Uncovering and minimising barriers to digital research infrastructure in environmental science faced by users with Attention-Deficit/Hyperactivity Disorder (ADHD)

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1. Introduction

1.1 Overview

Environmental science is largely a mission-oriented crisis discipline (Soule, 1985), addressing contemporary 'wicked problems' global in scope. Wicked problems denote issues plagued by high levels of complexity, uncertainty and contention, e.g., climate change and biodiversity loss (Weaver et al, 2023). Such complexity necessitates interdisciplinary, systems thinking to integrate data and expertise from a variety of domains (Widdicks et al, 2024). Consequently, digital research infrastructure (DRI) is vital to environmental science; DRI encompasses all the digital technologies (e.g., monitoring infrastructure, platforms/tools, computational resources) and objects (data science and AI methods, models) that underpin the discipline (Widdicks et al, 2026). Innovations in DRI provide a foundation to make sense of noisy, disparate datasets spanning large spatial and temporal scales. DRI also uncovers untapped potential for cross-disciplinary collaboration fundamental to addressing complex feedbacks inherent in environmental systems (Widdicks et al, 2024).

The use and development of DRI to tackle environmental issues would undoubtedly benefit from a diverse array of knowledge and skillsets; research has exemplified beneficial effects of workplace diversity on problem-solving and creativity (Covington et al, 2025). Additionally, many societal injustices are inseparable from environmental disparities (De Zylva et al, 2020; Mehta, 2025). It is crucial to avoid perpetuating inequities by listening to the lived experiences of marginalised groups to address barriers to equity, equality, diversity and inclusion (EEDI) within DRI and environmental science.

Stakeholders can include but are not limited to researchers, policymakers, software developers, citizen scientists and students. An example of a stakeholder group with potential to be further marginalised by DRI designed without accessibility in mind are neurodivergent users. The umbrella term neurodivergence includes neurotypes such as Dyslexia, Dyscalculia, Dyspraxia, Autism Spectrum Condition, Tourette's Syndrome and ADHD (Dalton, 2013); due to time constraints of this study and the diverse needs of various neurotypes, ADHD was centred (see section 1.2 for a definition). ADHD was chosen due to being one of the most common neurodivergences in the UK, at 3.7% and 3.1% prevalence rates for men and women, respectively (NHS England, 2025), along with high rates of underdiagnosis due to long wait times, misdiagnoses, outdated criteria and the tendency for individuals with ADHD to develop adaptive strategies that mask its expression at a cost to their well-being (Asherson et al, 2012, Mylett et al, 2026).

The distinction between neurodiversity and neurodivergence is important to note. Neurodiversity denotes the infinite variation in neurocognitive functioning within the human genome (Walker, 2024), whereas neurodivergent people describe themselves as having a significant difference from what is considered conventional cognitive functioning or self-expression (Tcherdakoff et al, 2025). Neurodivergence can be innate (i.e., neurodevelopmental conditions) or environmentally influenced (by e.g., trauma, long-term mediation practice, or heavy usage of psychedelic drugs) (Walker, 2024).

Rather than a disability, neurodivergence refers to cognitive differences, though on an individual basis some may choose to identify as disabled when their neurotype substantially affects daily life. In disability discourse, there are two approaches to explaining outcomes on health: the medical model and the social model. The social model, introduced by sociologist Mike Oliver in 1983, states challenges that lead to neurodivergent individuals identifying as disabled are imposed upon them by societal attitudes and systemic barriers rather than by individual impairments as in the medical model (Haegele and Hodge, 2016). The social model may better acknowledge the many positive aspects of neurodivergence (Dalton, 2013); strengths such as pattern-spotting, systems thinking, novelty-seeking and questioning the status quo (De Saram, 2025) can drive innovations in science. While important to avoid deficit-focused perspectives and highlight these strengths, it is equally crucial to avoid minimising support needs (Tcherdakoff et al, 2025). This review will aim to address such support needs to prevent exclusion of neurodivergent stakeholders' talents and expertise from environmental DRI.

Innovations in environmental research made possible by DRI, such as cloud computing, artificial intelligence (AI) and data science models (Widdicks et al, 2024), synergise computer science and environmental science. While pivotal for furthering problem-solving, this synergy compounds barriers to each of these disciplines faced by stakeholders belonging to marginalised demographics, such as those with ADHD. This intersection is an emerging, heterogenous and complex research area; a scoping review was necessary to lay the groundwork for future research.

Participatory co-design is one possible method to ensure DRI is designed to be accessible to marginalised user groups, but itself also presents challenges in terms of inclusivity. In Human-Computer Interaction (HCI), participatory co-design refers to digital systems being developed with stakeholders iteratively and flexibly, valuing their perspectives equally to those in the development team in every stage of the software's design, testing and dissemination (Widdicks et al, 2024). As of the current state of knowledge, no published studies directly evaluate accessibility of DRI or of participatory co-design for DRI in an environmental science context for users with ADHD. The objective of this scoping review is to assess existing literature to uncover and minimise barriers stakeholders with ADHD face regarding a) DRI design and b) engagement with developed DRI. Consequently, two initial research questions were formulated:

RQ1. What potential barriers exist surrounding digital tools for individuals with ADHD and how can they be mitigated?

RQ2. What potential barriers exist surrounding participatory co-design engagement mechanisms for individuals with ADHD and how can they be mitigated?

Insights gained will then be explored in relation to case studies of DRI for environmental science and engagement mechanisms developed under the NC-UK (National Capability for UK Challenges) programme. Co-designed DRI aims to assist with monitoring and management of the UK's land, air and freshwater environments to accelerate progress toward a sustainable future (UKCEH, 2026). The two case studies were specifically a) the Spatial Explorer, aiming to enhance discoverability and accessibility of spatial data collected under NC-UK; and b) the Community Conversations, a participatory engagement mechanism designed to gather community feedback and insights in the DRI co-design process. The case studies gave rise to two further research questions:

RQ1.1. How can these considerations be applied to a case study: Spatial Explorer?

RQ2.1 How can these considerations be applied to a case study: Community Conversations?

