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**A d factor? Understanding Trait Distractibility and Its Relationships with ADHD
Symptomatology - A Replication and Extension Study**

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Abstract

Distraction, whether internal or external, is known to hinder productivity, especially among people with Attention Deficit Hyperactivity Disorder (ADHD). Although previous research has analyzed both internal and external forms of distraction, further categorization of the different features of distractibility is necessary. Using a publicly available dataset from two adult samples (total $N = 1,220$), we reanalyzed self-report measures that capture four commonly studied forms of distraction: external distraction, unwanted intrusive thoughts, repetitive negative thinking, and mind-wandering. Rather than collapsing these constructs into broader categories at the outset, we modeled them as separate but correlated factors to better understand their unique and shared contributions to attention.

Our findings underscore the complex nature of distractibility, ADHD, and functional impairment, and the crucial role of multidimensional assessment in understanding these phenomena. We found that these four factors were moderately interrelated, supporting the existence of a general distractibility factor, referred to as the 'd-factor.' We then examined how this d-factor relates to self-reported ADHD symptoms and functional impairment. In a further extension, we tested for gender differences in the associations among distraction constructs. Additionally, exploratory analyses revealed that different operationalizations of self-report measures yielded varying patterns of association among the distraction constructs. This foregrounds the need for a multidimensional approach in assessing distractibility and ADHD symptoms, as a one-size-fits-all method may not capture the full complexity of these conditions.

Introduction

Background Information

Distraction plays a significant role in everyday life, and it is known to be one of the key factors of ADHD, a neurodevelopmental disorder that affects more than 3% of the population. (Ayano et al., 2023). To comprehend how the general population differs in their tendencies toward distraction, it is necessary to understand the various forms of distraction. Past research has often focused on individual aspects, such as mind-wandering or intrusive thoughts, without considering how these types of distraction might be connected (Zhang et al., 2023). Zhang et al. (2023) reviewed existing literature and identified several commonly studied types of distractibility, including mind-wandering, intrusive thoughts, repetitive negative thinking, and external distraction. However, these studies typically examined each type in isolation, limiting our understanding of how they relate to one another.

The original study on which this replication and extension paper is based, addressed this limitation by proposing a 'unity and diversity' model of distraction. This model suggests that while distraction can take various forms, they are all interconnected and can be categorized into distinct but correlated factors. Using confirmatory factor analysis on self-report data from two large samples, they categorized different types of distraction into separate dimensions, including external distraction, thought intrusions, repetitive negative thinking, and mind-wandering. Their analysis identified these as separate dimensions and examined how these related to ADHD symptoms.

Our project revisits Zhang et al.'s dataset to evaluate the structure and meaning of distractibility. Specifically, we aimed to assess whether a broader, general factor of distraction (the "d-factor") can be meaningfully applied across these distinct components. The goal was to

understand better whether this overarching factor correlates with ADHD symptoms and functional impairment, and how these relationships vary based on measurement decisions. This re-analysis is essential because it examines whether patterns of distractibility reflect shared underlying traits rather than unrelated forms of cognitive interference. Additionally, in our extension, we examined gender differences in the associations among distraction constructs. By identifying these patterns, our work aims to enhance the understanding of distraction and its measurement, with the broader goal of supporting more precise assessments and interventions for individuals with ADHD.

ADHD, Attention, and Distraction

ADHD is a neurodevelopmental condition characterized by persistent inattention, hyperactivity, and impulsivity that impairs functioning (APA, 2022). Individuals with ADHD often exhibit higher levels of external distractibility, sluggish cognitive tempo (SCT), and mind-wandering compared to neurotypical peers (Gini, 2021). As observed in one specific study, children with ADHD made more errors in response to auditory or visual distractions even when presented individually (Cassuto et al., 2013). In contrast, non-ADHD children required combined stimuli to show similar impairments (Cassuto et al., 2013). This suggests heightened susceptibility to irrelevant stimuli among people with ADHD.

