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Reconceptualizing the Interaction Between ADHD Symptoms and Environmental Context

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Abstract

Difficult questions regarding etiology, prevalence, and individual treatment allude to the heterogenous and complex neurocognitive profile ADHD. Current understandings do not point to there being any yet-undiscovered, succinct set of features for the condition that will answer these questions. ADHD in fact has a heterogeneous etiology and neurocognitive profile (Sonuga-Barke et al., 2022), suffers from both overdiagnosis and underdiagnosis (Aronson, 2016; Gascon et al., 2022; Lasky et al., 2016), and a variety of styles of treatment are conceivable to address this. Sociocultural factors have crucially guided the direction of ADHD pathology and medicalization and are woven into institutional environments. These extant problems have eluded ADHD research, and the debate over the construction and validity of its diagnosis have been ever present. Despite the evidence supporting that environmental settings have a crucial role in risk, functioning, diagnosis, and treatment, ADHD is not often conceptualized as an interaction between the person and environment. There must be a reconceptualization of ADHD research to understand the interaction between ADHD functioning and environmental settings.

Introduction

Despite continual efforts in ADHD research, there has been lackluster improvement in the way of treatment from a public health or individual level for those who struggle to succeed in traditionally structured institutions (Sonuga-Barke et al., 2022). Persisting questions in the field regarding ADHD etiology, prevalence, stability, and treatment allude to a heterogenous and complex neurocognitive profile. Increasing effort contributed to the study of ADHD has still not supported a clear model that can explain any of these questions. Researchers trying to make sense of the ADHD diagnosis have argued whether it is predominantly a social construction (Timimi & Taylor, 2004) a dopamine-related neurostructural disorder (Kanarik et al., 2022; Swanson et al., 2007), or a symptom of the medicalization of behavior (Conrad, 1992; Singh, 2002). This dialectic has not conceded total favor to any of these interpretations and has contributed a lack of clarity to the discourse of the condition, though it should be noted that identification with the diagnosis has been found meaningful (and not entirely a construction of a "lazy culture" or the pharmaceutical industry) and clearly associated with impairments in many areas of people's lives (Singh, 2002).

Despite a lack of consensus surrounding ADHD, approaches to treatment are often narrowed to a wavering set of assumptions about the diagnosis. Methylphenidate medication is at the forefront of ADHD treatment despite the mechanisms behind its efficacy being still relatively unknown (Hawk et al., 2018; Merrill et al., 2021). A summative review of the current scientific research on ADHD by Sonuga-Barke et al. (2023) questions the assumption that cases share a distinct etiology or profile (contrasting the DSM-V classification), further suggesting that the current conceptualization of ADHD has not addressed the entire picture.

These views of etiology are not in direct conflict and there are likely no simple answer to the origin of ADHD nor a silver bullet for treatment. It is likely that the diagnosis in the terms it has been defined has a complex system of causal pathways, suffers from both overdiagnosis and underdiagnosis, and expresses multiple symptom trajectories. For the field to make progress in supporting those with ADHD there may need to be a broadening of the approach in treatment to address this heterogeneity. The goal presented in this research is to review discourse on the relationship between environmental context and ADHD symptom expression for the purpose of informing conceptualizations in research and treatment of the condition.

Environmental Risk In ADHD Research

Though not always entirely reflected in conceptions of ADHD, psychological conditions—especially other neurodevelopmental conditions—generally have significant environmental components, and in the case of ADHD have been increasingly relevant for understanding the condition (Sonuga-Barke et al., 2022). Examples of environmental factors possibly associated with ADHD symptoms are sleep (Cavalli et al., 2021; Shephard et al., 2022), digital media usage (Thorell et al., 2022), complications with pregnancy like low birthweight and alcohol use (Agnew-Blais et al., 2022; Swanson et al., 2007), and the early family environment in general (Claussen et al., 2022; Crea et al., 2014, 2014; Shephard et al., 2022). Though there is increasing support for these as possible strong environmental risk factors, this is by no means a comprehensive list of every variable found to have been reasonably associated with ADHD.