1.2 ADHD Background

The label ADHD is ultimately contentious due to containing words with pathologizing connotations such as 'deficit' and 'disorder'. The label aligns with the medical model, which defines ADHD as a neurodevelopmental condition impacting regulation of executive functions and characterised by persistent patterns of inattention, hyperactivity and/or impulsivity that can affect daily functioning. It designates three sub-types according to dominant symptom expression: inattentive, hyperactive-impulsive and combined (Purper-Ouakil et al, 2011; Sonne et al, 2016). Suggested biological mechanisms are rooted in differences in dopamine regulation and prefrontal cortex structure (Purper-Ouakil et al, 2011). While useful for the development of medication and therapy, the medical model fundamentally frames the ADHD neurotype as an impairment. An alternative model is the social model, where it is the inaccessible environment and systemic barriers (e.g., cultural and political conditions) that lead to a person with an ADHD neurotype identifying as disabled (Halpin et al, 2025). The social model can offer helpful insights during participatory co-design involving individuals with ADHD as it shifts the focus onto their internal experience rather than outward expression of behaviour (Sonne et al, 2016; Burtscher and Gerling, 2024).

Traits associated with ADHD such as hyperfocus, associative thinking and high novelty-seeking can align well with the demands of scientific research such as creative problem-solving (NeuroLaunch, 2024; Nowgrodzki, 2025). However, the condition may also impose significant challenges on a context-dependent basis linked to executive function (NeuroLaunch, 2024), which is the name for a collection of cognitive processes that facilitate planning, initiation and regulation of behaviour to achieve goals (Burgess, 2012). Executive dysfunction may give rise to a multiplicity of challenges surrounding e.g., working memory, motivation and focus (Burgess, 2012).

Historically, ADHD was misclassified as a 'childhood disorder' and the inattentive subtype was vastly overshadowed by the hyperactive subtype (Spiel et al, 2022). This harmful misclassification has influenced a lot of the contemporary stigma surrounding ADHD, which may often be internalised (Spiel et al, 2022). Challenges imposed by ADHD may lead to co-occurring chronic health issues (Wehmeier et al, 2010; Reale et al, 2017). For example, the risk for anxiety disorders is higher in individuals with ADHD than in the general population (Katzman et al, 2017). These symptoms can manifest in a vicious cycle, with ADHD symptoms contributing to the development of anxiety, which subsequently exacerbates inattention (Fu et al, 2025). Consequently, designing DRI software to minimise these challenges could also have beneficial consequences for mental health of stakeholders.

A holistic understanding of challenges faced by neurodivergent environmental scientists necessitates a lens of intersectionality (Stevenson, 2025); a term coined by civil rights advocate and Black Feminist theorist Kimberlé Crenshaw (Crenshaw, 1989). Intersectionality describes how combinations of individuals' social identities (e.g., gender, race/ethnicity, age, class) impact their lives and compound privilege and disadvantage (Calvard et al, 2026). The time constraints of this study necessitated a streamlined focus on one neurotype (ADHD), but recommendations for an intersectional lens are included in the discussion (section 4.2.1).

2. Methods

To address RQ1 and RQ2 (Section 1.1), a scoping review was carried out. This scoping review was inspired by PRISMA-ScR (Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews) guidelines (Tricco et al, 2018), which were developed between 2016 and 2018 by an international team of experts to improve the quality and standardisation of scoping reviews. The approach was adapted due to the broad and pioneering nature of this investigation that necessitated a more exploratory approach to searching. Databases Google Scholar and Scopus were searched for literature pertaining to accessibility and inclusivity for individuals with ADHD in HCI and co-design. Backward snowballing was then conducted by screening reference lists of relevant literature to identify additional sources. To ensure good coverage and that no key papers were missed, expert professionals such as social scientists, accessibility professionals, software developers and data scientists were also consulted. Additionally, blog posts and websites were studied to learn from those with lived experience of ADHD, and web accessibility guidelines were examined before synthesising key concepts and themes, trends and patterns, and research gaps.

To address RQ1.1 and RQ2.1 (section 1.1), insights gained from the literature were then applied to specific case studies for **a) DRI** and **b) engagement mechanisms which are being developed and iterated as part of the NC-UK programme**. The DRI case study was UKCEH's (UK Centre for Ecology and Hydrology) Spatial Explorer tool

(Figure 1), a discovery tool developed for users to visualise spatial data with an interactive map. It encompasses a suite of spatial datasets (raster, polygon and vector) covering Great Britain and Northern Ireland (UKCEH, 2024) and conveys a wide breadth of information including land cover class, fertilisers, recreation demand, soil type among many other aspects. This open-access tool is intended to make geospatial data quickly accessible to a broad range of users of varying technical expertise, from researchers to students to members of the public.

