	.216	1,193	0.57	.452
Social role functioning	52.55 (33.36)	47.32 (9.23)	50.65 (27.20)	71.92 (28.90)	48.86 (11.10)	61.35 (25.26)	1,193	8.13	.005	1,193	14.87	.000	1,193	5.91	.016
Emotional role functioning	47.62 (40.68)	50.60 (41.45)	48.70 (40.71)	66.15 (40.61)	69.39 (38.99)	67.64 (39.74)	1,193	9.57	.002	1,193	0.27	.607	1,193	0.00	.983
Mental health	44.57 (21.48)	57.86 (11.29)	49.40 (19.44)	58.77 (21.89)	59.13 (10.29)	58.93 (17.48)	1,193	8.31	.004	1,193	6.47	.012	1,193	5.81	.017
Psychological functioning							9,185	3.89	.000	9,185	14.42	.000	9,185	2.77	.005
Somatization	6.41 (4.71)	5.04 (4.32)	5.91 (4.59)	3.75 (4.95)	3.36 (3.11)	3.58 (4.19)	1,193	11.01	.001	1,193	1.83	.178	1,193	0.57	.452
Obsessive-compulsive	13.86 (4.86)	11.21 (5.01)	12.90 (5.05)	7.58 (6.06)	8.98 (5.28)	8.23 (5.74)	1,193	27.45	.000	1,193	0.59	.444	1,193	6.19	.014
Interpersonal sensitivity	8.39 (4.53)	4.79 (2.44)	7.08 (4.25)	4.74 (4.27)	4.80 (2.20)	4.77 (3.46)	1,193	11.07	.001	1,193	10.50	.001	1,193	11.24	.001
Depression	9.76 (5.54)	8.21 (2.50)	9.19 (4.71)	5.40 (5.16)	8.60 (2.14)	6.87 (4.36)	1,193	9.43	.002	1,193	1.65	.201	1,193	13.45	.000
Anxiety	10.27 (6.74)	8.25 (2.77)	9.53 (5.69)	5.49 (5.82)	7.58 (2.90)	6.45 (4.81)	1,193	12.71	.000	1,193	0.00	.961	1,193	7.23	.008
Hostility	8.84 (5.06)	5.64 (2.95)	7.68 (4.65)	5.02 (4.27)	4.65 (3.77)	4.85 (4.03)	1,193	14.66	.000	1,193	8.01	.005	1,193	5.09	.025
Phobic anxiety	5.12 (4.45)	4.07 (4.36)	4.74 (4.42)	2.00 (3.44)	2.02 (2.44)	2.01 (3.01)	1,193	22.69	.000	1,193	0.90	.343	1,193	0.97	.326
Paranoid ideation	7.71 (5.51)	6.96 (4.19)	7.44 (5.06)	4.11 (4.60)	4.49 (3.47)	4.28 (4.11)	1,193	20.21	.000	1,193	0.07	.787	1,193	0.70	.403

