Associations Between ADHD and Self-Regulated Learning Strategies in University Students: Exploring the Role of Self-Compassion.

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Abstract

Objective: The present study examined the relationship between the use of self-regulated learning strategies and attention deficit hyperactivity disorder. It further explored the potential role of self-compassion as a mediating or moderating factor within this relationship.

Method: Participants were 168 college students, aged 16 to 29 (*M* = 19.68, *SD* = 1.96), from a Dutch university who completed the Conners' Adult ADHD Rating Scales self-report long version, a shortened, generalized version of the Motivated Strategies for Learning Questionnaire and the long version of the Self-Compassion Scale. Statistical analyses were performed using the PROCESS macro for SPSS.

Results: Among college students, attention deficit hyperactivity disorder symptomatology was significantly negatively associated with the use of self-regulated learning strategies (R^2 =.04, *F* (1, 166) = 7.41, $p < .0072$). Additionally, analyses revealed no significant role of self-compassion within this relationship.

Conclusion: Findings from this study show that students who exhibit more characteristics of attention deficit hyperactivity disorder tend to use less self-regulated learning strategies in the context of their academic education. Therefore, boosting self-regulated learning strategies might be a promising way to enhance academic performance in individuals with attention deficit hyperactivity disorder, which should further be investigated in future intervention studies. As self-compassion did not emerge as a moderator or mediator of this relationship alternative factors that may explain the relationship between symptoms of attention deficit hyperactivity disorder and self-regulated learning strategies are discussed.

Keywords: attention deficit hyperactivity disorder, academic performance, self-regulated learning, self-compassion

Associations between ADHD and Self-Regulated Learning Strategies in University Students: Exploring the Role of Self-Compassion.

Attention deficit hyperactivity disorder (ADHD) is a neurodevelopmental disorder characterized by persistent patterns of inattention, hyperactivity, and impulsivity, significantly impacting daily functioning (American Psychiatric Association, 2013). Individuals differ significantly from each other in their clinical picture and can experience individual fluctuations within the clinical presentation that are influenced by different factors, such as/including social, educational, or occupational demands (Pacheco, 2022; see Appendix A). ADHD is particularly known to be associated with impairments within the academic context (Stevens et al., 2022). Accordingly, meta-analytic evidence suggests that children impacted by ADHD tend to achieve academic scores below the average (Frazier et al., 2007). This becomes evident through lower performance on standardized achievement tests, longer duration to finish secondary school, dropouts, fewer obtained secondary degrees, less prevalence in higher education, and lower likelihood of finishing and obtaining a higher educational degree in comparison to the general population (Advokat et al., 2011; Kuriyan et al., 2013). Additionally, individuals diagnosed with ADHD are far less represented in universities compared to individuals of the general population (Stevens, 2020). Whereas previous studies primarily focused on ADHD in children and adolescent, publications on the adult population with ADHD are less represented in research. However, the number of students with ADHD at universities is increasing (Blase et al., 2009; DuPaul et al., 2009; Wolf, 2001 as cited in Shelton et al., 2019) highlighting the importance of investigating ADHD in the university student population. More specifically, as the number of people being diagnosed with ADHD is increasing worldwide (Blase et al., 2009), with a global prevalence of 5.9% in youth (Willcutt 2015, as cited in Faraone et al., 2021) and 2.8% in adults (Fayyad et al., 2017, as cited in Faraone et al., 2021), there is a need for in-depth research on potential factors affecting the academic success of individuals with ADHD in order to provide the possibility of equal chances of achieving satisfying academic results. This is particularly important, considering that educational achievements of individuals with ADHD seem to affect later

occupational success. Research shows that overall, fewer individuals with a diagnosis are represented in the labour market (Kuriyan et al., 2013). Furthermore, academic-related jobs are much fewer obtained by individuals with ADHD symptomatology and the socioeconomic status of people with ADHD is on average lower in comparison with the general population (Kuriyan et al., 2013).

Considering the negative consequences of poorer educational performance, there is a need to investigate compensatory habits and skills, that might benefit affected individuals with regard to their educational performance (Henderson, 2001; Norwalk et al., 2009; Wolf, 2001). The educational difficulties of individuals with ADHD are attributed to impaired executive functioning, which negatively impacts their academic achievements (Weyandt et al., 2013). It has been shown that individuals with ADHD who implement planning-, strategically monitoring study behavior, carry out study skills, and setting goals, do have a higher success rate in academia than those who do not use these skills (Stevens et al., 2022). However, individuals with ADHD report less frequent use of learning strategies (Du Paul et al., 2021), face challenges in executing goal-directed behaviors, and often prioritize leisure activities over academic responsibilities (Stevens et al., 2022).

The current study aims to investigate the relationship between ADHD and learning strategies within an academic context. The study draws on earlier work by Shelton and colleagues (2019) on the relationship between ADHD and the use of self-regulated learning (SRL) strategies. Their findings indicate that the ADHD symptom of inattention was positively related to the use of self-regulated learning strategies and hyperactivity/impulsivity was deemed a protective factor. To deepen the understanding of this relationship we aim to partially replicate this study to contribute to a stronger foundation for this relationship. We furthermore extend this line of research by investigating the role of self-compassion in the relationship between ADHD and SRL strategies in a sample of university students.

Self-Regulated Learning Strategies

Studying in higher education requires a self-regulated habitus due to the loose structure of the higher educational sector. This might be particularly challenging for students with ADHD. Past research has shown that using learning strategies is positively related to average grades for students after the first year in college (Stevens et al., 2022), and the use of learning strategies could be particularly helpful for people with ADHD. According to Pintrich (1995), self-regulated learning strategies represent a learning pattern in students that is characterised by controlled learning, devoted to behavior, motivation, affect, and cognition. It describes the ability to monitor and judge one's own performance and having control about own actions. "In short, self-regulated learning involves the active, goal-directed, self-control of behavior motivation and cognition for academic tasks by individual students." (Pintrich, 1995, p. 5). SRL strategies have been shown to improve self-set learning goals and lead to a better performance in academia (Garner, 2009; Pintrich, 1995; Schunk, 2020). Students can improve their SRL strategies on their own, or in cooperation with their teacher by receiving feedback on their performance and learning about different tools, which leaves great potential for interventions (Pintrich, 1995). Using SRL strategies might be especially important for college students` academic success since close supervision from teachers and parents is known to be reduced after secondary education (Wolf, 2001). However, skills that are established by learning interventions may become routinized and therefore contribute to greater academic achievements among individuals with ADHD (Du Paul et al., 2020).