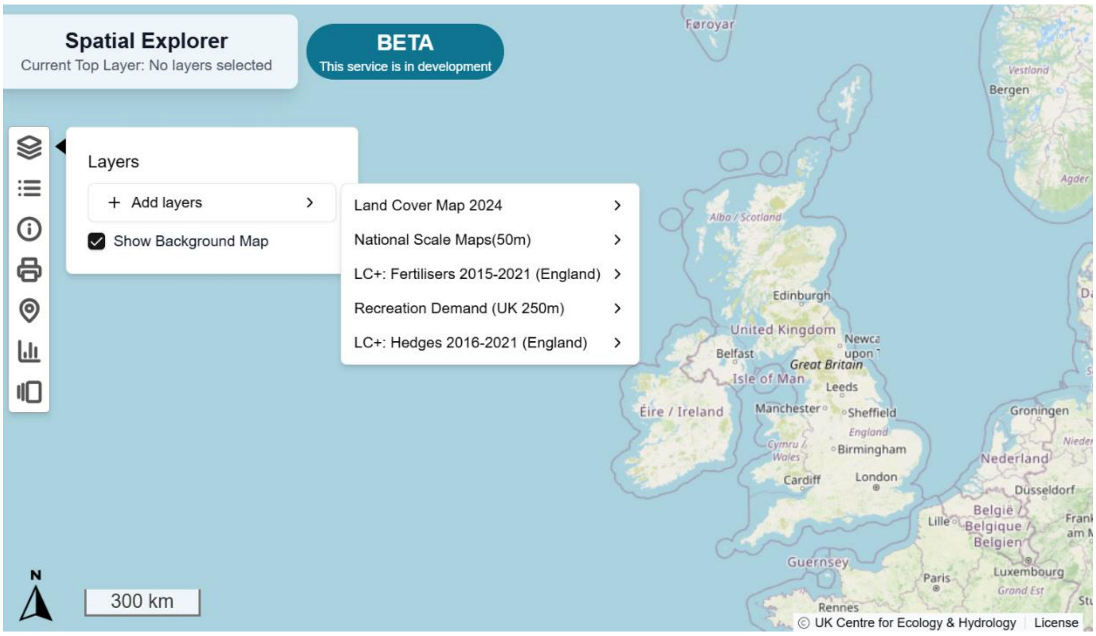


Figure 1. Screenshot from Spatial Explorer (Beta) showing the basemap and the categories of layers it can display.

The specific co-design engagement mechanism selected was Community Conversations, a series of online workshops that showcase initial NC-UK DRI development ideas, gather perspectives from the community, and shape next steps together with equal input from both technical expert and non-technical stakeholders (Widdicks et al, 2026). These have thus far consisted of four online workshops running from May – December 2025 and shared common themes of enhancing discovery and access to DRI and the digital objects they serve (Widdicks et al, 2026). The workshops aim to ensure DRI research and development focuses on the needs of the user community by encouraging their feedback, ideas and questions. The number of attendees ranged from 25 to 90, with a mixture of internal and external organisational affiliations.

To evaluate accessibility of each case study for users with ADHD, tables of best practices guidelines were first devised based on WCAG accessibility guidelines (Level Access, 2025), UKCEH's DRI EEDI/A Best Practices guidelines (Blair and Butler-Eldridge, 2026), and findings from the wider literature. The guidelines are presented in table format in sections 3.1.6 and 3.2.5. They represent an ongoing process to supporting users with ADHD rather than a comprehensive checklist; the guidelines themselves would benefit from iterative co-design (Section 3.2). The two case studies were then assessed against these criteria, noting both positive aspects and areas for improvement. For RQ1.1, the Spatial Explorer tool itself (UKCEH, 2024) was evaluated whereas for RQ2.1 the presentation slide decks and reflective reports (Widdicks et al, 2026) from the online workshops were evaluated retrospectively.

3. Results

3.1 RQ1: DRI design

Across the literature on digital accessibility for ADHD, a consistent theme was that ADHD does not manifest identically across different individuals (Sonne et al, 2016, Kasatskii et al, 2023, NeuroLaunch, 2024b) or even within the same individual from day to day (Burtscher and Gerling, 2024). The executive function difficulties that characterise ADHD vary enormously due to its complex and heterogenous genetic and environmental influences. Nevertheless, overarching barriers did repeatedly emerge, which the following sections will address to answer RQ1 (section 1.1). Each of the solutions to these barriers shares an underlying framework; digital accommodations should externalise aspects of executive function (NeuroLaunch, 2024b) to facilitate the talents and expertise of users with ADHD. Consequently, barriers discussed are organised around four executive function-related themes: **a) working memory, b) cognitive load, c) motivation/ task initiation and d) navigation**, with a fifth overarching theme highlighting the importance of **customisation**. Barriers and potential solutions are summarised in Figure 2 below. These findings were then applied to the Spatial Explorer case study to address RQ1.1 (section 1.1).

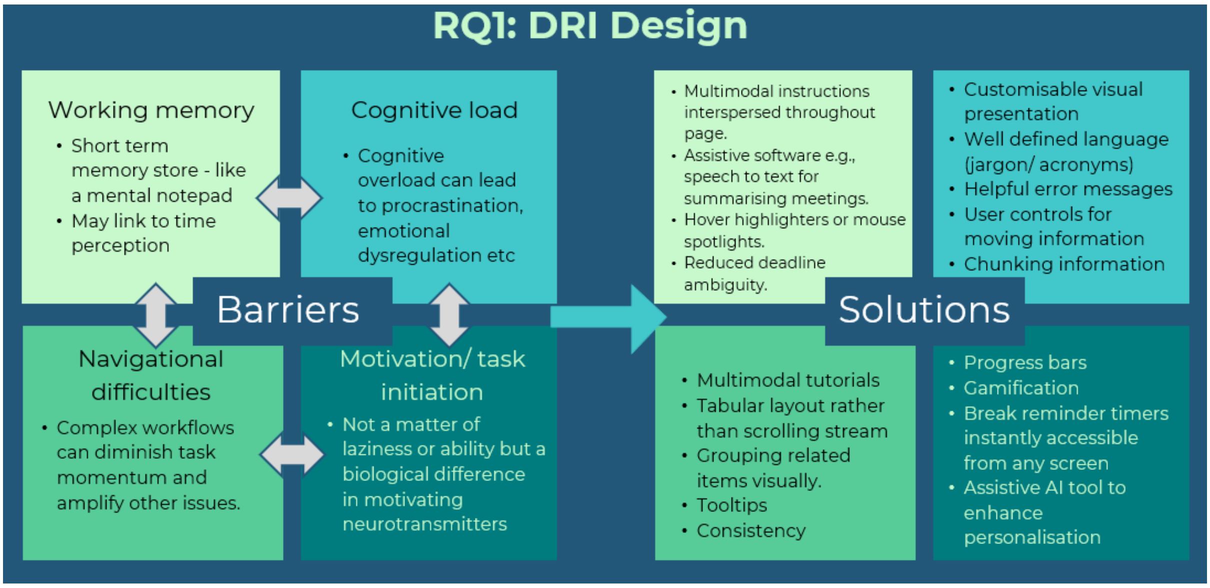


Figure 2. Diagram summarising four key themes of barriers which are linked by executive function. Potential solutions are also suggested.