Psychoticism	7.27 (4.94)	9.00 (1.89)	7.90 (4.17)	3.42 (4.57)	7.44 (2.42)	5.26 (4.23)	1,193	21.61	.000	1,193	24.42	.000	1,193	3.85	.051
Dietary habits							4,190	2.79	.027	4,190	9.46	.000	4,190	2.13	.073
Cognitive restraint of eating	8.34 (4.36)	6.32 (3.10)	7.60 (4.05)	6.71 (4.06)	4.80 (2.73)	5.83 (3.62)	1,193	8.13	.005	1,193	12.60	.000	1,193	0.01	.923
Disinhibition	18.86 (8.80)	17.11 (6.68)	18.22 (8.09)	18.02 (7.17)	19.46 (5.66)	18.68 (6.54)	1,193	0.50	.482	1,193	0.02	.888	1,193	2.21	.138
Hunger	7.26 (4.25)	7.73 (3.31)	7.43 (3.92)	6.37 (3.19)	6.17 (3.55)	6.28 (3.34)	1,193	5.16	.024	1,193	0.07	.795	1,193	0.39	.532
EVT	51.76 (12.09)	44.29 (4.44)	49.04 (10.60)	46.11 (6.69)	43.33 (4.79)	44.83 (6.04)	1,193	8.06	.000	1,193	19.40	.000	1,193	4.06	.045
Achievement Motivation							17,177	5.26	.000	17,177	4.74	.000	17,177	1.63	.061
Persistence	27.90 (6.34)	29.50 (11.47)	28.48 (8.53)	36.89 (12.34)	32.89 (9.03)	35.06 (11.08)	1,193	16.82	.000	1,193	0.63	.428	1,193	3.44	.065
Dominance	46.80 (11.16)	51.00 (8.33)	48.32 (10.36)	44.95 (8.22)	46.00 (9.96)	45.43 (9.03)	1,193	5.75	.017	1,193	3.38	.067	1,193	1.22	.270
Engagement	41.82 (11.77)	30.96 (11.93)	37.87 (12.87)	34.26 (12.75)	32.40 (10.50)	33.41 (11.76)	1,193	3.00	.085	1,193	12.96	.000	1,193	6.48	.012
Confidence in success	39.31 (12.43)	49.46 (11.62)	43.00 (13.03)	43.43 (10.51)	45.11 (10.41)	44.20 (10.45)	1,193	0.01	.945	1,193	12.57	.000	1,193	6.45	.012
Flexibility	46.76 (7.70)	49.54 (10.76)	47.77 (8.97)	46.11 (9.78)	47.78 (8.45)	46.88 (9.19)	1,193	0.78	.379	1,193	2.68	.103	1,193	0.17	.685
Flow	53.31 (11.48)	52.21 (11.19)	52.91 (11.31)	46.48 (10.22)	45.55 (9.52)	46.05 (9.87)	1,193	18.43	.000	1,193	0.41	.521	1,193	0.00	.959
Fearlessness	27.53 (11.83)	35.75 (13.68)	30.52 (13.07)	35.58 (12.14)	39.18 (10.35)	37.23 (11.45)	1,193	10.52	.001	1,193	11.13	.001	1,193	1.70	.193
Internality	44.88 (9.02)	42.39 (6.41)	43.97 (8.21)	47.89 (8.74)	46.60 (7.92)	47.30 (8.37)	1,193	8.44	.004	1,193	2.31	.130	1,193	0.23	.632
Compensatory Effort	46.73 (12.28)	40.39 (10.90)	44.43 (12.12)	44.91 (9.96)	38.80 (8.65)	42.11 (9.83)	1,193	1.21	.273	3,191	16.00	.000	3,191	0.01	.940
Pride in Productivity	55.06 (10.67)	53.07 (10.88)	54.34 (10.72)	52.78 (8.75)	50.24 (8.79)	51.62 (8.83)	3,191	3.17	.077	1,193	2.50	.116	1,193	0.04	.846
Eagerness to learn	49.29 (10.21)	50.29 (11.09)	49.65 (10.48)	44.03 (9.31)	45.31 (9.06)	44.62 (9.18)	1,193	12.30	.001	1,193	0.61	.436	1,193	0.01	.924
Preference for difficult tasks	41.69 (13.07)	44.50 (12.83)	42.71 (12.97)	40.88 (11.09)	40.27 (11.32)	40.60 (11.15)	1,193	2.00	.159	1,193	0.38	.538	1,193	0.91	.341
Independence	40.18 (10.69)	45.00 (8.96)	41.94 (10.31)	41.62 (9.11)	42.04 (9.06)	41.81 (9.05)	1,193	0.29	.591	1,193	3.39	.067	1,193	2.39	.124
Self-control	27.78 (8.03)	25.57 (10.18)	26.97 (8.87)	36.48 (12.45)	31.29 (7.77)	34.10 (10.84)	1,193	23.45	.000	1,193	6.16	.014	1,193	1.00	.318
Status orientation	50.35 (13.18)	51.75 (9.81)	50.86 (12.01)	41.62 (10.23)	42.78 (11.02)	42.15 (10.57)	1,193	27.88	.000	1,193	0.59	.444	1,193	0.01	.944
Competitiveness	49.35 (13.69)	47.50 (12.24)	48.68 (13.13)	43.17 (11.89)	41.58 (10.26)	42.44 (11.15)	1,193	11.34	.001	1,193	0.91	.340	1,193	0.01	.942
Goal setting	46.39 (8.87)	46.57 (9.35)	46.45 (8.99)	41.29 (9.44)	42.04 (9.09)	41.63 (9.25)	1,193	12.24	.001	1,193	0.11	.736	1,193	0.04	.839

Der Artikel „Merkt, J., Singmann, H., Bodenbug, S., Goossens-Merkt, H., Kappes, A., Wendt, M., & Gawrilow, C. (in press). Flanker Performance in Female College Students with ADHD – A Diffusion Model Analysis. *ADHD*.“ wird aus urheberrechtlichen Gründen in der elektronischen Version der Dissertation nicht veröffentlicht.

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12. Lebenslauf

Der Lebenslauf wird aus datenschutzrechtlichen Gründen in der elektronischen Version der Dissertation nicht veröffentlicht.