Research into environments associated with ADHD have focused predominantly on risk factors strongly associated with developing ADHD in early environments of caregiving (i.e. the family environment and early education), (Claussen et al., 2022; Crea et al., 2014). For example, household chaos and abuse were found to be associated with increased symptoms (Mitchell et

al., 2021), and a recent meta-analysis of risk factors associated with family environment found that the childhood family environment is significantly associated with ADHD diagnosis (Claussen et al., 2022). A less-often discussed symptom in children with ADHD, irritability, was also found to be moderated by dysfunctional parenting practices (Courbet et al., 2021). Because the family environment mediates the interaction between risk factors and ADHD functioning (Crea et al., 2014), it is suggested that more studies are necessary to understand the influence of early childhood environments on ADHD outcomes (Claussen et al., 2022; Crea et al., 2014). It is also conceivable that parent and family quality of life, even simply improving the wellbeing of parents, could be a possible intervention for improving ADHD outcomes and impact diagnosis rates (Claussen et al., 2022; Crea et al., 2014).

As increasingly demonstrated by the more recent development of gene-environment interaction (G×E) studies, variables of environmental context are shown to influence the expression and development of ADHD symptoms. G×E studies explore genes in conjunction with possible environmental risk factors to understand if a certain genetic polymorphism (associated with ADHD) mediates an environmental influence on a particular outcome (for example ADHD symptoms) (Sonuga-Barke et al., 2022). Low birthweight and maternal depression are two factors that showed statistical significance in this type of study, as well as household chaos (Agnew-Blaise et al., 2022), parental rejection (Brinksma et al., 2023), maternal alcohol consumption (Swanson et al., 2007) and many other environments throughout childhood (Kanarik et al., 2022). There was strong longitudinal support for associations between parenting factors and ADHD (Claussen et al., 2022), and further support for early life institutional neglect as a possible risk factor (Agnew-Blais et al., 2022), current G×E findings further suggest that early developmental environments are significant predictors of ADHD risk. Since the genetic

factor cannot be manipulated, G×E studies cannot determine causality of the factor the implications of the results are thus limited (Sonuga-Barke et al., 2022).

Findings from environmental risk studies can help identify the general settings in which to target developmental factors of ADHD. Emphasizing how alleles and environmental factors can lead to different outcomes with the growing popularity of G×E research is a step in the direction of better addressing the complexity of ADHD etiology, though G×E studies and other environmental interaction studies have suffered from additional difficulties in research design including large sample requirements (Sonuga-Barke et al., 2022; Swanson et al., 2007). Another conceptual problem associated with narrowness in ADHD research is the way that assumptions are often made about what impact the environment can have when environmental factors are studied; certain environments are necessarily categorized into their conceived constituent parts for the purpose of description abstracting the complex nature of individual context and development. This does not address the possibility for unmeasured interactions within and between environment classifications to have large effects on ADHD development and functioning. Additionally, emphasizing risk factors assumes that the environment influence largely effects etiology, not distinguishing when symptoms or functioning might be moderated acutely by the environment. Further research of environmental risk could be understood within a larger view of ADHD development to understand how features within environmental settings moderate ADHD symptoms to inform more ecologically valid conceptualizations of environmental effects.

Environment and Sociocultural Context

The concern of sociocultural influence within environmental context has been ever-present in the current era of ADHD research. An editorial of oppositional opinions on the matter of

ADHD as a cultural construct represents this argument two decades ago (Timimi & Taylor, 2004), suggesting that the condition is either a fabrication of culture and the pharmaceutical industry or a cognitive problem that has yet to be solved. Granting that research is clearly limited by an individualistic biomedical model, Singh (2002) suggests the "cultural construct" perspective is ungrounded in current findings; There is clearly a significant population in need of support that shares common traits and must be addressed by the psychology community (Bauermeister et al., 2010; Singh, 2002). Still, the pathologization of underperformance is considered to be an important factor in increasing diagnosis rates (Conrad & Bergey, 2014; Gascon et al., 2022; Singh, 2008). One way of understanding the sociocultural influence on ADHD is to look at how environments mediate this interaction.

