# A Preliminary Catalog of Cognitive Demands in Software Engineering Activities to Support the Inclusion of ADHD Developers


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## Abstract

Studies on ADHD in Software Engineering have mainly examined professionals' reported challenges, strengths, and strategies. Less is known about the cognitive demands embedded in Software Engineering activities and how they may create inclusion barriers. This paper presents a preliminary activity-level catalog of 12 activities across Requirements, Design, Construction, and Testing. Using Brown's Executive Functions model, the study combines document analysis, evaluations by Software Engineering and Psychology specialists, and four exploratory interviews with ADHD developers. The catalog relates each activity to cognitive demands, ADHD-related cognitive impacts, convergence levels, and possible points of attention. The interdisciplinary analysis highlighted recurrent demands involving Focus, Memory, Effort, and Activation, while interview reports were broadly consistent with these points. The catalog offers an initial basis for investigating cognitive inclusion in Software Engineering without prescribing interventions, predicting individual performance, or generalizing difficulties to all ADHD developers.



## Keywords

Software Engineering, Neurodiversity, ADHD, Executive Functions, Inclusion


## 1 Introduction

Software Engineering is central to a society increasingly dependent on computational solutions [2, 26]. In this context, discussing diversity, equity, and inclusion involves not only broadening participation, but also understanding how different forms of cognitive functioning relate to software development work. Although diversity, equity, and inclusion initiatives have advanced in Software Engineering [10, 23], challenges remain in understanding how neurodivergent individuals interact with the field's practices, processes, and activities [14, 21, 25, 27]. Among the conditions associated with neurodiversity, Attention Deficit Hyperactivity Disorder (ADHD), characterized by persistent patterns of inattention and/or hyperactivity-impulsivity [3], has received growing attention in studies on software development. The 2022 *Stack Overflow Developer Survey* reported that 10.57% of developers identified themselves as having ADHD or difficulties related to attention and memory [28]. Recent studies have investigated the challenges, strengths, and strategies of ADHD developers, identifying difficulties related to memory, distractions, time management, communication, abstraction, and work organization, as well as strengths such as creativity, non-linear thinking, cognitive flexibility, and hyperfocus [14, 22, 27]. Although these studies are essential for understanding ADHD developers' experiences, they mainly analyze the problem from an individual perspective. Less is known about how Software Engineering work itself, through its activities, processes, artifacts, tools, and interactions, may produce specific cognitive demands. Activities such as debugging code, modeling systems, or specifying requirements may impose distinct combinations of attention, memory, organization, persistence, and self-monitoring. In this study, cognitive demands refer to the Executive Functions required by Software Engineering activities; cognitive impacts refer to Executive Functions whose functioning may be more vulnerable in ADHD during activity execution; and potential cognitive barriers refer to inclusion difficulties that may emerge when these two dimensions converge. Making these demands explicit is important because work outcomes depend not only on developers' individual characteristics, but also on how Software Engineering work is structured. Without an activity-level analysis, it becomes more difficult to identify critical points for inclusion and to support adaptations in processes, practices, and tools [8, 11]. To investigate this gap, we defined the following research questions:

**RQ1.** What cognitive demands are associated with Software Engineering activities and may constitute potential barriers to the inclusion of ADHD developers?

**RQ2.** How do ADHD developers describe their experiences related to performing these activities?

The main contribution of this paper is a preliminary activity-level catalog that provides an initial mapping of twelve Software Engineering activities to their cognitive demands, cognitive impacts associated with ADHD, and potential cognitive barriers. The catalog was constructed through an interdisciplinary approach combining document analysis, evaluations by Software Engineering and Psychology specialists, and four exploratory interviews with ADHD developers. The analysis adopts Brown's Executive Functions model [7] and covers four SWEBOK knowledge areas: Requirements, Design, Construction, and Testing [31]. In each area, three activities were selected from the Software Engineering literature [8] and examined for traceability and compatibility with SWEBOK and ISO/IEC/IEEE 12207 [1, 31]. The catalog is exploratory and does not aim to cover all possible activities, prescribe interventions, predict individual performance, or claim that these activities necessarily produce difficulties for all ADHD developers. Its purpose is to make visible possible points of attention at the activity level, providing an initial basis for future research and, preliminarily, for practitioners to examine activities, workflows, and tools in relation to possible cognitive inclusion barriers.