3.1.1 Working memory

The first barrier concerned working memory. Working memory refers to the ability to hold information in a limited capacity short-term store and use it to perform a wide range of cognitive tasks, including transfer into and retrieval from long-term memory (Baddeley, 2006). It involves storing information in the short-term memory along with analysing and manipulating it. Concerning DRI, working memory differences common in ADHD (Kofler et al, 2010; Tcherdakoff et al, 2025) could be exacerbated by software design, such as layouts with many instructions at the beginning rather than interspersed throughout the page. Halpin et al (2025) conducted a think-aloud study to explore the experiences of computer scientists with ADHD when using integrated development environments and found that difficulties arose surrounding keeping track of different variables and functions, as well as remembering different coding languages. Consequently, features that streamline focus by enhancing visibility of tasks sequentially may assist with keeping track of numerous elements, akin to 'hover-highlighters' or mouse spotlights seen in some accessibility plugins. Another potential accommodation for working memory difficulties are tooltips (Milbergs, 2025); messages which appear when a cursor is positioned over an element in a graphical user interface (see Table 2, row 2).

Improvements can be made to instructions to assist those with working memory differences. Consistent language, such as avoiding synonyms for the same action, as well as reducing jargon and defining acronyms are examples (Level Access, 2025; Milbergs, 2025). Speech-to-text software and/ or written summaries for verbal instructions and meetings (NeuroLaunch, 2024b) can also support memory. Working memory issues may also contribute to common ADHD experiences such as ‘time blindness’, which is a difference in how the brain processes time at a neurological level and often results in a need to either mask or modify one’s natural temporal rhythms to fit into the dominant neurotypical framework of time (Tolani and Venkatesan, 2025). To assist with remembering deadlines, ambiguity should be reduced i.e., explicitly state a date rather than saying ‘soon’ (NeuroLaunch, 2024b).

3.1.2 Cognitive load

Closely related to working memory, the second barrier identified was cognitive overload (Kasatskii et al, 2023, Seery et al, 2025, Halpin et al, 2025). Cognitive load refers to the amount of working memory resources used when engaged in a cognitive task (Le Cunff et al, 2023). Although cognitive overload is something everyone may experience, neurological differences in those with ADHD alongside the emotional and physical toll of managing these can increase susceptibility to cognitive overload and subsequent executive dysfunction. Executive dysfunction associated with ADHD can sometimes constrain ability to prioritise and filter incoming demands (Meyer, 2026), potentially resulting in decision fatigue and task avoidance. Hence, digital systems with excess complexity, low intuitiveness and a high number of steps in a task can result in cognitive overload, triggering symptoms such as procrastination, task paralysis, executive dysfunction, overwhelm, and emotional dysregulation (Nowogrodzki, 2025; Tcherdakoff et al, 2025). However, a study found that depending on the ADHD symptom users struggled with most, either high or low perceptual load was beneficial (Kasatskii et al, 2023), highlighting the importance of adaptable design.

Potential accommodations link to reducing visual clutter; participants with ADHD using an integrated development environment reported a feeling of wanting to reduce the volume of visible information (Halpin et al, 2025). Animations and auto playing media should be minimised or given full user controls as they can pose challenges for those who already struggle with attentional filtering (NeuroLaunch, 2024b). Categorisation and chunking information can also be incredibly beneficial to break information into manageable segments (Seery et al, 2025, Milbergs, 2025), e.g., via use of tables rather than large walls of text (Tcherdakoff et al, 2025). Best user interface design practises point to colours that are meaningful (i.e., clearly labelled) but not overwhelming, in addition to visual signifiers of information to allow for faster processing. In graphic design there are three categories of signifiers: icons, indexes or symbols. Icons are factual visual representations of subjects, indexes represent something closely related to the subject that cannot exist without it, and symbols are not visually connected to the subject therefore their meaning must be culturally learned, e.g., traffic lights (Bradley, 2016). To enhance simplicity and aid visual processing, icons may be better than indexes or symbols.

Following the FAIR (findable, accessible, interoperable, reusable) guiding principles for scientific data management (Wilkinson et al, 2016) is not only universally beneficial but could assist with reducing cognitive load for users with ADHD. The FAIR principles were developed to support knowledge integration and reuse of published data across different users and operating systems. Among other improvements, the principles aim to reduce the effort needed to locate information and use consistent formats to reduce workload, along with standardising dataset structures and metadata (Wilkinson et al, 2016). The 'Accessible' component of FAIR concerns providing clear information about how data can be accessed, including protocols for authentication and authorisation (Wilkinson et al, 2016) rather than accessibility in the sense of EEDI (equity, equality, diversity and inclusion). Nevertheless, improvements to data access may indirectly support users with ADHD by streamlining workflows and reducing unnecessary cognitive load, facilitating aspects of executive function such as task planning and prioritisation.

3.1.3 Motivation, task initiation and task switching

In addition to cognitive barriers, behavioural barriers were also identified. For example, motivation regulation and task initiation are prevalent difficulties associated with ADHD. Altered dopamine pathways, the neurotransmitter that plays a crucial role in motivation, is one of the key neurological mechanisms postulated to underlie cognitive differences in ADHD (Volkow et al, 2011). Consequently, motivational issues associated with ADHD such as difficulties with task initiation and task switching are not a matter of laziness, intelligence or character but a biological difference in activity of motivating neurotransmitters on a task-contingent basis. The differences in neurotransmitter signalling may be amplified by systems that are not designed to support such users.

Lengthy research workflows can thus present a persistent challenge to stakeholders with ADHD. While fundamental to environmental research and therefore unfeasible to eliminate, methods to sustain motivation throughout exist. For example, game-based training has been found to be a significant improver of inattention symptoms (Liu et al, 2024) and may include structuring methods like progress bars which assist with task initiation by making progress tangible (Milbergs, 2025). Indicating roughly how long the whole process will take as well as the estimated time remaining can also give users advance notice between context switches to allow for structured transitions between tasks (NeuroLaunch, 2024b), assisting with 'time-blindness' related barriers (section 3.1.1) (Tolani and Venkatesan, 2025).