Sociocultural environmental factors have inordinate effects on how behavior is perceived, allowing bias to leak into the diagnosis of ADHD which necessarily involves the evaluation of behavior. One study found that children's friends presenting inattention can have a strong influence on their own self-reported inattention despite the assumption of trait stability that underlies the use of self-report measures in diagnosis and pre-diagnostic evaluation of children (Aronson, 2016). This is indicative of issues with the diagnostic criteria being too lenient (as to be socially influenced) (Lasky et al., 2016), which might inflate the numbers of diagnosis in some populations (Aronson, 2016; Gascon et al., 2022). Despite these findings that suggest overdiagnosis, research has supported that it might still be underdiagnosed in some populations (Gascon et al., 2022; Sonuga-Barke et al., 2022). Though these findings can help increase the accuracy and validity of the ADHD diagnosis, they might be an indication that there is an issue at the core of its conceptualization.

Kang and Harvey (2020) demonstrated the power of racial attitudes in psychology, showing that White teachers were found to evaluate Black boys as exhibiting behaviors of ADHD at an inordinate rate, positively mediated by their negative racial attitudes, also suggesting the mediating factor of the role of adults and the context in which the behavior is evaluated to be studied (DuPaul, 2020). Whether a teacher's narrow—or in this case racist—evaluation of abnormal behavior in a classroom affects a child's likelihood to receive an ADHD diagnosis, that evaluation describes a real feature of that institutional environment and how it pushes those within it to perform and behave. One solution could be to strengthen the diagnostic criteria of the condition so that latent unwanted values and beliefs like racism, overperformance, or overbearing social conformity have less of an effect, but this would do little to change how well a child belongs within that system. On the other hand, the system in question could be adapted to better suit a wider range of functioning first, rather than trying to affect change in children at the individual level to fit within the system.

The way that institutions like schools, occupations, and other environmental contexts determine normal functioning is described by the process of medicalization. Though ideas of abnormal or deviant behavior are a necessary part of the institution of Western medicine, they are relatively subjective and can sometimes be wielded as a form of control as medicine expands jurisdiction over peoples' lives and infringes on normal individuality (Conrad, 1992). In psychology, abnormal behavior is pathologized as an impairment to be treated by medical professionals, though in the case of ADHD some believe that normal behavior in children and adults is routinely labelled as impaired (Gascon et al., 2022). A popular explanation for the unimproved incidence of ADHD in Western culture is an increasing emphasis on

overperformance in academics and the economy (Conrad & Bergey, 2014; Gascon et al., 2022; Singh, 2002).

Singh (2008) describes how the U.S. has increased the influence of psychology in schools to control the "pre-delinquent behavior" of students, which when paired with insufficient knowledge and resources to handle ADHD, designates natural differences in development and personality as deviant. Thus, through cultural expectations of performance, the school moderates the diagnosis of ADHD and translates to increases in ADHD diagnoses and psychostimulant prescription (Singh, 2008). This is the process through which general issues with competence are both justified and presumed to be solved by an ADHD diagnosis, both for children in educational settings and adults in occupational and higher education environments (Gascon et al., 2022). Because institutions and settings are influenced to varying degrees by culture, they are often structured around narrow and ill-fitting ideas of ability and performance; Rather than reflecting how people really function, they prescribe how they ought to. A problem arises when under-performance becomes a driving factor of a presumed developmental disorder and begins to undermine the nominative purpose and therapeutic goals of pathology.