## 2 Background and Related Work

### 2.1 Executive Functions and ADHD

Executive Functions are cognitive processes involved in regulating attention, behavior, and goal-oriented actions, supporting initiation, organization, sustained focus, mental effort, emotional regulation, working memory, and action monitoring [4, 7]. In complex activities such as software development, these functions may be mobilized across multiple steps, artifact dependencies, decisions, and changing contexts [8]. In the ADHD literature, Executive Function difficulties are frequently associated with attention, organization, working memory, effort, and emotional regulation [4, 7], although they do not manifest uniformly across individuals. In this study, Executive Functions are therefore used as an analytical lens for characterizing cognitive demands embedded in Software Engineering activities, rather than for evaluating individuals, inferring performance, or generalizing limitations. We adopted Brown's model [7], which organizes Executive Functions into six groups: Activation, Focus, Effort, Emotion, Memory, and Action. Activation concerns initiating and organizing work; Focus, sustaining and shifting attention; Effort, maintaining alertness and persistence; Emotion, regulating frustration and affective responses; Memory, retaining and retrieving task-relevant information; and Action, monitoring and regulating behavior during execution.

### 2.2 Related Work

Recent studies in Software Engineering have investigated how neurodivergent professionals experience work in software development teams, with particular attention to challenges, adaptation strategies, and organizational conditions. Liebel et al. [22], for example, investigated the experiences of software engineers with ADHD and identified difficulties related to organization, forgetfulness, communication, prioritization, and task management.

The authors also highlight strengths associated with ADHD, such as creativity and non-linear thinking, and suggest adaptive practices to support different working styles in software teams. Studies by Gama et al. [14, 15] analyzed the experiences of neurodivergent professionals in agile practices. Their findings indicate that meetings, effort estimation, social interactions, and task coordination may generate cognitive and emotional tensions in everyday work. These studies reinforce that the inclusion of neurodivergent professionals depends not only on individual characteristics, but also on how processes, practices, and interactions are organized within software development environments.

Other studies discuss behavioral patterns, productivity, and compensatory strategies adopted by ADHD developers. Morris et al. and Newman et al. [25, 27] discuss phenomena such as procrastination, hyperfocus, mental fatigue, and difficulties related to prioritization and organization, as well as strategies used by developers themselves, including activity decomposition, support tools, progressive deadlines, and structured written communication. These findings are aligned with broader research on well-being and mental health in Software Engineering, which associates emotional states, interruptions, frustration, and work conditions with sustained attention, engagement, and developers' cognitive performance [12, 13, 18, 24, 29].

> **Research gap.** Existing studies help understand how ADHD developers experience work in Software Engineering and which strategies they use to deal with everyday challenges. However, there is still limited understanding of how Software Engineering activities themselves require specific cognitive demands that may become barriers to inclusion. This study differs by shifting the focus from individual experience to the activity level, considering representative activities from Requirements, Design, Construction, and Testing.

## 3 Methodology

This study adopts a qualitative and exploratory approach [9], combining document analysis [17], expert evaluation [20], and interviews with ADHD developers. It constructs a preliminary catalog of Software Engineering activities, cognitive demands, cognitive impacts, and potential cognitive barriers. The analysis focuses on activities in four SWEBOK knowledge areas: Requirements, Design, Construction, and Testing [31]. Figure 1 summarizes the process. The first five stages address **RQ1**; the sixth addresses **RQ2** through interviews with ADHD developers.