Gamification can also include competitive elements like weekly challenges (Episteme, 2025), although some may find these stressful so they would need to be optional and low stakes. Moreover, a prominent feature of gamification is reward systems to provide frequent, immediate feedback and acknowledgement (Grund et al, 2020). For example, badges are visual representations of achievements users can collect (Shah et al, 2025) and could be applied to DRI if users achieve them after completing certain tutorials/ training courses for different software. Other assistive software for neurodivergent students have included milestone screens which list all collected badges and rewards since starting work, serving as a visual reminder of past accomplishments to boost self-motivation (Grund et al, 2020). Another successful example of a reward system is the app 'Forest', where users plant a virtual tree which grows proportionally to time spent focusing on a task (Seekrtech, 2014). Additionally, timed challenges could assist those who benefit from urgency, though it is important not to have consequences for failing to avoid crossing the threshold into creating extra stress (Episteme, 2025). Nevertheless, the gamification approach should be supportive rather than manipulative, meaning not difficult to avoid, controlling or addictive (Widdicks, 2020; Mildner et al, 2025).

Motivation is also interlinked with emotional regulation in bidirectional feedback, where emotional dysregulation can arise from frustrations associated with e.g., task paralysis and procrastination, but motivation can also be reduced by the negative expectations of outcomes induced by emotional dysregulation (Pan et al, 2023). Seery et al (2025) interviewed users as to the effectiveness of a psychoeducational app tailored to improving mental health of users with ADHD. Interviewees praised the mindfulness breaks feature, which could potentially be applied to DRI in the form of a browser extension pomodoro-style timer that reminds users to take mindfulness breaks, simultaneously assisting with time management (Tolani and Venkatesan, 2025). However, some people with ADHD reported feeling disrupted when switching between task and timer applications, therefore an integrated timer instantly accessible from any screen may be better (Bellinganood et al, 2025). The use of this break reminder would need to be paired with increased awareness in the workplace that a user is not idling but strategically regulating their brain.

3.1.4 Navigation

Furthermore, a potential barrier in DRI design is navigation, aligning with the findability principle of the FAIR (findable, accessible, interoperable, reusable) guiding principles for scientific data management (Wilkinson et al, 2016; section 3.1.2). Navigation is closely linked to motivation; navigation difficulties can diminish task momentum and amplify issues with task switching/ initiation. Grouping related items together visually can help (Milbergs, 2025); visual menus may also enable recognition rather than recall, somewhat externalising working memory. Flow chart-style layouts may assist with navigating each step sequentially to prevent overwhelm and distraction (Seery et al, 2025). Moreover, Tcherdakoff et al (2025) suggest a top-most tabular layout (i.e., drop-down menus) rather than a scrolling stream can assist with navigation, linked with categorisation and minimising cognitive load.

In cases where a simplified layout is unfeasible due to demands of research and complexity of datasets, guided workflows and multimodal tutorials e.g., written and video, may be viable solutions. According to the VARK model of learning styles, information processing preferences can include visuals audio, reading and kinaesthetics (i.e., engaging in hands-on tasks) (Fleming and Mills, 1992). Most learners exhibit bimodal or trimodal preferences (i.e., multiple forms of information), thus, multimodal tutorials could cast a broader net for accessibility. Video tutorials could align with accessibility best practices for users with ADHD, including those uncovered by Jiang et al (2025) e.g., captions and dynamic imagery for focusing attention. Furthermore, as with working memory, tooltips and consistent visual cues could also accommodate navigational difficulties (Milbergs, 2025).

3.1.5 Customisability

The Web Content Accessibility Guidelines (WCAG) provide comprehensive guidance to create inclusive software. It includes criteria that align with potential support needs of users with ADHD, such as 'consistent help' and 'focus order' (Level Access, 2025). WCAG aligns with the principles of universal design, which is defined as 'the design of products and environments to be usable by all people, to the greatest extent possible, without the need for adaptation or specialised design' (Persson et al, 2015, p. 508). In contrast to universal design, user-sensitive inclusive design aims to address dynamic diversity through adaptability (Persson et al, 2015).

A consistent theme that appeared in assessed literature was the benefit of customisability (Sonne et al, 2016, Motti, 2019, Spiel et al, 2022, Kasatskii et al, 2023, NeuroLaunch, 2024b, Halpin et al, 2025, Tcherdakoff et al, 2025). For example, Kasatskii et al (2023) found that perceptual load affected the efficiency metrics of programmers with ADHD differently depending on the ADHD symptoms they struggled with most; some benefited from high perceptual load while others low. Customisable or adaptive design could be as simple as creating options to adjust colours, fonts and text size, or adjust the amount of information visible on the screen at any one time via e.g., drop-down user interface (UI) menus (Silchenko and Yanchiy, 2026).

One emerging potential method of facilitating personalisation and inclusivity for neurodivergent users is the use of AI. Current assistive technologies for ADHD mostly comprise browser extensions, mobile apps or wearable devices; AI presents a novel avenue (Shah et al, 2025). AI could be used to adapt task difficulty, pace and feedback on an individual basis (Xu et al, 2025). For example, large language models (LLMs) could support users with ADHD in structuring their workflows, prioritising tasks and maintaining focus, aligning with the framework of externalising key executive processes such as planning and organisation to reduce the pressure on their internal control (Shah et al, 2025). For example, Tether is an AI assistive tool developed specifically for software engineers with ADHD and can support both task management and emotional regulation, offering task guidance, grounding techniques, empathetic conversation among many more features (Shah et al, 2025). However, a crucial limitation of this is the environmental impacts of information technology, including AI; trade-offs between benefits for users and drawbacks for the environment would need to be carefully factored in, drawing on responsible innovation principles (Widdicks et al, 2023).

Another challenge is that the assistive tool itself could become a distraction to the user with ADHD (Sonne et al, 2016); further research and iterative co-design is essential for development of new assistive technologies.