ADHD functioning within environmental settings

Much of the research on environmental factors centers around pre-adult developmental periods such as school and early home environments, though conceivably any environmental context is relevant to study impairments people with ADHD might face within them. A lack of attention on environmental factors that affect ADHD functioning in adults may stem from an emphasis on finding mechanistically significant variables to target with interventions, though this task has been difficult due to significant heterogeneity and complexity in developmental etiologies of ADHD which reduces the measured effects of any single factor (Sonuga-Barke et

al., 2022; Swanson et al., 2007). Though it is sometimes helpful to discover environmental factors that might be mechanistically informative, it may be misguided to always distinguish between mechanistic and other associated factors.

ADHD expression is not stable between environments or across the lifespan, partially influenced by changes in environmental factors (Sonuga-Barke et al., 2022). As ADHD diagnosis describes levels of continuous traits (Sonuga-Barke et al., 2022), changes in functioning due to differences in environmental factors might be enough to reach the clinical threshold. Because environmental factors might affect diagnosis through etiology or acute changes, they cannot be assumed to be mechanistically significant. In this view, there is less room for clear distinction between mechanistic and non-mechanistic environmental effects. Just as early life environments are studied to find possible risk factors, environmental settings in childhood as well as important adult settings like the workplace or postsecondary education can inform what factors affect how individuals with ADHD function within them (Lasky et al., 2016; Lyhne et al., 2021).

Diagnosis or remission of ADHD in adulthood can be due both to distinct symptom trajectories from genetic and environmental differences or changes in environmental context over the lifespan that bring changes in challenges or support structures (Kosaka et al., 2019; Mitchell et al., 2021; Sonuga-Barke et al., 2022). A change in support structures is a likely driver of many late-onset diagnoses when supportive home and school environments are lost (Mitchell et al., 2021), and in this view symptoms are “masked” by other attributes, like intelligence (Kosaka et al., 2019). This can be seen with an increase in diagnosis at large life transitions—like graduating high school and entering college or the workforce—that bring changes which might exacerbate symptoms of impairment (Lasky et al., 2016). Conversely, some people find

that the flexibility or independence associated with becoming an adult creates circumstances where they are functionally unimpaired (Lasky et al., 2016; Mitchell et al., 2021). Increasing research into adult ADHD suggests this process of masking is a significant factor in the diagnosis of ADHD (Asherson & Agnew-Blais, 2019; Kosaka et al., 2019). This suggests promise for identifying treatment possibilities in interactions with environmental context, though it also may suggest a dubious foundation for claiming these cases display dysfunctional behavior in the first place.

Studying the environmental settings of adults and children can be an ecologically valid way of representing relevant categories of environmental context such as sociocultural factors, built or physical structure, systemic influences and more, without having to tackle some of the near-impossible problems of ADHD etiology and pathology (Bennett et al., 2006; Delisle & Braun, 2011). Notably, it is often difficult to isolate environmental variables and focusing on a less controlled but more ecologically valid approach may do more justice to the conditions that contribute to ADHD symptoms. For example, in a qualitative study by Mitchell et al. (2021) it is described how traumatic home and personal life environments including substance use by self and family are relevant to the development and trajectory of ADHD symptoms. This demonstrates how factors like chaotic home environments and maternal substance use may tend to manifest together.

As ADHD becomes a greater concern to the wellbeing of adults (Gascon et al., 2022; Sonuga-Barke et al., 2022) and their success and placement in the professional world (Biederman et al., 2005; Delisle & Braun, 2011; Fuermaier et al., 2021; Lasky et al., 2016), more emphasis is placed on the occupational environment as a setting for studying ADHD functioning. One of the earliest studies of this nature observed adults with and without ADHD in a work-like

setting simulated through questionnaires and found measurable impairments in relation to their measures of important workplace skills and features, but no significant difference in inattention (Biederman et al., 2005). Though not addressed within the study, it would also be important to note was that this “workplace simulation" was structured in such a way that might have caused difficulties due to under stimulation because it reflects an unmotivating environment (ex. long periods sitting, menial tasks, lack of purpose) which has been shown people with ADHD are more sensitive to (Delisle & Braun, 2011; Lasky et al., 2016). Though the design of this study would make it difficult to generalize results to a specific type of workplace, it demonstrated a way to model a setting to understand impairment in ADHD which brought unexpected results (lack of attentional impairment). Unfortunately, there appears to be a lack of studies that have attempted similar methods simulating settings in this way.