As we consider the importance of SRL strategies in academic success, factors like motivation, mastery goals and self-efficacy beliefs are known to influence the effectiveness of SRL strategies (Pintrich, 2995). In line with this, the subsequent discussion on self-compassion aims to unveil its potential role within the relationship between ADHD and SRL strategies.

Self-Compassion

Facing difficulties in life, individuals with ADHD exhibit higher degrees of negative self-statements than controls (Du Paul et al., 2020). They also have higher levels of negative emotions

such as frustration and anxiety than controls, as well as more difficulties with emotion regulation (Stevens et al., 2022). Consistent with previously mentioned academic hurdles, individuals with ADHD often display a low sense of self-worth, and/or depressive symptoms (Du Paul et al., 2020).

In relation to that, self-compassion as a construct, developed by Neff (2003), describes how individuals relate to themselves when confronted with personal failure, personal inadequacy, or personal suffering. Self-compassion describes a warm and caring feeling regarding the self. Moreover, it entails that people can be present with their discomfort in a nurturing, tender, and accepting way. Furthermore, self-compassion has a diminishing effect on negative thinking and automatic thinking processes, it decreases emotional avoidance tendencies and enhances emotional regulation skills (Neff, 2003). Thus, self-compassion is a safe, and non-judgemental approach to confront one´s own negative characteristics (Neff, 2003). The clinical relevance of self-compassion lies in the potential of training. Next to informal practices like speaking kindly to oneself, mindfulness-based self-compassion intervention programs, but also mindfulness-based stress reduction are known to increase self-compassion within individuals (Neff, 2023).

Building on this, Akin (2008) revealed a positive association between self-compassion and the tendency to approach learning with a positive goal-orientated attitude. Individuals with higher levels of self-compassion tend to navigate negative life experiences by eliminating or adapting factors leading to failure, avoiding self-blame, and negative self-criticism to facilitate behavior and cognition (Akin, 2008). Neff and colleagues (2007) discovered that individuals with ADHD are more prone to self-criticism and less likely to exhibit self-compassion compared to those without ADHD.

Given ADHD's inherent challenges of distraction, disorganization, and impulsivity, individuals with ADHD are predisposed to difficulties in planning and self-discipline. The disappointments associated with these challenges often lead to avoidant coping strategies (Farmer, 2022). However, self-compassion has the potential to influence this pattern (Beaton, 2021). Farmer (2022) highlights that by fostering self-compassion, individuals with ADHD can enhance their general self-regulation capacities. They tested the relationship between ADHD, self-compassion and emotional regulation

suggesting that self-compassion is strongly associated with the ability to regulate one´s emotions. This relationship in turn is supposed to influence the well-being of individuals with ADHD. In essence, self-compassion becomes a valuable resource in navigating the complexities associated with ADHD symptoms.

Willoughby and Evans (2019) investigated the relationship between self-compassion and individuals with learning disabilities and/or ADHD among university students. The study suggests that individuals with ADHD score low on self-compassion in comparison to their controls. The relationship between ADHD, SRL strategies and self-compassion was examined, showing that ADHD was associated with reduced SRL strategies. Moreover, ADHD was negatively related to self-compassion. However, the study did not find a significant relationship between SRL strategies and self-compassion (Willoughby & Evans, 2019). It is important to note that Willoughby and Evans (2019) used a sample of students identifying with either learning disabilities, or ADHD: they used a taxonomical approach on ADHD and did not include a healthy control group which makes it more challenging to rule out alternative explanations or factors that may contribute to the relationship between the measured variables and thereby also reducing internal validity of the measured variables.

Furthermore, the study might have been underpowered with a sample of only 30 students. The present study addresses some of the aforementioned limitations. Firstly, we used a larger sample size to ensure sufficient power to detect the hypothesized effects. Secondly, we adopt a dimensional approach of ADHD to not only capture the heterogeneity of the disorder but to be able to provide an adequate comparison between people who score higher on self-reported ADHD and people who score lower (Conners et al., 1999).

The Present Study

Based on previous research suggesting that SRL strategies can benefit academic achievement in people with ADHD symptomatology and in the face of the current replication crisis (Zwaan et al., 2018), the current study aims to strengthen the robustness of previous findings

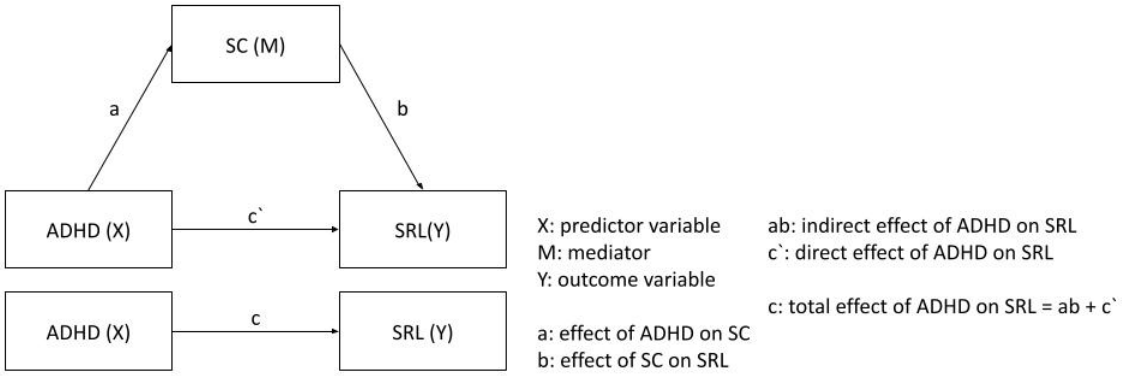
understanding of the relationship between ADHD and SRL strategies in university students. In line with that, the present study aims to partially replicate findings by Shelton and colleagues (2019).

Given the potential that self-compassion bears in context of personal drawbacks we additionally yield to explore the role of self-compassion within the relationship of ADHD symptomatology and SRL strategies based on the study by Willoughby and Evans (2019). The current study employs a cross-sectional design and uses self-reports of first-year psychology students at the University of Groningen (Nederland), since first-year academic performance is a strong predictor of attaining a degree and obtaining an occupation (Stevens, 2020).