3.1.6 Case study: Spatial Explorer

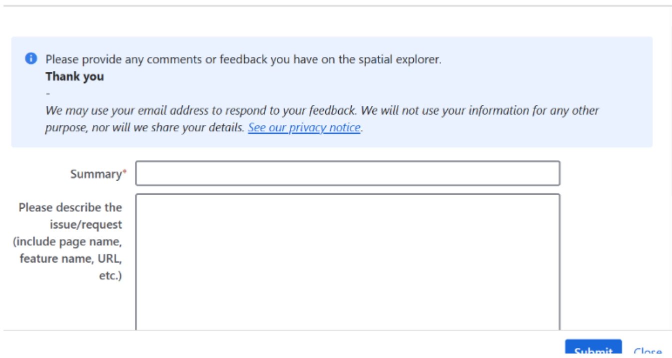
Findings from the literature were applied to a specific DRI case study developed under NC-UK: UKCEH's Spatial Explorer tool to answer RQ1.1 (section 1.1). Guidelines are summarised in Table 1. The Spatial Explorer is a discovery tool enabling visualisation of spatial datasets (raster, polygon and vector) covering Great Britain and Northern Ireland (UKCEH, 2024). This case study was selected as its overall aim, to make geospatial data more accessible to a wider range of users of varying technical expertise, aligned with accessibility considerations for those with ADHD. Additionally, its highly visual presentation lent itself well to discussions surrounding executive function. Aspects of the tool that already align with accessibility requirements of ADHD are highlighted in Table 2, and areas for improvement are suggested in Table 3.

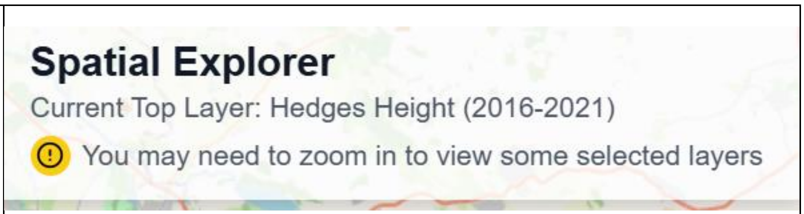
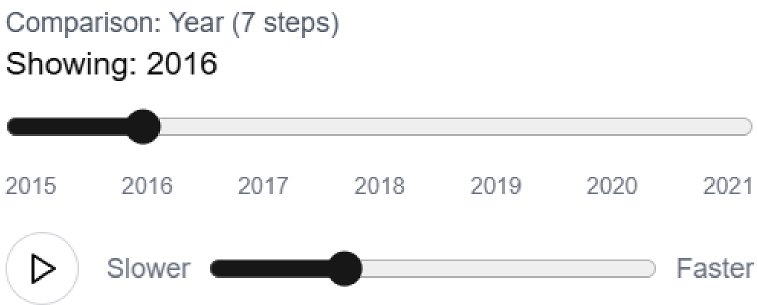
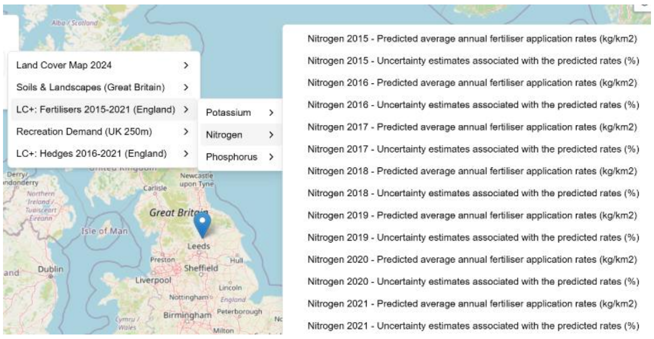
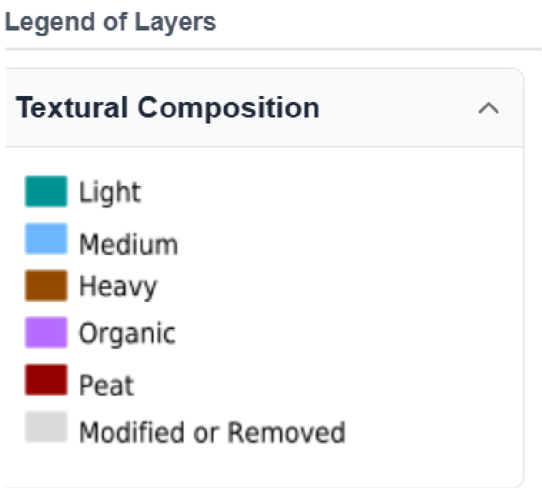
Table 1. Summary of barriers to DRI identified and suggestions of best practices to address these barriers. Best practices are not comprehensive; improvements are an iterative process.

Barrier identified	Best practices to address barrier
Working memory (section 3.1.1)	• Multiple sensory modalities of instructions interspersed throughout page (i.e., written and video/audio). • Assistive software e.g., speech to text for summarising meetings. • Hover highlighters or mouse spotlights to sequentially track information. • Reduced deadline ambiguity for e.g., projects involving use of the Spatial Explorer. • Components with the same functionality are consistently identified via both language and location.
Cognitive load (section 3.1.2)	• Customisable visual presentation e.g., changing colours, font size, font, amount of information on the screen at any one time. • Graphic elements are preferably icons rather than indexes or symbols. • User controls provided for moving, audio or dynamically changing content. • Well defined language (especially jargon and acronyms).

	• Descriptive error messages with a fix suggested. • Chunking information by section headings or tables. • The contrast ratio between regular-sized, non-decorative text and its background is at least 4.5:1.
Motivation & task initiation (section 3.1.3)	• Gamification e.g., reward systems or low-stakes competitions and timed challenges. • Progress bars e.g., for anchoring attention when datasets are loading in. • Break reminder timers instantly accessible from any screen.
Navigation (section 3.1.4)	• Multiple sensory modalities of tutorials e.g., written/video/audio. • Tabular layout rather than scrolling stream. • Group related items visually. • Navigational elements are consistently displayed including their location and order of their content. • Contextual help, tooltips and additional information that remain available long enough for users to read them and are dismissible when no longer needed.