### 3.1 Stage 1: Selection of Software Engineering areas and activities

A document analysis [17] was conducted to define the study scope through three steps. First, we selected four SWEBOK knowledge areas: Requirements, Design, Construction, and Testing [31], because they cover distinct moments of software development and involve stakeholder interaction, modeling, implementation, and verification [16, 30]. Second, we identified an initial set of activities described in the Software Engineering literature, using Chentouf et al. [8] as a reference. Third, these activities were examined in relation to SWEBOK [31] and ISO/IEC/IEEE 12207 [1], considering their compatibility with the selected areas and traceability to recognized processes or descriptions in the field. From this initial set, three activities were retained in each area to balance the representation of the four areas while maintaining a feasible scope for the interdisciplinary analysis. The selection prioritized activities that were documented, traceable, compatible with the selected areas, and sufficiently distinct for an initial activity-level analysis of cognitive demands. This procedure resulted in 12 activities and was not intended to identify the most frequent activities or exhaustively represent Software Engineering practice. The selected activities are presented in Table 1, and the complete criteria are available in the supplementary material[1].

### 3.2 Stage 2: Cognitive demands of activities

In the second stage, two Software Engineering specialists were purposively selected based on their academic and practical experience in software development. They independently analyzed the 12 activities to identify their main cognitive demands, defined as the Executive Functions required by the activities themselves, independently of characteristics associated with ADHD. The analysis considered each activity's technical nature, steps, and type of reasoning. Before the classification, the specialists received an orientation protocol containing instructions and brief descriptions of Brown's six Executive Functions: Activation, Focus, Effort, Emotion, Memory, and Action [7]. Following expert evaluation practices in exploratory studies [20], each specialist indicated one primary and one secondary Executive Function per activity. Divergent classifications were discussed based on the specialists' rationales, activity descriptions, and Executive Function definitions until consensus was reached. Given the qualitative, exploratory, and consensus-based nature of this stage, no inter-rater agreement measure was calculated. The resulting mapping, individual classifications, and consensus procedure are available in the supplementary material[1].

### 3.3 Stage 3: Cognitive impacts associated with ADHD

In the third stage, two Psychology specialists were purposively selected based on their graduate-level training and experience in neuropsychology and ADHD. They independently analyzed the 12 selected activities. To support their understanding without requiring prior Software Engineering expertise, the specialists received a briefing document describing each activity, its area, purpose, and expected execution context. The objective was to identify which

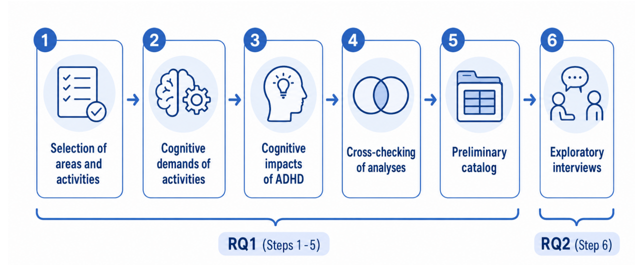


**Figure 1: Methodology Process**

Executive Functions could be more vulnerable in ADHD during activity execution, considering the ADHD literature and Brown's model [4, 7]. In this stage, cognitive impacts refer to Executive Functions potentially associated with difficulties during activity execution by ADHD developers, rather than to observed individual limitations. Each specialist indicated one primary and one secondary Executive Function for each activity. Divergent classifications were discussed based on the specialists' rationales, the activity descriptions, and the Executive Function definitions until consensus was reached. This stage resulted in a mapping of cognitive impacts associated with ADHD, available in the supplementary material[1].

### 3.4 Stage 4: Cross-checking of analyses

In the fourth stage, the evaluations conducted by the Software Engineering and Psychology specialists were cross-checked. For each activity, we compared the primary and secondary Executive Functions identified in both analyses to examine the convergence between activity cognitive demands and ADHD-related cognitive impacts. We adopted an exploratory heuristic with three convergence levels: high, when both Executive Functions converged; medium, when one function was shared; and low, when there was no overlap. Potential cognitive barriers were interpreted as possible inclusion difficulties that may emerge when activity demands correspond to Executive Functions potentially more vulnerable in ADHD. The levels represent the extent of convergence between the mappings, rather than barrier severity. This classification is a preliminary analytical synthesis, not a statistical measure, validated scale, or assessment of individuals, and it does not capture all contextual variations in activity execution. Alternative classification strategies should be examined in future studies. The resulting convergence matrix supported the construction of the preliminary catalog; additional details are available in the supplementary material[1].