First, we hypothesize that ADHD symptoms are negatively correlated to students' application of SRL strategies. Second, we explore whether self-compassion serves as a mediator between ADHD and SRL strategies, such that we assume an increase of symptomatology of ADHD is associated with reduced self-compassion, which in turn is associated with lower use of SRL strategies (see Figure 1.).

Figure 1

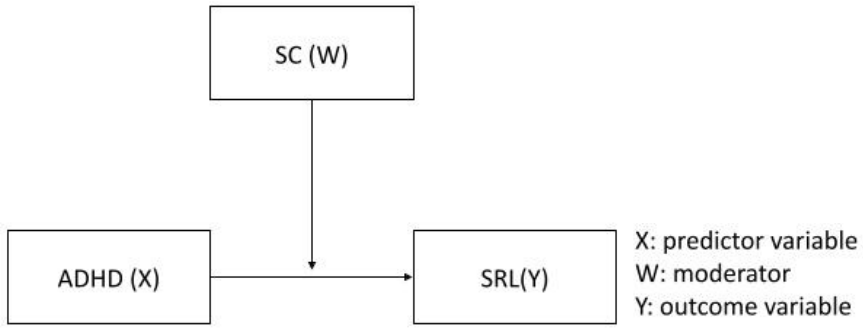
Mediation Model



Third, as an alternative to our proposed mediation, we want to explore whether self-compassion functions as a moderator within this relationship, such that the amount of self-compassion influences the strength of the effect of ADHD on SRL strategies (see Figure 2).

Figure 2

Moderation Model



Method

Participants

The sample of our study consisted of first-year students from the Dutch and International track of the Psychology B.Sc. program of the University of Groningen (UG), the Netherlands. The participant recruitment was facilitated through the Experiment Management System (SONA), serving as an integral component of the students' coursework. Participation was voluntary and participants received course credits (SONA credits) as compensation. Prior to their involvement in the present study, participants took a self-report assessment on ADHD symptomatology. Inclusion criteria for this study entailed language proficiency in English and completion of the self-report assessment on ADHD symptoms. Consistently, the study was conducted in English. We excluded 69 participants from the analysis for reasons such as incomplete data or failure to correctly answer the honesty/attention question and the inconsistency/infrequency index.

The final sample consisted of 168 participants, of which 76% were female (*n*=127), 23% male (*n*=38) and 2% other (*n*=3) (see Table B1). The ages of the participants ranged from 16 to 29 (*M* =

19.68, *SD* = 1.96) (see Table B2). In terms of their first language, the majority indicated Dutch as their first language (53%), followed by German (12%).

Materials

Self-Regulated Learning Strategies

Self-regulated learning (SRL) strategies were assessed with the Motivated Strategies for Learning Questionnaire (MSLQ), which is based on the conceptualization of self-regulated learning by Pintrich (1995). The questionnaire investigates both motivational and cognitive components of academic learning strategies. In total, this self-report instrument includes 85 items, which were designed to measure the attitudes towards learning and learning strategies (Wang et al., 2022). We slightly adapted the items, such that the questions referred to the course Introduction to Psychology (English track) or "Overzicht in de psychologie" (Dutch track). Items were rated on a 7-point Likert-type scale ranging from 1 (*not at all true for me*) to 7 (*very true of me*). While the MSLQ is originally divided into 15 different subscales, we used a measure that is based on the three-factor model of the MSLQ developed by Hilpert and colleagues (2013). The factor structure consists of 38 of the original 81 items to investigate SRL strategies. The first factor is the Expectancy scale, which consists of two subscales: Self-Efficacy and Control of Learning, and summarizes internal efforts, task mastery appraisals, and expectancy of task performance. The second factor is The Value scale, which consists of two subscales: Intrinsic Goal Orientation and Task Value which describes the subjective internal value, importance, and usefulness of accomplishing academic tasks. The third factor: the Self-Regulation-Scale consists of two subscales: Metacognitive Regulation and Effort Regulation and summarizes the usage of self-regulatory strategies like planning, monitoring, and regulating learning as well as the ability to stay focused (Hilpert et al., 2013).

According to Hilpert and colleagues (2013), the alpha level ranges from $\alpha = .64$ to $\alpha = .80$. Moreover, the MSLQ contains predictive validity on attained final grades, but the correlation has a modest value (Shelton et al., 2017).

ADHD

To assess ADHD, we used the DSM-IV ADHD Symptoms Total Scale of the CAARS-S:L which is the self-report long form of Connor's Adult ADHD Rating Scale (CAARS) to assess ADHD.

The CAARS-S:L consists of 66 items. The items are measured on a 4-point Likert-scale from (0 = *Not at all, never*; 1 = *Just a little, once in a while*; 2 = *Pretty much, often*, 3 = *Very much, very frequently*). In total the scale consists of nine subscales which of four factor-derived subscales, three symptom measures according to the DSM-IV (APA, 1994), an ADHD Index, and an Inconsistency Index subscale. To measure ADHD symptoms, the subscale of the DSM-IV was used. This measures the total amount of ADHD symptoms without differentiation between the inattentive or hyperactive-impulsive symptoms (APA, 1994). Flory and colleagues (2021) revealed in their factor analysis that this unidimensional analysis of ADHD is superior to a bifactorial or a three-factorial model for the representation of a non-clinical sample of college students.

The Inconsistency Index is constructed to evaluate inconsistencies in the participant`s response to items that measure related content (e.g., 'I'm disorganized' and 'I'm absent-minded in daily activities'). According to Conners and colleagues (1999) using a cut of score of 8 is best suited and therefore used in the present study.

The CAARS-S:L has shown to be a valid measure of ADHD symptoms. According to Conners and colleagues (1999), the test met the criteria for a good fit, and the intercorrelations of the subscales provided support for the multidimensionality of the CAARS. Both indicate factorial validity. The four factor-derived subscales and the ADHD Index were assessed for discriminant validity with both showing good results (the former 85% overall correct classification and the latter 73% overall correct classification) (Conners et al., 1999). Lastly, the construct validity was evaluated by looking at the relationship between childhood and current symptoms as well as, self-report and observer ratings. Both cases support the argument that the CAARS has good construct validity (Conners et al., 1999). The self-report forms were normed on a large sample of nonclinical adults (*N* = 1.026) ranging from 18 to 72 years old.