Table 2. Existing strengths of the Spatial Explorer tool regarding barriers identified for users with ADHD.

Barrier(s)	Strength of spatial explorer in addressing this barrier	Screenshot representation of strength
Working memory (section 3.1.1)	Labels/ tooltips appear when icons are hovered over.	
Motivation, navigation and cognitive load (sections 3.1.3, 3.1.4 and 3.1.2)	Feedback form is easily findable.	

Motivation and cognitive load (sections 3.1.3 and 3.1.2)	Detailed error message with helpful suggestion.	
Cognitive load (section 3.1.2)	User controls provided for moving elements.	
Navigation and cognitive load (sections 3.1.4 and 3.1.2)	Tabular layout rather than continuous scrolling stream. Information is grouped and presented in a meaningful (chronological) order.	
Working memory and cognitive load (sections 3.1.1 and 3.1.2)	Well defined legends.	

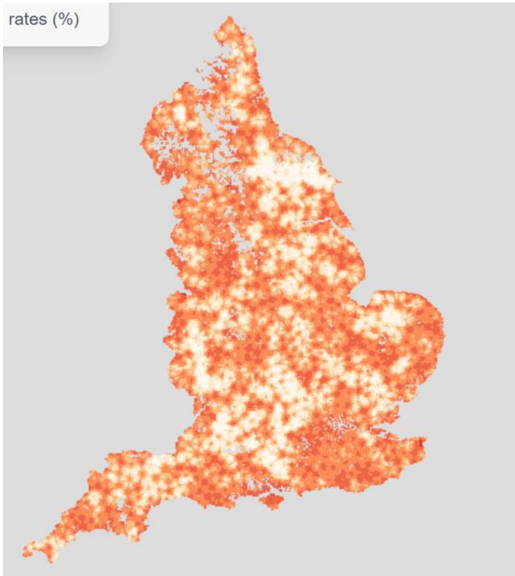
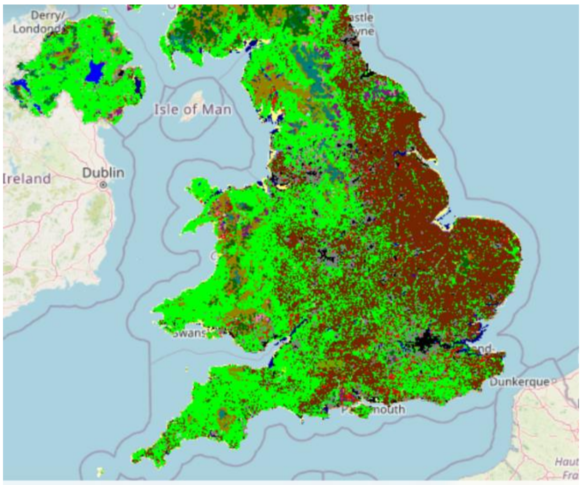
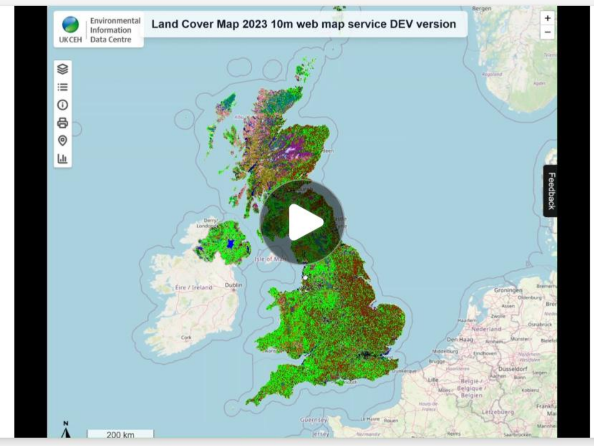
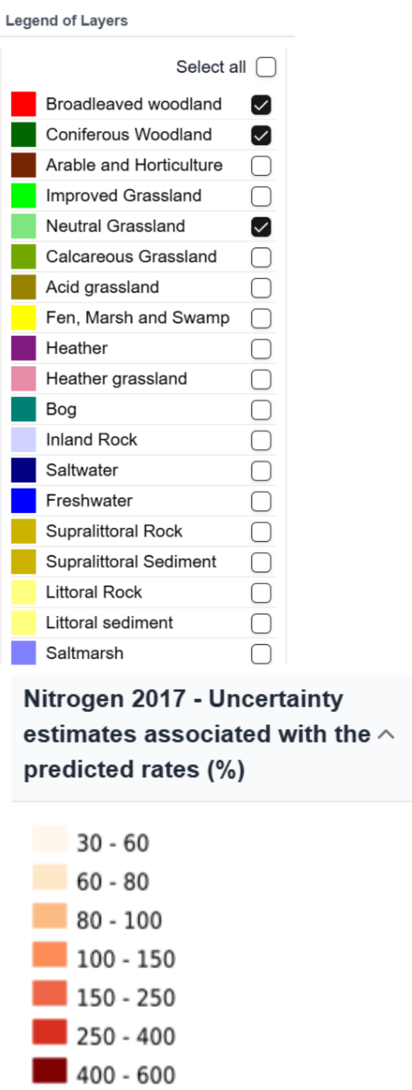
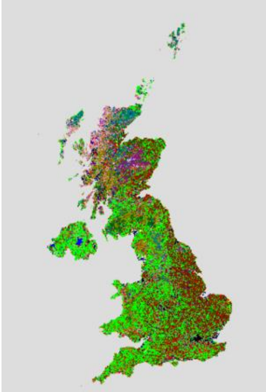
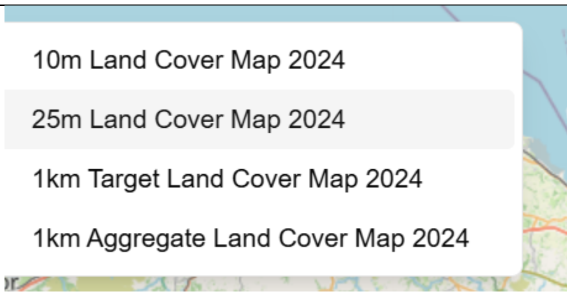
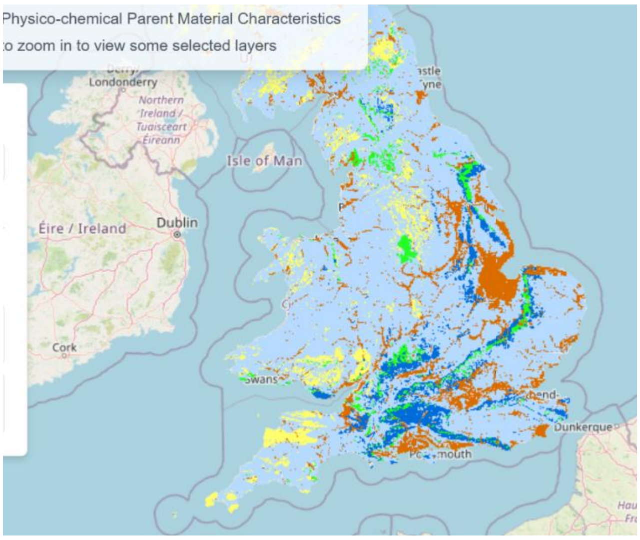
Motivation and cognitive load (sections 3.1.3 and 3.1.2)	Area selection feature is good for attentional filtering/ prioritisation and reducing cognitive overload.	
Cognitive load (section 3.1.2)	Ability to remove basemap is a built-in way to reduce visual clutter if needed.	
Cognitive load	High contrast between colours of data in some datasets.	 Example dataset with colours that contrast highly from each other (ratio of dark red: bright green is 7.62:1) (1km Target Land Cover Map 2024).