In attempting to do a more ecologically valid study of a workplace environment akin to Biederman et al. (2005), Delisle & Braun (2011) simulated a work environment through videogame-like tasks with parameters designed to increase motivation. They found that symptoms could be compensated for in the ADHD group, contrasting the results found by (Biederman et al., 2005). The current research found no other studies that attempted to simulate settings of possible impairment for people with ADHD in the same way, however. By aiming at what features of certain tasks or environments might influence outcomes in ADHD populations, studies have had clear and direct implications for functional treatment.

In a similar direction, studies using computerized tasks have shown that relatively small changes in the context or presentation of stimuli have in some cases led to children with ADHD performing normally relative to their non-ADHD peers in school-like tasks. In a study of computerized math tasks, when given the option of how to receive feedback upon answering

math questions opposed to having no choice over how the feedback was presented, behavioral responses in the ADHD group improved to the same level as their non-ADHD peers (Bennett et al., 2006) showing how a small change could normalize symptoms. In the same study it was also found when problems were spoken and answers presented visually (cross-modal) the accuracy performance of the ADHD students was also normalized (Bennett et al., 2006). Another study using a stop-task measuring inhibition found that when the incentive was increased, children with ADHD performed just as well as their peers (Slusarek et al., 2001). Though the results of this study are not entirely generalized to real-world applications, the large effect size combined with modest change in presentation of the tasks suggests something as simple as modifying the mode of information presentation could improve the ability of ADHD students. These results elicit the need for further research on ways to help normalize ADHD symptoms in experimental simulations.

Another way to approach studying the interaction of ADHD symptoms and environment is to approach the setting top-down to get a more ecologically relevant perspective of the interaction. To this end, a study by Lyhne et al. (2021) attempted to understand how occupational specialists can help young adults who have functional impairments in the workplace. Structural factors, such as a necessity for clear instruction, social support, and routine were highly implicated as crucial for the success of the participants in their occupations (Lyhne et al., 2021). In a qualitative study of young adults, Lasky et al. (2016) describes how part of what helps people with ADHD find success in an occupation is to create the best possible “fit” between the individual and their environmental context. Participants in this study describe how certain traits that are impairing in some contexts can be an asset in others, and that some contexts seem to make concentrating more difficult while others do not (Lasky et al., 2016). Considering the

discussion of functioning within environments so far, it might be that systemic features are a crucial part of what defines ADHD. These results seem to reflect the concept of masking that is theorized to moderate the late-onset or remission of ADHD diagnoses, though the change to "fit" in this concept seems to put agency in affecting the interaction between the environment and the individual. A specific occupational environment is not made the focus in either of these examples, yet rich description by individual, differing cases yields specific suggestions for how ADHD people can be better suited to their environments. Part of what makes interviews in ADHD research, as shown in these examples, particularly informative on occupational impairment is how it addresses the individual heterogeneity of cases, made even more complex by the countless an occupational environment could be conceived. More such studies which understand how people with ADHD fit within their environment (Lasky et al., 2016) and successfully fulfil work roles (Lyhne et al., 2021) could greatly expand how ADHD research is conceptualized.

Discussion

The conceptualization of ADHD within research and treatment needs to be expanded to address the reality of an extremely heterogeneous population with clear treatment needs and limited support for intervention. The greatest emphasis of this research is that there is not and likely will not be a "one size fits all" understanding due to multiple paradoxes within the diagnosis: it is both culturally influenced and genetically based, inconsistent yet distinctly identifiable, and even over and under-diagnosed. Though there are clearly theory-laden issues to parse and possibly further diagnostic distinctions to be made, efforts can be made to address the deficits shared within the ADHD population. A greater emphasis on environmental context in conceptualizing research and treatment has shown progress towards that end.