The CAARS-S:L does not include a measure to assess noncredible self-report. The included Inconstancy Index only measures inconsistency in responding to items that measure the same content. An Infrequency Index for CAARS (CII) was therefore designed by Suhr et al. (2010). According to their research, it is not difficult for a motivated participant to identify the ADHD symptoms and to simulate having these, which makes it necessary for an additional instrument that measures this potential overreporting (Suhr et al., 2010). The constructed CII was found to have a good internal consistency with a Cronbach's Alpha of α = .86. Using a cutoff score of 22 was found to give the best results, being specific and relatively sensitive to an external criterion of validity, noncredible cognitive performance. The use of the CII adds 15 items to the CAARS-S:L making it a questionnaire with a total of 81 items (Conners et al., 1999). .

The CAARS-S:L does not include a measure to assess noncredible self-report. The reliability of the CAARS-S:L has proven to be good. The internal consistency of the subscales found in the original study by Conners and colleagues (1999) gives support for this claim, ranging from .64 to .91. The mean inter-item correlations also provide support for the reliability ranging from .14 to .64 in the original study (Conners et al., 1999), and 3.6 to 9.4 in ours. Finally, the test-retest reliability for the CAARS-S:L was originally evaluated with 61 individuals, with an interval of one month.

Self-Compassion

Self-compassion was measured by the long version of the Self-Compassion-Scale (SCS) which was developed by Neff (2003), using an undergraduate sample with an average age of 21,3 years (*n*=71). The SCS is a self-report scale and consists of 26 items using a 5-point Likert-scale from 1 (*Almost never*) to 5 (*Almost always*). These 26-items are compartmentalized in six factors that measure self-kindness, self-judgment, common humanity, isolation, mindfulness, and over-identification. A confirmatory factor analysis (CFA) found an adequate fit for a six-factor structure. Additionally, the CFA found a marginal fit to a single higher-order factor that could explain the intercorrelations between subscales (Neff, 2003).

Further, the internal consistency for the 26-Items in the original study was found to be .92 (Neff, 2003). In addition, the test-retest reliability of the SCS showed solely significant correlations ranging from .80 to .93 (Neff, 2003). Besides that, SCS could demonstrate internal reliability across different studies (e.g., Allen et al. 2012; Neff & Pommier 2013; Werner et al. 2012, as cited in Neff, 2016).

Moreover, the predictive validity could be demonstrated by investigating self-compassion as an independent variable of well-being (Neff, 2003). Furthermore, the SCS encompasses a high group validity, as tested by comparing a sample of practicing Buddhists with a sample of undergraduate students. The group of Buddhists did score higher on self-compassion than the undergraduates (Neff, 2003). Additionally, the SCS shows a good discriminative validity to other self-attitude scales that tested for concepts of self-esteem and narcissism (Neff, 2003).

Procedure

The study was reviewed and approved by the Ethical Committee of Psychology at the University of Groningen (PSY-2021-S-0054), as a study conducted in the context of a bachelor's thesis project. Participants were recruited via the first-year practicum platform SONA, allowing participants to acquire course credits. Only those participants whose demographic information was collected, and whose ADHD symptoms were assessed with the CAARS-S:L (Conners et al., 1999) in the previous studies "PSY-2122-S-0006 Parts 1 & 2" were eligible to participate in the current study.

Administration of the study happened digitally, via Qualtrics (https://www.qualtrics.com), participants were briefed about the study, then signed informed consent forms, and subsequently were able to begin the questionnaire parts of the study. Firstly, they completed the MSLQ, then the SCS, and thirdly they optionally, after consent, provided their grade on the course Introduction to Psychology/Inleiding in de Psychologie (PSBE1-01/PSBA1-01, respectively).

Before ending the survey, participants were asked to confirm whether they had answered seriously and honestly and whether they would allow us to use their data in our research. On the final screen they were instructed to click the red arrow to receive their SONA credits.

Statistical Analysis

The statistical analysis was done using IBM SPSS Statistics 27. A correlational design was applied. Histograms were examined, revealing that the distribution for all three variables appeared to be approximately normal (see Appendix C).

Analysis was performed using the PROCESS macro for SPSS (see Appendix D). We investigated the relation between ADHD, SRL strategies and self-compassion and explored the indirect effect of the mediation model. In addition, we conducted a moderation analysis testing for an interaction effect between ADHD and self-compassion within the relationship to SRL strategies. Prior to the mediation and the moderation analysis, key assumptions have been tested and confirmed (see Appendix E).

The output of the mediation model provides information about the total effect, namely the effect of ADHD symptomatology on SRL strategies, as well as the indirect effect, namely the extent to which ADHD symptomatology affects SRL strategies indirectly through its effect on self-compassion.

Concerning the mediation model it directly quantifies the development of SRL strategies (Y) by ADHD symptomatology (X) through self-compassion (M) instead of investigating individual pathways, respectively the effect of ADHD on self-compassion (pathway a), the effect of self-compassion on SRL strategies (pathway b) and the direct effect of ADHD symptomatology on SRL strategies (pathway c´) (Figure 1). This provides simplicity to the model and prevents inaccurate inferences based on the results of the individual pathways. The total effect, the influence of ADHD symptomatology (X) on SRL strategies (Y) (pathway c), the direct effect, the influence of ADHD symptomatology (X) on SRL strategies (Y) controlling for self-compassion (M) (pathway c`) and the indirect effect, the influence of ADHD symptomatology (X) through self-compassion (M) (pathway ab) were investigated (Figure 1).

The moderation model was tested by examining the interaction between ADHD symptomatology (X) and self-compassion (W) and aimed to determine whether the relationship

between ADHD symptomatology (X) and SRL strategies (Y) varies depending on different levels of self-compassion (W) (Figure 2). Prior to the analysis, we inverse the variable self-compassion to ensure no unwanted influence based on the direction of the scale.

In addition, both the mediation and moderation model of PROCESS macro enables the inclusion of linear, non-linear, and conditional processes. Also, PROCESS macro engenders results that are less contingent upon sample size variations, thereby enhancing the reproducibility and external validity of empirical findings. Such resilience to sample size discrepancies distinguishes PROCESS from conventional methods, which may exhibit greater susceptibility to inconsistencies across samples, particularly in instances of small sample sizes or data that deviate from underlying assumptions. In sum, PROCESS macro provides a multifaceted testing and is applicable to multiple conditions. With an easy interface and reduced effort, it provides a ground for comparison and replication in the context of research (Hayes & Rockwood, 2017).