### 3.5 Stage 5: Preliminary catalog construction

Based on the cross-checking performed in Stage 4, a preliminary catalog was constructed to organize the results into a structured and traceable format. A catalog is understood as a way of organizing and representing information about a set of items according to defined criteria [19]. The catalog was organized by the four selected Software Engineering knowledge areas: Requirements, Design, Construction, and Testing, with three activities per area. For each activity, it presents the cognitive demands, the cognitive impacts associated with ADHD, the convergence level between the two mappings, and a brief interpretation of possible points of

[1]Supplementary materials available at https://figshare.com/s/2192a174969e2480c1d1

attention during activity execution. The resulting catalog is presented in Table 1; detailed matrices and complementary materials are available in the supplementary material[1].

## 3.6 Stage 6: Experiences of ADHD developers

We conducted exploratory semi-structured interviews with four software developers who reported an ADHD diagnosis to complement the catalog with their experiences of the selected activities, rather than to provide generalizable validation. Participants were 23 to 40 years old, had 3 to 10 years of professional experience, and reported experience with all 12 activities; one participant also reported an autism diagnosis. The study was approved by the institutional Research Ethics Committee (CAAE: 88054525.1.0000.5347), and participants signed an Informed Consent Form authorizing the anonymized use of their data. The remote interviews lasted 38 to 47 minutes, were audio-recorded and transcribed, and addressed experiences, difficulties, facilitators, and strategies related to activity execution. To preserve privacy, full transcripts were not published; the interview script, supporting materials, and coding artifacts are available in the supplementary material[1]. The data were analyzed through inductive thematic analysis following Braun and Clarke [5, 6]. The process comprised transcript familiarization, coding, grouping codes into candidate themes, and reviewing them until five final themes were defined. Figure 2 presents the resulting themes and categories.

# 4 Results

## 4.1 Preliminary catalog of cognitive demands and possible barriers

To answer RQ1, the interdisciplinary cross-analysis resulted in a preliminary catalog relating Software Engineering activities to cognitive demands, ADHD-related cognitive impacts, convergence levels, and possible points of attention. Cognitive demands correspond to the Executive Functions required by each activity, whereas cognitive impacts refer to functions potentially more vulnerable in ADHD during activity execution. The convergence level reflects the overlap between the mappings produced by Software Engineering and Psychology specialists. Table 1 presents the resulting catalog.

Requirements elicitation illustrates the classification process. Software Engineering specialists identified Focus and Memory as cognitive demands, whereas Psychology specialists identified Focus and Effort as cognitive impacts. Because Focus appeared in both mappings, the activity received a medium convergence level, indicating a possible point of attention when listening to, interpreting, and recording stakeholder needs. Most activities presented medium convergence, with Focus, Activation, Memory, and Effort recurring across the four areas. In Requirements, Focus was the main convergence point, particularly in activities involving the elicitation, specification, and comparison of distributed information. In Design, Activation and Memory were associated with initiating, structuring, and retrieving information across models, requirements, and design decisions. Construction showed greater variation: unit testing presented medium convergence related mainly to Focus, whereas structured coding and debugging presented low convergence. Nevertheless, these activities still involved points of attention related to sustaining effort, recalling planned structures, monitoring actions, and regulating frustration. Testing presented the highest convergence in the catalog. Test execution was classified as high because Focus and Effort converged in both mappings, suggesting that sequential and prolonged procedures may be particularly demanding in terms of sustained attention and persistence. Test design and result interpretation presented medium convergence, associated with organizing scenarios and analyzing evidence, patterns, and conclusions. Overall, the catalog indicates where activity demands and ADHD-related cognitive impacts may converge into possible inclusion barriers. It does not define individual limitations, but identifies preliminary points of attention in the cognitive structure of Software Engineering activities.

## 4.2 Experiences of ADHD developers in performing the activities

To answer RQ2, the interview analysis resulted in five themes describing perceived difficulties, strategies, and contextual conditions influencing participants' experiences with Software Engineering activities. Figure 2 presents the themes and their categories.