SCT, characterized by daydreaming, lethargy, and slowed processing, is developmentally persistent and correlates with inattention, though it is distinct from hyperactivity (Leopold et al., 2016). Mind-wandering, another core feature, involves shifts from task-relevant to unrelated internal thoughts and is closely tied to inattentive symptoms (Biederman et al., 2017; Goncalves & Silva, 2022). The DSM-5 defines inattention in terms of difficulty sustaining attention, which

aligns with research on attentional control, a top-down process governed by executive systems that filter distractions (APA, 2022). Individuals with ADHD often show deficits in this area and struggle more with distraction filtering during low-demand tasks, indicating impaired engagement of attentional control rather than a complete inability to filter distractions (Friedman-Hill et al., 2010).

Reaction time variability (RTV), inconsistencies in response times, is another marker of attentional dysregulation (Tye et al., 2016). Elevated RTV in ADHD suggests fluctuations in attentional engagement and executive control. These patterns show that distractibility is not merely a tendency to be "easily distracted" but reflects difficulties in sustaining goal-directed focus and suppressing irrelevant input.

Although attention can operate automatically, it often requires conscious regulation. External distractions (e.g., noise) and internal distractions (e.g., ruminations) disrupt this goal-directed focus (Foroughi et al., 2016). For instance, one study found that external distractions impaired student task performance regardless of ADHD status, but those with ADHD were disproportionately affected by even single sensory inputs (Foroughi et al., 2016). Internal distractions such as mind-wandering are especially prevalent in ADHD and may reflect lapses in attentional control (Merrill et al., 2022). Understanding the relationship between these internal and external factors is crucial for understanding how ADHD symptoms manifest in daily life.

Building on the work of Zhang et al. (2023), our study replicates their findings using the same dataset. It extends the analysis to examine how general distractibility (d-factor) correlates with ADHD symptoms and functional impairment. Replication ensures the reliability of the original results. At the same time, the extension allows for the investigation of gender differences

in the associations among distraction constructs. It explores the relationships between functional impairment, ADHD symptom severity, and rumination and worry.

Original Methods

Participants

In the original research, Zhang et al. (2023) collected data from 1,220 participants via Prolific, an online recruitment platform. The first sample ($N = 651$) consisted of participants between the ages of 18 and 35, residing in the United States or Canada (M age = 26.9, SD age = 5; 45.3% female; 67.7% White). Sample 2 recruited 569 undergraduate psychology students from the University of Michigan (M age = 18.8, SD age = 1.2; 66.3% female; 56.8% white).

Materials and Measures

The original study utilized a variety of self-reporting instruments to comprehensively assess participants' vulnerability to four categories of distractibility: external distraction, mind wandering, thought intrusions, and repetitive negative thinking. The original study employed a range of questionnaires, inventory methods, and scales to capture the four categories of interest. Additionally, the study used the following scales to measure ADHD.

Adhd Related Scales

Adult ADHD Self-Report Scale. An 18-item clinical measure for screening adults with ADHD. The items corresponded to the eighteen criteria used to diagnose ADHD. Questions were rated on a 5-point Likert scale, from 0 (Never) to 4 (Very often). The total score was calculated by summing up all positive symptoms, yielding a range of 0-18.

ADHD Functional Impairment Questionnaire. The 10 questions regarding the functional impairment in ADHD were taken from the Current Symptoms Scale. Questions were rated on a 0-3 scale, from 0 (Never/Rarely) to 3 (Very often). The final score was the average of all items, where the higher score indicated greater functional impairment.

Adult Dispositional Hyperfocus Questionnaire. This 12-item scale measured a participant's tendency to experience hyperfocus on a 6-point Likert scale, ranging from 1 (Never) to 6 (Daily). The final score was the average rate of all items, with a higher score indicating a greater tendency to engage in hyperfocus.

Procedure

In the original study, the scales were randomly presented to participants, except for the Function Impairment Questionnaire, which was always given after the ADHD Self-Report Scale. The participants then completed 15 questionnaires, which assessed multiple areas and current states of mind, to be used in a comprehensive analysis examining correlations and interactions between variables and measures.

Replication

Methods

Our re-analysis focused on one specific analysis from Zhang et al. (2023): the correlation heatmap among four core distractibility constructs: External Distraction, Thought Intrusions, Repetitive Negative Thinking, and Mind-Wandering. While Zhang et al. (2023) collected responses from a total of 15 questionnaires, we selected a targeted subset of scales that mapped onto these four constructs. Each distractibility construct was modeled as a distinct latent factor, with multiple scales loading onto each factor based on theoretical alignment.