Results

Bivariate Correlations

The bivariate correlations among the studied variables are displayed in Table E1. There was a significant negative correlation between ADHD and SRL strategies, r (165) = -.21, p = .01. Moreover, ADHD and self-compassion were negatively correlated, r (165) = -.26, p = .01. Self-compassion, and SRL strategies were positively associated, r (165) = .09, p = .05 (Table E1).

Main Analysis

Hypothesis 1

First, we examined whether ADHD was associated with SRL strategies, the total effect, which corresponds to “pathway c” (Figure 1). In line with Hypothesis 1, the association between ADHD and SRL strategies was significant, R^2 =.04, F (1, 166) = 7.41, p < .0072, and ADHD accounted for 4 % of the total variance in SRL strategies. The analysis further revealed that a one-point increase of the ADHD symptomatology results in a decrease of SRL strategies by .01, t (166) = -2.72, p <.0072, b = -.01, 95% *CI* [−.024, −.004] (see Table F1).

Explorative Hypothesis 2

Next, we explored the mediation of self-compassion on ADHD and SRL as displayed in Figure 1. In line with that we first investigated whether ADHD was associated with SRL strategies controlling for self-compassion, the direct effect, respectively "pathway c`" (see Figure 1). This relationship was found to be significant, a one-point increase of the ADHD symptomatology results in a decrease of SRL strategies by 0.1, t (166) =-2.48, p <.0139, 95% *CI* [-.023, -.003], when controlled for self-compassion (see Table F2). Secondly, we examined the indirect effect. Contrary to Hypothesis 2, the indirect effect between the predictor variable on SRL strategies was not significant, 95% *CI* [−.004, .002] as the decreased use of SRL strategies in people with high ADHD symptomatology is not mediated by self-compassion (see Table F3).

Explorative Hypothesis 3.

Additionally, to explore a moderation effect of self-compassion, we examined the interaction effect of self-compassion and ADHD on SRL strategies (see Figure 2). Given that the confidence interval of the interaction term included zero, 95% *CI* [-.023, .006], the interaction effect was insignificant, which means that different degrees (pathways b1, b2, b3) of self-compassion did not have a substantial influence on the relationship between ADHD symptomatology and SRL strategies (see Figure F1; see Table F4).

Discussion

The present study aimed to partially replicate earlier findings (Shelton et al., 2019) suggesting a negative relationship between ADHD symptoms and the use of self-regulated learning (SRL) strategies in college students and to extend this line of research by additionally exploring the role of self-compassion.

The investigation of ADHD influencing the use of SRL strategies in college students yielded several findings. First, our data revealed covariations between all the unique phenomena: bivariate correlations revealed an association between high levels of ADHD symptoms and lower levels of the use of SRL strategies. Additionally, reported lower levels of self-compassion were related to a higher

level of ADHD symptoms. Besides that, the data revealed a link between higher levels of self-compassion and an increased use of SRL strategies. However, all bivariate correlations were weak (Agresti & Finaly, 2009), and reported values under $r = .3$. Whereas the strength of the association between self-compassion and SRL strategies in our sample is consistent with previous findings (see Willoughby et al., 2019), the interrelation between ADHD symptoms and SRL strategies of our study was low in comparison to our exemplar study by Shelton and colleagues (2019), who reported moderate associations ranging from $r = .35$ to $r = .43$.

Additionally, investigating the predictive effect of ADHD symptoms on the use of SRL strategies our findings were consistent with the study of Shelton and colleagues (2019): individuals who reported more ADHD symptoms were less likely to report the use of SRL strategies suggesting that ADHD symptoms might influence the ability to monitor and adjust study behavior in college students. Nevertheless, the explained variance of ADHD symptoms on SRL strategies in the current study was relatively low at 4%, whereas Shelton and colleagues (2019), reported inattention accounting for 15% of SRL strategies. This might be explained by the methodological differences between the two studies. For the sake of simplicity, the current study did not disaggregate the various facets of ADHD. Consequently, we were unable to thoroughly examine the individual contributions of inattention and hyperactivity/impulsivity, as scrutinized in the exemplar paper by Shelton and colleagues (2019). This limitation may account for the decreased explained variance of ADHD on SRL strategies, in comparison to our exemplar study. In alignment with the findings of Shelton and colleagues (2019), inattention exhibited a negative relationship with SRL strategies, while hyperactivity/impulsivity displayed a positive correlation, suggesting a potentially mitigating influence of hyperactive/impulsive symptoms. Not differentiating these aspects in our study may have resulted in hyperactivity partially diminishing the observable negative impact of ADHD. Further, the current study demonstrated a significant influence of ADHD symptoms on SRL strategies while reported self-compassion was held as a constant.

The present study also aimed to expand the knowledge on the relationship between ADHD symptoms and SRL strategies in college students. Thus, inspired by the study of Willoughby and colleagues (2019), we explored the potential role of self-compassion by conducting an explorative analysis: first, we ran a mediation analysis to see whether the diminished use of SRL strategies in individuals with higher levels of ADHD symptoms might be resolving due to lower levels of self-compassion. Secondly, we ran a moderation analysis to investigate whether different degrees of self-compassion might influence the strength and direction of the use of self-regulated learning in individuals who experience symptoms of ADHD. Contrary to our expectations the explorations could not identify self-compassion as a component in the relationship between ADHD symptoms and the use of SRL strategies. These results suggest searching for alternative explanations to enhance the understanding of study behavior in individuals with ADHD. As a related concept to self-compassion (Smeets et al., 2014), self-efficacy might account for the relationship between ADHD symptoms and academic performance. The MSLQ captures the construct of self-efficacy in its Expectancy subscale (Hilpert et al., 2013). While self-compassion incorporates self-kindness, mindfulness, and common humanity, in the light of experienced individual drawbacks (Neff, 2003), self-efficacy targets beliefs about one's potential to attain a certain outcome. Further, individuals who have greater self-efficacy beliefs are known to put greater effort into a task (Worick et al., 2023). Thus, it might be fruitful to disaggregate the different subscales of the MSLQ and thereby investigate student's self-efficacy beliefs to enable more profound findings concerning ADHD symptoms and academic performance.

Nevertheless, self-compassion holds significance in the realm of ADHD research within the academic context. Research has shown that practicing self-compassion can effectively manage negative self-statements, emotional dysregulation, and difficulties with self-worth (Hirsch et al., 2018). Given that ADHD symptoms often lead to academic challenges, enhancing self-compassion could prove beneficial. By promoting self-compassion, individuals may better navigate negative feedback and mitigate the impact of ADHD-related difficulties. Thus, the role of self-compassion in ADHD research merits ongoing attention and investigation.