Environmental context is shown to be etiologically important and associated with symptoms and functioning, though this research has shown where there are gaps in promising areas for future research. For example, environmental factors are abstracted to the level of risk factors and lack contextualization within other ecological levels. Environmental contexts interact in conjunction with genetic components in complex ways that have proven difficult to isolate, exacerbated by an inability to find any clear and consistent causal factors of ADHD (Sonuga-Barke et al., 2022). This suggests that the task of finding isolated risk factors for ADHD might not be an entirely useful direction for research, unless they are used to identify environmental contexts which seem to give rise to the condition. One way of interpreting current environmental risk data is that stressful and chaotic early life environments tend to be associated with ADHD. This suggests that supporting the general welfare and positive support within communities might help improve ADHD functioning. Psychological research tends to avoid such broad sweeping public health suggestions, though it might be necessary to address the increased public health impacts associated with ADHD.

It was found in the current research that there are multiple conceptual hurdles that may prevent progress in the study of ADHD symptoms and treatment. An emphasis on traditional views of pathology and treatment and might be an umbrella concept for some of these problems, but they are nonetheless numerous. For example, there is clearly sufficient evidence for a view of ADHD that is compensable in certain settings or circumstances, even questioning the necessity for pharmacological treatment in some cases, but medical structures of diagnosis and treatment have not adapted with current conceptions. Speaking on pathology, there are valid criticisms of the DSM-V diagnosis of ADHD that display a mismatch between ADHD discourse and practice including misguided assumptions within the pathological classification of the condition (Sonuga-

Barke et al., 2022), certain criteria in the diagnosis might be overly-vague and lead to hyper-pathologization and overdiagnosis (Gascon et al., 2022). It need also be addressed that there are financial and convenience incentives preventing the field from moving away from the pharma-central treatment of this condition. Along with diagnostic issues, research conceptualizations of ADHD should be critically examined to incorporate other ecological levels of analysis to counteract misconceptions and vestigial traditions in the field to guide more accurate research and ensure appropriate care for relevant populations.

Some studies that focus on settings and environments of ADHD functioning have shown promise in analyzing ecological levels beyond the individual, providing directions for interventions for problematic environments. In this way, forms of treatment could be conceived of through modifying environmental contexts to compensate for differences in functioning in individuals with ADHD. Lasky et al. (2006) suggests finding occupational contexts wherein people "fit" best can be an effective form of treatment. This can be done through the help of an occupational specialist, as described in the study by Lyhne et al. (2022), or through finding ways of modifying elements of the environment that propagate pathologization or could simply better suit the needs of people within it. Some other ways could be through applications and tools that might help people with ADHD manage symptoms of executive dysfunction (Lyhne et al., 2021), or helping teachers develop knowledge and resources to structure their classrooms in effective ways (McDougal et al., 2022). There is already ample knowledge of motivational research and the dopamine deficiency model of ADHD which can be used to develop environmental models and interventions (Swanson et al., 2007). However, there is still much to room explore questions of ADHD conceptualization at multiple ecological levels.

Future research could also consider how more potent and widespread change in settings and environmental context could help improve functioning for people with ADHD. It appears that socioeconomic and cultural trends are in part driving the severity of ADHD, so it would be necessary to at least work on informing disciplines and institutions (i.e. regulatory and advocatory) to understand the condition in sociocultural terms.

Though the current analysis does not outline a clear model for how to proceed, the goal is to inform a mode of thinking that might help the field of ADHD research overcome some of the issues described. Based on the research presented in this review, to expand the conceptualization of a stagnating issue future research would benefit from understanding ADHD symptoms at the intersection between individuals and their complex genetics and development, and the settings or environments they are free and suited to participate within. Conceptualizing ADHD functioning as an interaction between people and environmental settings can be elucidative and effective. To fully realize this there must be a humble reflection on the part of the field to rectify some of the clear issues with individualizing treatment and addressing sociocultural factors that clearly play a part in the pathology.

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