Following Zhang et al.'s procedure, we computed symmetrical correlation heatmaps comparing the factor intercorrelations across two independent samples (Sample 1: $N = 651$; Sample 2: $N = 569$). Moreover, to further investigate the potential impact of shared content across constructs, we conducted a sensitivity analysis focusing on the Perseverative Thinking Questionnaire (PTQ).

Perseverative Thinking Questionnaire (PTQ). The PTQ is a 15-item measure that assesses the frequency with which individuals experience repetitive, uncontrollable, and intrusive negative thoughts. Responses are rated on a scale from 0 (never) to 4 (almost always), and the final score is the average of all items. Higher scores reflect a stronger tendency toward persistent negative thinking. (Ehring et al., 2011).

Given that the PTQ captures a form of repetitive, uncontrollable thought that conceptually overlaps with multiple internal distraction domains (Thought Intrusions, Repetitive Negative Thinking, and Mind-Wandering), there was a risk that its inclusion could artificially inflate correlations among these factors due to shared perseverative content (Ehrin et al., 2011). To address this, we generated a heatmap that excluded the PTW from the Repetitive Negative Thinking (RNT) factor. This approach revealed the extent to which PTQ-specific variance drove observed associations between RNT and other distractibility constructs, as opposed to reflecting broader relationships among the four distractibility constructs.

Results

In both samples, Thought Intrusions and Repetitive Negative Thinking were highly correlated ($r = 0.95$ in Sample 1 and $r = 0.92$ in Sample 2), supporting the combination of these constructs into a unified construct: Unwanted Intrusive Thoughts. This analytical approach

highlighted the interrelationships between the constructs while justifying modifications to the confirmatory factor analysis (CFA) model.

External Distraction showed moderate correlations with Internal Distractions ($r = 0.32\text{--}0.56$), suggesting that these constructs are related but distinct. Mind-Wandering correlated with Thought Intrusions (0.64 in Sample 1; 0.59 in Sample 2) and Repetitive Negative Thinking (0.69 in Sample 1; 0.61 in Sample 2), underscoring its close relationship with internal distractions while remaining distinct.

When PTQ was removed, most correlations among constructs, especially between Repetitive Negative Thinking and Mind-Wandering in Sample 2, declined. This decline suggests that the PTQ meaningfully contributes to the shared variance among internal distraction constructs; that is, perseveration may be present across these very different types of distraction. This sensitivity analysis illustrates that construct definitions can shift depending on the specific measures included. Thus, a careful consideration of scale content and psychometric properties is essential when attempting to represent a multidimensional symptom such as distractibility.

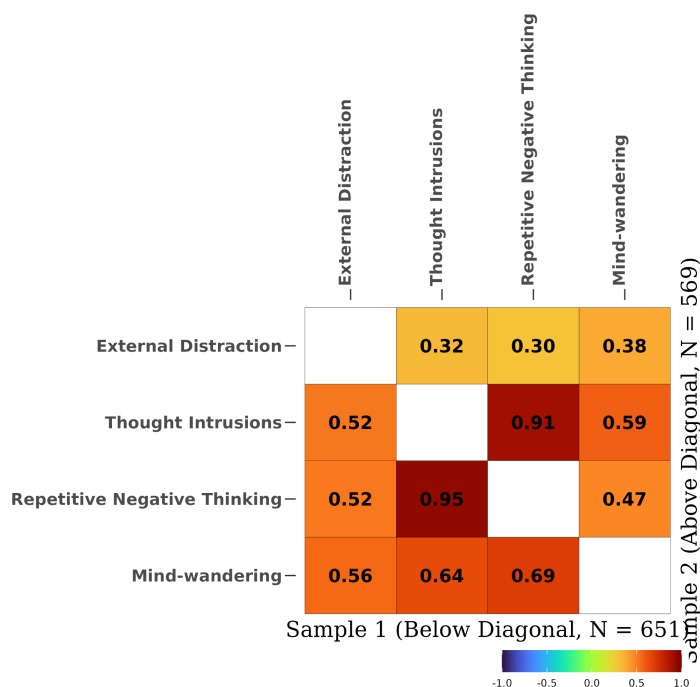


Figure 1. Replication of Figure 2 from Zhang et al. (2023), excluding PTQ.