Strengths, Limitations, and Future Directions

The current study contributes valuable findings to the discourse on ADHD symptoms in the context of academic demands. Thereby our study demonstrates several strengths: To begin with, we employed validated questionnaires tailored to our target population (Flory et al., 2021; Hilpert et al., 2019) to ensure that we test the concept of interest and control for extraneous factors. Hence, using validated measures also facilitates the consistency in measurements across different contexts and enables the comparison of results between studies.

Additionally, by adopting a dimensional approach to investigate ADHD our study not only facilitates comparisons between individuals exhibiting various degrees of ADHD symptomatology but also comprehensively captures the intrinsic heterogeneity within the ADHD construct itself. The high manifestation and variability of ADHD symptomatology in our study (M = 19.5, SD = 9.87), compared to the normative sample captured by Conners and colleagues (1999) (M = 12.49, SD = 6.44), demonstrates the importance of using the dimensional approach. Coherently, this conceptualization contributes to a reduction of stigmata concerning ADHD by preventing arbitrary boundaries between eligible healthy and unhealthy individuals (Pacheco et al., 2022) and thereby also identifying individuals who may fall below the border of the diagnostic threshold.

In addition, the use of PROCESS macro provided a straightforward and robust analysis enabling us to directly quantify the indirect effect and the direct effect, while ignoring delving into other pathways and reducing the risk of type I and type II error (Hayes & Rockwood, 2017). The simplicity and clarity of this method provided straightforward results and offered great conditions for clear and simple replications. In this line, our research on ADHD symptoms and academic performance within the little-investigated demographic of university students aligns with the ambition of tackling the current replication crisis (Zwaan et al., 2018).

Furthermore, our study boasts a large sample size of 168 university students enhancing the statistical power of our analyses and thereby promoting the generalizability of our findings.

However, despite these strengths, there are some limitations in the present study. Firstly, there are conceptual constrains: As mentioned before, this study did not differentiate the construct of ADHD into its predominant subparts which might have led to symptoms of hyperactivity/impulsivity diminishing the effects of inattention on the use of SRL strategies. Differentiating the subparts in future research might therefore lead to more profound findings and a larger explained variance of ADHD symptoms on SRL strategies. Additionally, as previously discussed the concept of self-compassion did not provide an explanation for the relationship between ADHD symptoms and SRL strategies. While self-compassion may help mitigate negative emotions associated with setbacks or failures, it might not necessarily address the underlying difficulties in sustaining the attention and effort required for effective self-regulation. Therefore, future studies might benefit from targeting concepts which are related to attention and effort sustainment, like the previous mentioned concepts of self-efficacy.

Secondly, another constraint of our study relates to its cross-sectional design. Thus, it hinders inference of any causal assumption between the investigated phenomena. The lack of temporal sequency prevents any empirical foundation about the cause-effect relationship between reported ADHD symptoms and the use of SRL strategies. Hence, we cannot account for potential reverse causation. Furthermore, it also prevents observing any fluctuations of the investigated variables. Since we solely recruited first-year students, we cannot be sure if certain strategies or symptoms diminish with ongoing study experience or other confounding variables consistent with temporal changes. Accordingly, future research might incorporate a longitudinal design to account for the discussed limitations.

An additional limitation is the specificity of our sample, namely first-year psychology students at a Dutch university. Mullen and Goyette (2019) investigated the relationship between socioeconomic status and university admission concluding that lower socioeconomic status diminishes efforts of application in higher education. Hence, future research might benefit by accounting for socioeconomic status to correct for confounding. Furthermore, Psychology is known

to be based on a high amount of self-studying, which differentiates it from other university domains like medicine (Vanderstoep et al., 1996). Thus, the previous use of SRL strategies might influence the selection of the university program and thereby bias individuals with more difficulties to choose for such a study in the first place, making it difficult to examine students with less use of SRL strategies. Hence, future research might benefit sampling from various academic domains.

Furthermore, the study would have benefited from controlling for additional factors that might interrogate the influence of ADHD symptoms and SRL strategies. We did not control for medication usage, as a promising factor that might influence the severity of ADHD symptoms. Methylphenidate, respectively Ritalin, is often used by people who experience higher complaints of ADHD symptoms and influences study behavior and abilities. The usage of medication like Ritalin positively influences executive functioning and contributes to better academic performance (Advokat et al., 2011). Hence, medication could mitigate the complaints of ADHD symptoms, enhancing SRL strategies and preventing profound examination of these concepts. Controlling for medication in future research could therefore result in more detailed findings on the manifestation of ADHD symptoms in university students and might promote more nuanced information attainment on the association between ADHD and the use of SRL strategies.

Clinical Implication and Conclusion

Finally, in the face of limited research on ADHD symptomatology and SRL strategies in university students, our research contributes to an in-depth understanding of challenges experienced by individuals incorporating high levels of ADHD symptoms. Our findings support the assumption that individuals with higher levels of ADHD symptoms make significantly less use of SRL strategies which in turn might contribute to differences in academic performance. In line with Pintrich (1995), teaching SRL strategies such as targeting devotion, monitoring, motivation, affect and cognition consistent with goal-directed learning in an academic context provides a solid foundation for positively influencing academic achievement. These strategies can be trained by individuals themselves or in cooperation with trained professionals (Pintrich, 1995). The adjustability

of SRL strategies leaves great potential for individuals with ADHD symptoms providing a greater range of action (Du Paul et al., 2020).

Furthermore, and regardless of SRL strategies, given the inherent challenges of ADHD, including heightened negative self-statements, emotional dysregulation, and difficulties with self-worth (Hirsch et al., 2018), fostering self-compassion becomes paramount as it offers a vital framework for individuals to navigate these obstacles with resilience, promote emotional well-being, and cultivate adaptive coping strategies (Akin, 2008).

Concluding, our study investigated the relationship between ADHD symptomatology, self-compassion, and the use of SRL strategies in undergraduate students at a Dutch university. Our data partially replicated the findings of Shelton and colleagues (2019) demonstrating that higher levels of self-reported ADHD symptoms are associated with self-reported decreased use of SRL strategies in university students. Returning to the central idea of understanding the discrepancy in academic achievements between individuals with higher manifestations of ADHD symptoms and individuals without this amount of manifestation, targeting SRL strategies might be susceptible to academic improvement.