Publikationen

- Ehm, J.-H., Merkt, J., Gawrilow, C., & Hasselhorn, M. (in press). Selbstkonzept und Schulleistungen von Grundschulern mit ADHS-Symptomen. *Zeitschrift für Entwicklungspsychologie und Pädagogische Psychologie*.
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Konferenzbeiträge / Vorträge

- Merkt, J. & Gawrilow, C. (Oktober, 2013). Prediction of ADHD symptoms and academic skills by measures of executive function. Poster auf dem 23rd Euethydis Network Meeting, Prag, Tschechien.
- Guderjahn, L., Fäsche, A., Gunzenhauser, C., Merkt, J., von Suchodoletz, A., & Gawrilow, C. (2013, Juni). *ADHD symptoms predict early math skills in preschool children*. Poster auf dem 4th World Congress on ADHD, Mailand, Italien.
- Merkt, J., Beck, L., Ernsthaus, J., Huschka, S., Kremer, S., Mikles, B., Thormählen, E., & Gawrilow, C. (2013, Juni). “*Uninhibited Imaginations*” - *Relation of impulsivity and creativity in college students*. Poster auf dem 4th World Congress on ADHD, Mailand, Italien.
- Merkt, J., Ehm, J.-H., Hasselhorn, M., & Gawrilow, C. (2013, Juni). *Self-concept and academic achievement of elementary school students with ADHD symptoms*. Poster auf dem 4th World Congress on ADHD, Mailand, Italien.
- Wirth, A., Merkt, J., Guzialowski, M., Luedecke, J., Nabi, C., Schmelz, J., Schmidt, A., Steinhübel, L., & Gawrilow, C. (2013, Juni). *Actually really irresistible: Impulsivity predicts M&M consumption*. Poster auf dem 4th World Congress on ADHD, Mailand, Italien.
- Gawrilow, C. & Merkt, J. (2013, April). *Association between ADHD symptoms in kindergarten and school performance in first grade: Teacher ratings outperform parent ratings*. Poster auf dem SRCD Biennial Meeting, Seattle, USA.
- Merkt, J., Singmann, H., & Gawrilow, C. (2012, Mai). *Relating obsessive-compulsive behavior to information uptake in female college students with ADHD*. Poster auf der Eunethydis 2nd International ADHD Conference, Barcelona, Spanien.
- Merkt, J. & Gawrilow, C. (2012, April). *Interrelations Between Measures of Shifting, Inhibition, and ADHD Symptoms in Preschool*. Poster auf dem Development of Executive Functions Workshop, Utrecht, Niederlande.
- Merkt, J. & Gawrilow, C. (2011, September). *Selbstregulation, exekutive Funktionen und ADHS-Symptome im Übergang von Kindergarten zur Grundschule*. Vortrag auf der 13. Fachgruppentagung der Pädagogischen Psychologie der DGPs, Erfurt, Deutschland.

- Merkt, J. & Gawrilow, C. (2011, Mai). *Measures of Inhibition Support the Prediction of Early Academic Skills*. Poster auf dem 3rd International Congress on ADHD, Berlin, Deutschland.
- Merkt, J. & Gawrilow, C. (2010, Mai). *Health, Dietary Habits, and Achievement Motivation in College Students With ADHD*. Poster auf der 22nd Annual Convention of the APS, Boston, USA.
- Merkt, J. & Gawrilow, C. (2009, Mai). *Multitasking in ADHD*. Poster auf der 21st Annual Convention of the APS, San Francisco, USA.
- Gawrilow, C., Merkt, J., Albert, J., Singmann, H., Kappes, A., & Wendt, M. (2009, Mai). *Reduced Interference of Distractor Stimuli in Female Undergraduates With ADHD*. Poster auf der 21st Annual Convention of the APS, San Francisco, USA.
- Albert, J., Singmann, H., Merkt, J., Schweikert, L., Kappes, A., Köhler, D., Gawrilow, C., & Wendt, M. (2009, Mai). *Social Presence Enhances Selective Spatial Attention Without Reducing Adaptation to Distractor Utility*. Poster auf der 21st Annual Convention of the APS, San Francisco, USA.
- Singmann, H., Merkt, J., Albert, J., Schweikert, L., Kappes, A., Köhler, D., Gawrilow, C., Wendt, M. (2009, April). *Soziale Erleichterung in der Flankierungsaufgabe*. Poster auf der Tagung Experimentell arbeitender Psychologen, Jena, Deutschland.
- Merkt, J., Gawrilow, C., Oettingen, G., & Gollwitzer, P. M. (2008, Mai). *If-Then Plans Improve Multitasking in Children with ADHD*. Poster auf der 20th Annual Convention of the APS, Chicago, USA.

13. Danksagung

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14. Anteilserklärung

Studie 1: Ehm, J.-H., Merkt, J., Gawrilow, C., & Hasselhorn, M. (in press). Selbstkonzept und Schulleistungen von Grundschulern mit ADHS-Symptomen. *Zeitschrift für Entwicklungspsychologie und Pädagogische Psychologie*.