Extension

Building on our replication of Zhang et al. (2023), which focused on the factor structure of distractibility in ADHD, our current study extends the analysis by examining how functional impairment in ADHD differentiates by gender. First, we test for gender differences in the associations among distraction constructs to explore whether the general distractibility factor (d-factor) may be expressed differently in male and female participants. Research across cultures consistently shows that ADHD symptoms change over time, particularly with inattention persisting into adulthood while hyperactivity declines (Lewczuk et al., 2024; Davis et al., 2011). However, even as symptom levels shift, functional difficulties often continue. Several studies have found limited or no significant gender differences in overall ADHD symptom severity; however, they have emphasized different patterns in how symptoms are expressed and the resulting consequences (Chan et al., 2022; Gómez-Benito et al., 2015; Davis et al., 2011). For instance, women and girls are more likely to experience internalizing symptoms, such as emotional dysregulation and anxiety, and report higher levels of stigma and self-blame (Lewczuk et al., 2024; Gómez-Benito et al., 2015). Men and boys, by contrast, more frequently display externalizing behaviors such as impulsivity and hyperactivity, which often lead to earlier identification and intervention (Trumini R. Coker et al., 2016).

Second, we explored the associations between functional impairment and three psychological dimensions, ADHD symptom severity, rumination, and worry, to identify which variables most strongly predict functional difficulties in adults. This analysis provides insight into the multidimensional nature of functional impairment in ADHD beyond core symptoms alone.

Methods

To examine gender differences in distraction correlations, participants were split into male and female groups. Within each group, Pearson correlation matrices were calculated among four distraction constructs: External Distraction, Thought Intrusions, Repetitive Negative Thinking, and Mind-Wandering. These constructs were derived from items from three widely used adult ADHD self-report scales and averaged within participants to form composite scores.

Functional impairment was measured by averaging scores from 10 items on the Barkley Adult ADHD Rating Scale-IV (Barkley, 2011). ADHD symptom severity was assessed using the Adult ADHD Self-Report Scale (ASRS) total score across all 18 items (Kessler et al., 2005). Rumination (brooding) was measured with a subscale of the Rumination Response Scale (RRS), and Worry was assessed using the Penn State Worry Questionnaire (PSWQ), with negatively worded items reverse-coded before computing total scores. (Topper et al., 2014; Meyer et al., 1990).

Participants were categorized into low, moderate, and high groups based on established cutoffs: ADHD as Mild (<35), Moderate (35–44), or Severe (≥ 45); Rumination as Low (<12), Moderate (12–15), or High (≥ 16); Worry as Low (<35), Moderate (35–59), or High (≥ 60).

For the correlation analyses with functional impairment, we computed Pearson correlations between functional impairment scores and each of the three psychological dimensions, stratified by severity level.

Results

Figure 2 displays the correlation matrices for male participants ($N = 296$) and female participants ($N = 344$). Mind-Wandering and Thought Intrusions were the most strongly correlated pair in both groups ($r = 0.52$ for males; $r = 0.62$ for females). Overall, correlation

coefficients tended to be higher in the female group, ranging from 0.22 to 0.62, compared to 0.18 to 0.52 in the male group. This pattern suggests that the general distractibility factor (d-factor) may be more strongly expressed or consistently reported among females, potentially reflecting social or cognitive differences (Rucklidge, 2008).