*4.2.1* ***Activity clarity and structure support execution*** Participants reported that activities with clear objectives, explicit criteria, and defined structures were easier to initiate, organize, and complete. In contrast, ambiguous or open-ended activities increased difficulties related to prioritization, continuity of reasoning, and mental organization, as illustrated by P1: *"When it is not clear what exactly is expected, I start several lines of reasoning at the same time and get lost"*. Recovering context after interruptions was also described as difficult, particularly in long activities involving multiple technical dependencies. These experiences appeared mainly in Requirements and Design activities.

*4.2.2* ***Interactive activities concentrate attention and communication demands*** Interactive activities involving technical communication, team alignment, and simultaneous interactions required sustained attention and increased cognitive effort. Context changes, interruptions, and long discussions made it difficult to maintain the reasoning process. P3 reported that *"When many people start talking at the same time or the focus of the conversation changes, I completely lose my train of thought"*. These experiences appeared mainly in requirements elicitation and specification, which combine understanding needs, organizing information, and interacting with others.

*4.2.3* ***Activity engagement influences motivation*** Participants reported greater engagement in activities involving novelty, investigation, creation, and problem-solving. Debugging, for example, was described as stimulating because it resembled an investigation. In contrast, repetitive and highly operational activities were associated with reduced interest and difficulty sustaining attention, as expressed by P2: *"When a task becomes too repetitive, my mind simply starts looking for something else to do"*. This contrast appeared particularly between debugging and repetitive testing activities.

*4.2.4* ***External resources support memory, comprehension, and continuity*** Participants used notes, diagrams, documentation, automation, and other external resources to support organization, memory, comprehension, and context recovery. As P4 explained, *"I*


**Figure 2: Organization of themes and categories resulting from the thematic analysis.**

**Table 1: Preliminary catalog of cognitive demands and possible barriers in Software Engineering activities**

| Activity | Cognitive demands | Cognitive impacts | Level | Possible cognitive barrier |
|---|---|---|---|---|
| **Requirements** | | | | |
| Elicitation | Focus<br>Memory | Focus<br>Effort | M | Maintaining attention while listening, interpreting, and recording stakeholder needs. |
| Specification | Effort<br>Focus | Memory<br>Focus | M | Organizing collected information into clear and less ambiguous requirements. |
| Inconsistency analysis | Memory<br>Focus | Focus<br>Effort | M | Comparing distributed information and identifying contradictions, omissions, or unclear descriptions. |
| **Design** | | | | |
| Graphical modeling | Memory<br>Activation | Activation<br>Focus | M | Initiating and structuring visual representations of components, interactions, and flows. |
| Requirements traceability | Focus<br>Memory | Memory<br>Effort | M | Retrieving requirements and relating them to design components or decisions. |
| Data modeling | Activation<br>Memory | Activation<br>Focus | M | Initiating the organization of data categories, relationships, and future changes. |
| **Construction** | | | | |
| Structured coding | Action<br>Focus | Memory<br>Effort | L | Recalling planned structures and sustaining effort during coding. |
| Unit testing | Focus<br>Memory | Focus<br>Emotion | M | Maintaining attention during test cycles, result comparison, and code adjustments. |
| Debugging | Effort<br>Focus | Action<br>Emotion | L | Self-monitoring and emotional regulation when facing persistent errors. |
| **Testing** | | | | |
| Test design | Activation<br>Memory | Activation<br>Focus | M | Initiating and organizing scenarios, steps, inputs, conditions, and expected results. |
| Test execution | Focus<br>Effort | Focus<br>Effort | H | Sustaining attention and persistence in sequential and prolonged activities. |
| Result interpretation | Memory<br>Focus | Focus<br>Effort | M | Analyzing results, identifying failure patterns, interpreting evidence, and communicating conclusions. |

*Note.* Cognitive demands refer to Executive Functions required by the activity; cognitive impacts refer to Executive Functions potentially more vulnerable in ADHD during activity execution. Level: L = no convergence; M = convergence in one Executive Function; H = convergence in both Executive Functions.