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Appendix A

ADHD

According to the DSM-5, ADHD is a neurodevelopmental disorder characterized by persistent patterns of inattention, hyperactivity, and impulsivity, significantly impacting daily functioning. The diagnostic criteria consider factors such as the age of onset, duration, and the pervasive impact on various life domains (American Psychiatric Association, 2013). The first set of criteria pertains to inattention, requiring the presence of six or more specific symptoms persisting for at least six months. These symptoms include a tendency to make careless mistakes, difficulty sustaining attention, not listening when spoken to directly, failure to complete tasks, organizational challenges, avoidance of tasks requiring mental effort, frequent loss of necessary items, and forgetfulness in daily activities (American Psychiatric Association, 2013).

The second set of criteria focuses on hyperactivity and impulsivity, also requiring the presence of six or more symptoms persisting for at least six months. These symptoms encompass behaviors such as fidgeting, inability to remain seated when expected to, inappropriate running or climbing, inability to play quietly, excessive talking, interrupting others, difficulty waiting for one's turn, and blurting out answers prematurely (American Psychiatric Association, 2013). Additional criteria include an onset of symptoms before the age of 12, the presence of symptoms in two or more settings, and evidence that symptoms interfere with social, academic, or occupational functioning. Importantly, the symptoms should not be exclusively attributed to another mental disorder (American Psychiatric Association, 2013). Despite the detailed description of symptoms, ADHD is known to display a high degree of interindividual variations: Individuals differ significantly from each other in their clinical picture. Also, the clinical presentation of ADHD is known to change over time within an individual and can be influenced by different factors like educational or occupational demands (Pacheco, 2022). To account for the heterogeneity of ADHD, the current study uses a dimensional approach to understand the clinical presentation of ADHD (Conners et al., 1999).

Appendix B

Sample Data

Table B1

Gender

What is your current gender identity?

	N	%
male	38	22,6%
female	127	75,6%
non binary/ genderqueer	3	1,8%

Table B2

Age

Descriptive Statistics

	Minimum	Maximum	Mean	Std. Deviation
How old are you?	16	29	19,68	1,955

Appendix C

Variables

Figure B1

Frequency distribution of SRL strategies.

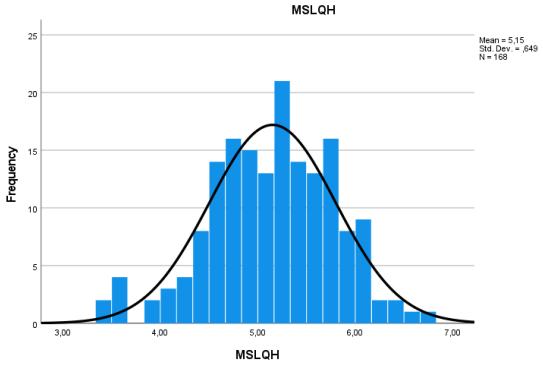


Figure B2

Frequency distribution of ADHD

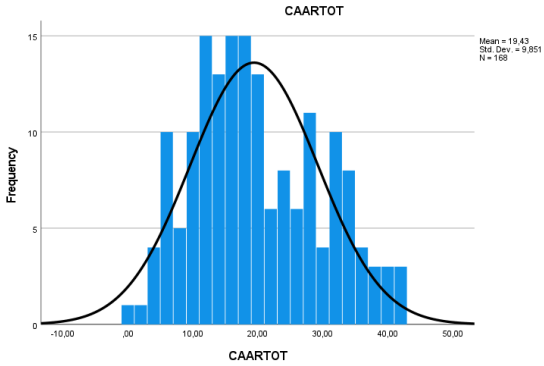


Figure B3

Frequency distribution of self-compassion

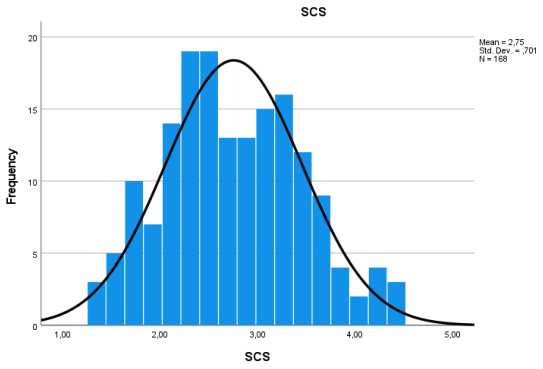


Table B1

Descriptive Statistics ADHD, self-compassion and SRL strategies.

Descriptive Statistics

	Minimum	Maximum	Mean	Std. Deviation
CAARTOT	,00	42,00	19,5030	9,86946
SCS	1,35	4,46	2,7492	,70111
MSLQH	3,34	6,74	5,1484	,64914

Appendix D

PROCESS macro.

Analysis was performed using the PROCESS macro for SPSS 5000 bootstrap samples with 95% bias-corrected confidence intervals (CIs) and a significance level of .05 was applied. PROCESS macro invented by Hayes (2013) is robust against violations of distributional assumptions by employing bootstrapping techniques. It mitigated assumptions like normality or homoscedasticity which makes it suitable for analysing real-world data, where such assumptions might not always be met.

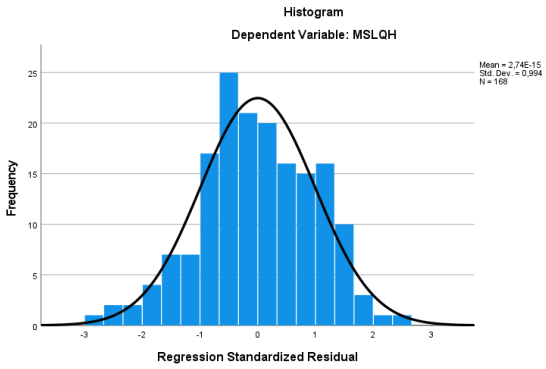
Appendix E

Key Assumptions

Assumptions for the correlational analysis were tested and confirmed prior to conducting the study.