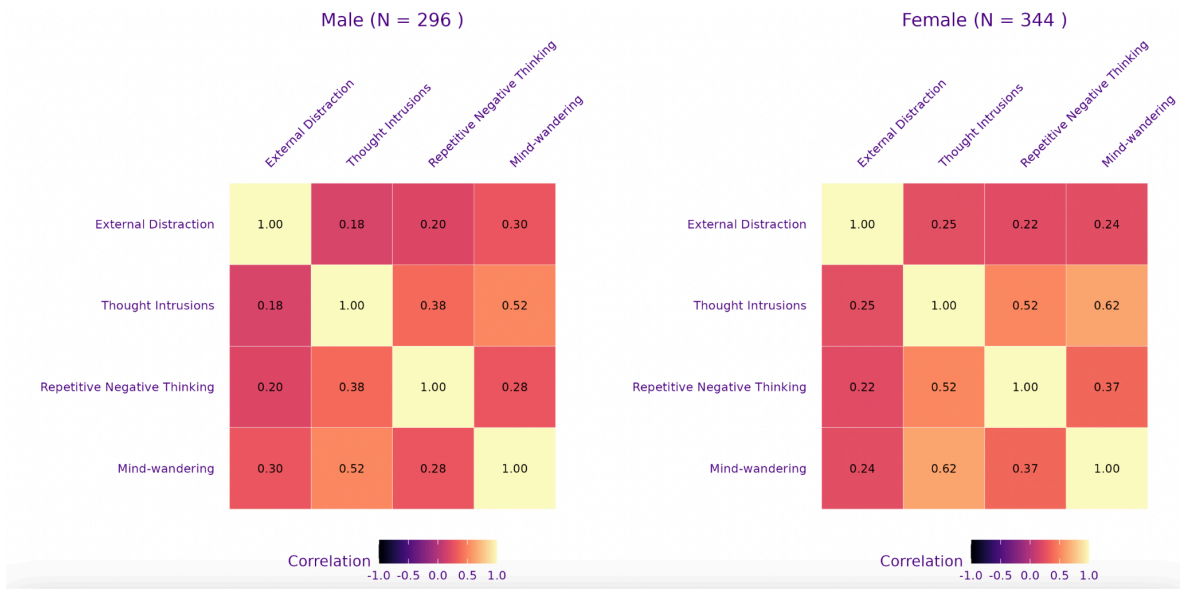


Figure 2. Two correlation plots displaying correlation matrices among the four variables: external distraction, thought intrusions, repetitive negative thinking, and mind-wandering.

In another analysis, Figure 3 presents bar plots showing the correlation between functional impairment and three psychological dimensions (ADHD, rumination, and worry), stratified by severity (mild, moderate, severe). ADHD severity showed the strongest correlations with functional impairment, particularly in the mild and moderate groups (~0.5). Rumination also showed a moderate relationship (~0.35), while Worry showed slightly lower correlations (~0.4). Notably, the strongest impairment association appeared in the severe ADHD group (~0.45), suggesting ADHD remains the most predictive variable among the three. These results highlight the multidimensional nature of functional impairment in ADHD. While ADHD

symptom severity is the primary driver, rumination and Worry also contribute meaningfully, suggesting that addressing comorbid cognitive-emotional processes may be necessary for comprehensive intervention.