- Die Daten wurden im Rahmen des Projektes „Schulreifes Kind“ erhoben. Aus der Gesamtstichprobe von 1675 Schülern wurden Teilstichproben gezogen um das Selbstkonzept bei Kindern mit und ohne ADHS-Symptomen untersuchen zu können
- Konzeption der Forschungsfrage und des Designs (mit Herrn Ehm)
- Beitrag des theoretischen Hintergrundes zum Selbstkonzept bei Kindern mit ADHS
- Anfertigung des Manuskriptes (mit Herrn Ehm, Frau Gawrilow und Herrn Hasselhorn)
- Überarbeitung des Manuskriptes nach den Rückmeldungen der Reviwer (mit Herrn Ehm, Frau Gawrilow und Herrn Hasselhorn)
- Keine Mitwirkung bei der Konzeption der Studie, der Auswahl der Erhebungsinstrumente, der Rekrutierung der Strichprobe, der Erhebung, Aufbereitung und Auswertung der Daten, oder der Submission des Manuskriptes (Mitarbeiter des Projektes „Schulreifes Kind“, Herr Ehm und Herr Hasselhorn)

Studie 2: Merkt, J., & Gawrilow, C. (submitted). Health, Dietary Habits, and Achievement Motivation in College Students with Self-Reported ADHD Diagnosis. *Journal of Attention Disorders*.

- Konzeption der Forschungsfrage und des Designs (mit Frau Gawrilow)
- Auswahl der Fragebögen (mit Frau Gawrilow und Praktikantinnen)
- Rekrutierung der Stichprobe über die Onlineplattform Studie VZ (mit Praktikantinnen)
- Aufbereitung der Daten

- Auswertung der Daten
- Anfertigung des Manuskriptes
- Überarbeitung des Manuskriptes (mit Frau Gawrilow)
- Submission des Manuskriptes

Studie 3: Merkt, J., Singmann, H., Bodenburg, S., Goossens-Merkt, H., Kappes, A., Wendt, M., & Gawrilow, C. (in press). Flanker Performance in Female College Students with ADHD – A Diffusion Model Analysis. *ADHD*.

- Rekrutierung von Studentinnen mit und ohne ADHS (mit Herrn Goossens-Merkt und Frau Gawrilow)
- Koordination der Testungen an der Universität und der Diagnostik in der neuropsychologischen Praxis
- Testung von Teilnehmerinnen an der Uni (mit Praktikantinnen)
- Durchführung der neuropsychologischen Diagnostik (mit Praktikantinnen)
- Statistische Auswertung des Zusammenhanges von Parametern des Diffusionsmodelles und dem Fragebogen zur psychischen Beeinträchtigung
- Substantielle Überarbeitung des Manuskriptes
- Submission des Manuskriptes
- Überarbeitung des Manuskriptes nach den Rückmeldungen der Reviewer (mit allen Koautoren)
- Keine Mitarbeit bei der Konzeption der Forschungsfrage und des Designs (Herr Kappes, Herr Wendt und Frau Gawrilow), bei der Auswahl der Erhebungsinstrumente (Herr Kappes, Herr Wendt und Frau Gawrilow), der Diagnostik der Teilnehmerinnen (Herr Bodenburg und Herr Goossens-Merkt), der Aufbereitung und Auswertung der Daten der Flankeraufgabe (Herr Singmann), oder der Anfertigung des ersten Manuskript-Entwurfes (Frau Gawrilow)

15. Erklärungen und Eidesstattliche Versicherung

Erklärung zu bisherigen Promotionsverfahren

Ich erkläre hiermit, dass ich mich bisher keiner Doktorprüfung unterzogen habe.

Frankfurt am Main, den 28.10.2013

Erklärung zur Promotionsordnung

Ich erkläre hiermit, dass mir die Promotionsordnung der Johann Wolfgang Goethe-Universität Frankfurt bekannt ist.

Frankfurt am Main, den 28.10.2013

Eidesstattliche Versicherung

Ich erkläre hiermit an Eides Statt, dass ich die vorgelegte Dissertation über „Psychological Compensation in Attention Deficit Hyperactivity Disorder – Application of a Theoretical Framework“ selbstständig angefertigt und mich nicht anderer Hilfsmittel als der in ihr angegebenen bedient habe, insbesondere, dass alle Entlehnungen aus anderen Schriften mit Angabe der betreffenden Schrift gekennzeichnet sind.

Ich versichere, nicht die Hilfe einer kommerziellen Promotionsvermittlung in Anspruch genommen zu haben.

Frankfurt am Main, den 28.10.2013