*need to keep everything very visual or written down because if I interrupt a task, it becomes difficult to resume exactly where I stopped"*. AI-based tools were described ambivalently: they could help organize ideas and recover possible paths, but could also increase confusion when generating imprecise or apparently correct responses. Thus, external resources may support activity continuity when they are understandable and reliable.

*4.2.5* ***Overload, environment, and management shape activity experience*** Participants emphasized that difficulties were influenced not only by the technical characteristics of an activity, but also by the conditions in which it was performed. Simultaneous demands, excessive information, interruptions, and inflexible environments increased cognitive overload. As P2 summarized, *"The problem is not always the task itself, but the environment, the interruptions, and the amount of things happening at the same time"*. Management support, understanding of neurodivergence, and environmental flexibility were described as conditions that could reduce or amplify this burden. These findings suggest that activity experiences emerge from the interaction between technical demands and organizational context.

## 5 Discussion

The results suggest an alignment between the preliminary catalog and the experiences reported by ADHD developers, without implying direct correspondence. Executive Functions identified in the catalog appeared in reports involving sustained attention, organization, context recovery, simultaneous demands, and persistence. These findings support considering the cognitive organization of activities alongside individual experiences when discussing inclusion. Previous studies have identified challenges related to memory, distractions, communication, prioritization, organization, effort, and compensatory strategies [14, 22, 27]. Our results are consistent with these findings and provide an initial activity-level structure for examining where such demands may be present in Software Engineering work. Convergences involving Focus were reflected in reports about interruptions, context switching, and simultaneous interactions, particularly in Requirements and Testing. In Design, convergences involving Activation were reflected in difficulties initiating, structuring, and resuming activities with multiple elements, dependencies, or artifacts. These relationships suggest that the catalog may help identify where activity demands and ADHD-related cognitive impacts converge into possible points of attention.

The interviews also indicate that activity experiences are shaped by the interaction between technical demands, tools, processes, and the work environment. Interruptions, simultaneous demands, unclear criteria, and limited flexibility may increase cognitive overload, whereas documentation, visual resources, automation, digital tools, and supportive management may support continuity, memory, and organization. Thus, cognitive inclusion may involve not only the technical complexity of activities, but also the conditions available for structuring work, visualizing information, and recovering context. As a preliminary analytical artifact, the catalog may support researchers in formulating hypotheses and planning empirical studies. It may also provide managers, process designers, and tool developers with an initial reference for examining cognitive demands in activities, workflows, and tools. Such use should focus on work structures rather than classifying developers, predicting performance, or prescribing interventions. By characterizing cognitive demands, ADHD-related cognitive impacts, and their convergence at the activity level, this study offers an initial perspective that complements research centered on individual experiences. It also supports further investigation into how practices, artifacts, tools, and workflows may contribute to more cognitively inclusive Software Engineering environments.

## 6 Conclusion

This paper presented a preliminary catalog of cognitive demands, cognitive impacts, and possible barriers associated with 12 Software Engineering activities, considering implications for the inclusion of ADHD developers.

> **Main Contribution.** The catalog offers an initial activity-level structure to anticipate potential cognitive barriers without prescribing interventions or generalizing limitations to all ADHD developers.

**This study has limitations**. The catalog is exploratory and based on a limited set of activities, a small purposively selected expert panel, and subjective classifications that may be affected by selection and consensus bias. The adoption of Brown's Executive Functions model also shaped the analytical categories considered. The interviews involved only four developers with ADHD and provide exploratory contextualization rather than generalizable validation. Future work may expand the activities and Software Engineering areas, involve larger and more diverse expert panels and participant samples, compare alternative classification strategies, and conduct quantitative and industrial replication studies.

## Artifact Availability

Supplementary materials, including expert analysis protocols, convergence matrices, the extended catalog, and thematic analysis artifacts, are publicly available in a Figshare repository.[2]

## Ethical Considerations on the Use of AI

We declare that Generative AI tools were used for English revision, manuscript editing support, supplementary material organization, and enhancement of Figures 1 and 2. All content was reviewed and validated by the authors, who assume full responsibility for the final text, in accordance with CNPq Ordinance No. 2.664/2026.

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[2]Supplementary materials available at https://figshare.com/s/2192a174969e2480c1d1

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