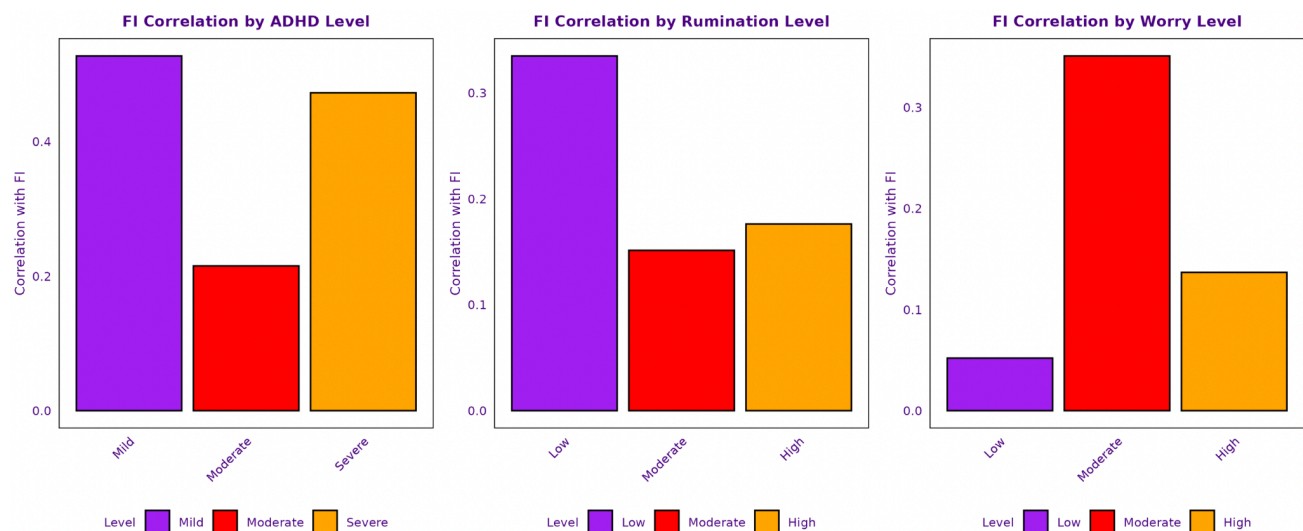


Figure 3. Three bar plots displaying the correlations of ADHD, Rumination (brooding), and Worry by severity level (mild, moderate, and severe).

Discussion

This replication and extension study reaffirmed the factor structure proposed by Zhang et al. (2023), supporting the conceptualization of distractibility as consisting of moderately correlated yet distinct factors: External Distraction, Unwanted Intrusive Thoughts, and Mind-Wandering. Our replication upheld their key findings using the same dataset. It validated the strength of associations among these components, particularly the consistently high correlations between Thought Intrusions and Repetitive Negative Thinking.

Our sensitivity analysis further demonstrated that the structure and strength of factor interrelationships depended on the inclusion of specific measures. Notably, removing the

Perseverative Thinking Questionnaire (PTQ) substantially reduced correlations within the internal distraction domain. This result highlights the importance of construct validity and scale selection in modeling multidimensional psychological traits, such as distractibility.

A key contribution of our extension was examining gender differences in correlations of the distraction construct. We found that females generally exhibited higher inter-factor correlations than males, suggesting the general distractibility factor (d-factor) may be more strongly expressed or consistently reported in female participants. This pattern could reflect differences in cognitive processing, socialization, or hormonal influences on attention and self-report (e.g., Gershon, 2002; Rucklidge, 2010). These results highlight the potential value of developing gender-sensitive assessments and interventions that recognize such variations in the experience and reporting of distractibility.

We also extended the analysis to examine associations between functional impairment and three psychological dimensions: ADHD symptom severity, rumination, and worry. ADHD symptom severity consistently showed the strongest correlations with functional impairment, particularly in the mild and moderate severity groups, while rumination and Worry contributed additional variance. These findings support the view that functional impairment in ADHD is multidimensional, with comorbid cognitive-emotional processes playing a meaningful role (Barkley, 2011; Nigg et al., 2020). Interventions that address not only core ADHD symptoms but also rumination and Worry may therefore be essential for improving daily functioning.

As with the original study, several limitations should be noted. Our sample was recruited through online platforms, which may introduce sampling bias toward individuals who are technologically proficient and potentially less consistent in their responses. The reliance on self-report measures is another limitation, given the risk of various response biases and limited

ecological validity. Future research should involve broader and more diverse samples, as well as consider in-person assessments, to enhance the representativeness and reliability of the findings. Additionally, including objective behavioral measures of distractibility could complement self-reports and provide a more comprehensive understanding of these constructs.

Conclusion

Looking ahead, other research directions are worth pursuing. Refining measurement tools and conducting further psychometric evaluation can help clarify the distinctiveness and validity of different distraction components. Longitudinal studies can track how distractibility patterns evolve over the lifespan, both with and without interventions such as medication, providing insight into the developmental trajectories of ADHD symptoms and associated functional challenges. Future work should also examine outcomes related to daily functioning and co-occurring psychological concerns, assessing the broader impact of distractibility in neurodiverse populations. Including objective, real-world measures of attention and distraction could improve ecological validity and support targeted and individualized interventions.

Overall, this study replicated and extended Zhang et al. (2023), reinforcing the value of the general distractibility factor (d-factor) as a framework for understanding distractibility across multiple dimensions. The consistent associations between internal distraction factors and ADHD symptoms support the notion of a shared vulnerability. At the same time, the gender differences we observed highlight the need for individualized assessment and intervention approaches. These findings suggest that distractibility is not a uniform experience and it may vary systematically across demographic and contextual factors. As research continues to explore attentional functioning in neurodiverse populations, the d-factor model offers a promising foundation, but one that will benefit from ongoing refinement and testing in diverse, real-world contexts.

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