Figure E1

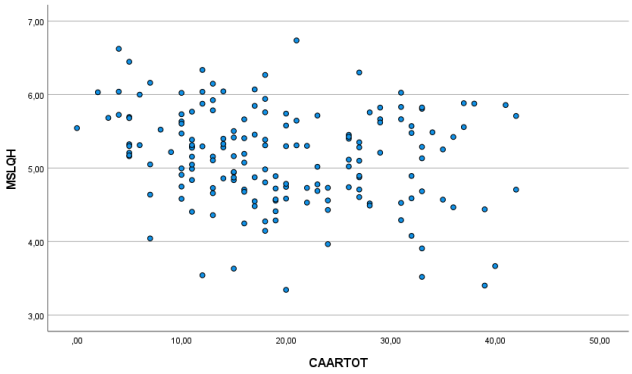
Normality assumption.



Note. Frequency of the standardized residuals of SRL strategies, revealed an approximately normal distribution, allowing to accept the normality assumption.

Figure E2

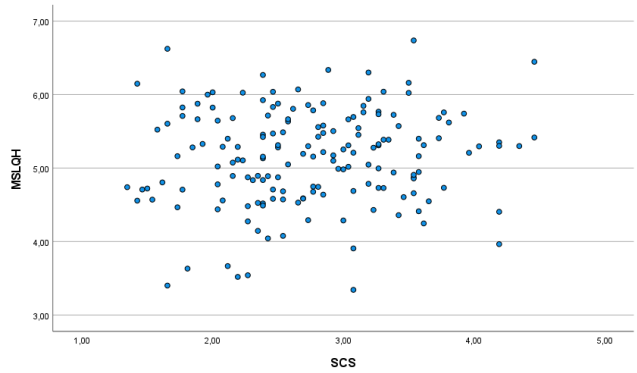
Linearity assumption.



Note. Scatterplot of the relationship between ADHD and SRL strategies appeared to be linear.

Figure E3

Linearity assumption.



Note. Scatterplot of the relationship between self-compassion appeared to be linear.

Table E1

Correlation matrix. Multicollinearity.

Correlations

	CAARTOT	SCS	MSLQH
CAARTOT	1	-,264**	-,207**
SCS	-,264**	1	,092
MSLQH	-,207**	,092	1

**. Correlation is significant at the 0.01 level (1-tailed).

Table E2

Coefficient table of ADHD, self-compassion and SRL strategies

Coefficients[a]

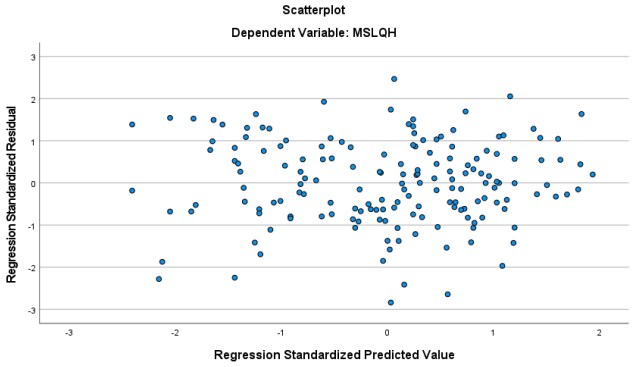
		Unstandardized Coefficients		Standardized Coefficients			95,0% Confidence Interval for B		Correlations	Collinearity Statistics
Model		B	Std. Error	Beta	t	Sig.	Lower Bound	Upper Bound	Part	VIF
1	(Constant)	5,300	,253		20,983	,000	4,802	5,799		
	CAARTOT	-,013	,005	-,196	-2,485	,014	-,023	-,003	-,189	1,075
	SCS	,037	,073	,040	,511	,610	-,107	,182	,039	1,075

a. Dependent Variable: MSLQH

Note. All correlations are below the threshold of r >.9, with ADHD and SRL strategies indicating the highest correlation, r (165) = -.26, p < .01. Furthermore, the variance inflation factor (VIF=1.08) was below the multicollinearity threshold of VIF > 5 (Agresti & Finlay, 2009). Therefore, the multicollinearity assumption could be accepted. The participants participated in an online survey. No known confounding variables could affect the relationship between the given three variables. Therefore, the assumption of independence could be confirmed.

Figure E4

Homoscedasticity assumption.



Note. Additionally, homoscedasticity was examined by plotting residuals and predicted values against each other. The residuals were randomly scattered around zero with no discernible pattern, supporting the homoscedasticity assumption. In conclusion, the key assumptions were deemed to have been met, supporting the validity of the linear regression analysis

Appendix F

Results

Table F1

Hypothesis 1. ADHD and SRL strategies

********** TOTAL EFFECT MODEL **********

OUTCOME VARIABLE:

MSLQH

Model Summary

R	R-sq	MSE	F	df1	df2	p
,2067	,0427	,4062	7,4099	1,0000	166,0000	,0072

Model

	coeff	se	t	p	LLCI	ULCI
constant	5,4167	,1090	49,6987	,0000	5,2015	5,6319
CAARTOT	-,0136	,0050	-2,7221	,0072	-,0235	-,0037

Total effect of X on Y

Effect	se	t	p	LLCI	ULCI
-,0136	,0050	-2,7221	,0072	-,0235	-,0037

Table F2

Hypothesis 2. Model of direct effect including of ADHD on SRL-strategies controlling for self-compassion

Direct effect of X on Y

Effect	se	t	p	LLCI	ULCI
-,0129	,0052	-2,4851	,0139	-,0232	-,0027

Table F3

Hypothesis 2. Model of Indirect effect including ADHD, self-compassion and SRL strategies

Indirect effect(s) of X on Y:

	Effect	BootSE	BootLLCI	BootULCI
SCS	-,0007	,0015	-,0042	,0020

Table F4

Hypothesis 3. Model of interaction effect of ADHD and self-compassion on SRL strategies

OUTCOME VARIABLE:

MSLQH

Model Summary

R	R-sq	MSE	F	df1	df2	p
,2270	,0515	,4074	2,9711	3,0000	164,0000	,0335

Model

	coeff	se	t	p	LLCI	ULCI
constant	5,0277	,5015	10,0247	,0000	4,0374	6,0180
CAARTOT	,0157	,0260	,6031	,5473	-,0356	,0669
SCS_M_R	,1124	,1520	,7398	,4605	-,1876	,4125
Int_1	-,0084	,0075	-1,1237	,2628	-,0232	,0064

```
Product terms key:

 Int_1     :        CAARTOT   x        SCS_M_R
```

Figure F1

Hypothesis 3. Conditional effects of the interaction of ADHD and self-compassion on SRL-strategies