Table 3. Suggested accessibility improvements to the Spatial Explorer specific to users with ADHD.

Barrier(s)	Improvement	Visual representation if applicable
Motivation (section 3.1.3)	Show progress indicators for data loading – reduces uncertainty and maintains attention during waiting periods.	N/A
Working memory (section 3.1.1)	Ability to bookmark frequently used datasets or combinations of datasets.	N/A
Working memory and Navigation (sections 3.1.1 and 3.1.4)	Integrated guided tours for advanced features. These could be shown once when first opening the software, then in another optional tab if users need to re-visit them later. For an example, Wildlife Acoustics have video tutorials available on their website for Kaleidoscope, a bioacoustics sound analysis platform. They also provide a written transcript of the video.	Example of digital tool which has video tutorials: https://www.wildlifeacoustics.com/resources/video-tutorials/song-meter-mini-bat/en/song-meter-mini-song-meter-mini-bat-quick-start These do exist for spatial explorer but could be embedded into the software. 
Working memory (section 3.1.1)	Recent actions panel/ saved dataset combination panel.	N/A

<table>
<tr>
<td>Cognitive load (section 3.1.2)</td>
<td>Large blocks of written information could be broken down/ chunked by section headings or table layouts.</td>
<td>
UKCEH Land Cover plus: Fertilisers 2015-2021 (England) Web Map Service
This web map service consists of maps of predicted annual application rates (kg/km2/yr) of three different inorganic chemical fertilisers - nitrogen (N), phosphorus (P) and potassium (K) - in England across a seven-year period (2015-2021). Annual estimates, along with their respective estimates of uncertainty, are provided at a 1 km x 1 km resolution with a separate map provided for each fertiliser. This product builds on the previous CEH Land Cover plus: Fertilisers 2010-2015 (England) product,...
Further details / Download the data</td>
</tr>
<tr>
<td>Cognitive load (section 3.1.2)</td>
<td>Option for one colour to be selected at a time exists for some datasets but not all of them. Lots of colours all at once could be overwhelming.</td>
<td>

Example of legends with and without selection option.</td>
</tr>
</table>

		 Example of all colours shown at once – possibly overwhelming.
Navigation and cognitive load (sections 3.1.4 and 3.1.2)	Additional tooltips may be helpful here to define that the numbers denote spatial resolutions for non-experts. Tooltips could come from the metadata.	
Cognitive load (section 3.1.2)	Other datasets do not have high contrast between basemap colours and datapoint colours.	 Example dataset with low contrast between data colours and basemap colours: Physico-chemical parent material characteristics. Contrast ratio between light blue colours and basemap = 1.11: 1.

3.2 RQ2: Engagement with participatory co-design of DRI

Accessibility evaluations e.g., WCAG typically involve a combination of automated testing and manual evaluation. Automated testing tools are useful but lack input from those with lived experience of inaccessibility; subsequent manual evaluation should include target users. In recent years, participatory co-design that is iterative and flexible has emerged as a prevalent collaborative method in design (Sanders and Stappers, 2008) and has since been adopted by other disciplines (Widdicks et al, 2024; Lipton et al, 2025).

Participatory co-design of DRI is particularly important concerning users with ADHD as they have historically been positioned as subjects to be managed rather than equal partners in technology design (Spiel et al, 2022). HCI is increasingly calling for approaches that centre neurodivergent voices and lived experience to challenge deficit-oriented perspectives (Fekete and Lucero, 2019; Tcherdakoff et al, 2025). Furthermore, much of the existing HCI research involving ADHD focuses on children and adolescents in education rather than adults in a workplace context, limiting the evidence base (Fekete and Lucero, 2019; Burtschler and Gerling, 2024; Morris et al, 2024). Consequently, as of current knowledge there is little guidance specific to involving adults with ADHD in participatory co-design workshops. Therefore, the best practices for workshop design detailed below were informed by broader participatory design methods alongside ADHD research and neurodiversity-inclusive co-production guidance. Although little guidance exists specifically for participatory co-design for adults with ADHD, the wider literature consistently emphasised four recurring themes:

1. **Reducing executive functioning demands via structure and clarity.**
2. **Accommodating diverse communication and learning styles.**
3. **Minimising sensory barriers.**
4. **Fostering psychologically safe environments.**

These principles will be further described in this chapter and are summarised in Figure 3 below.

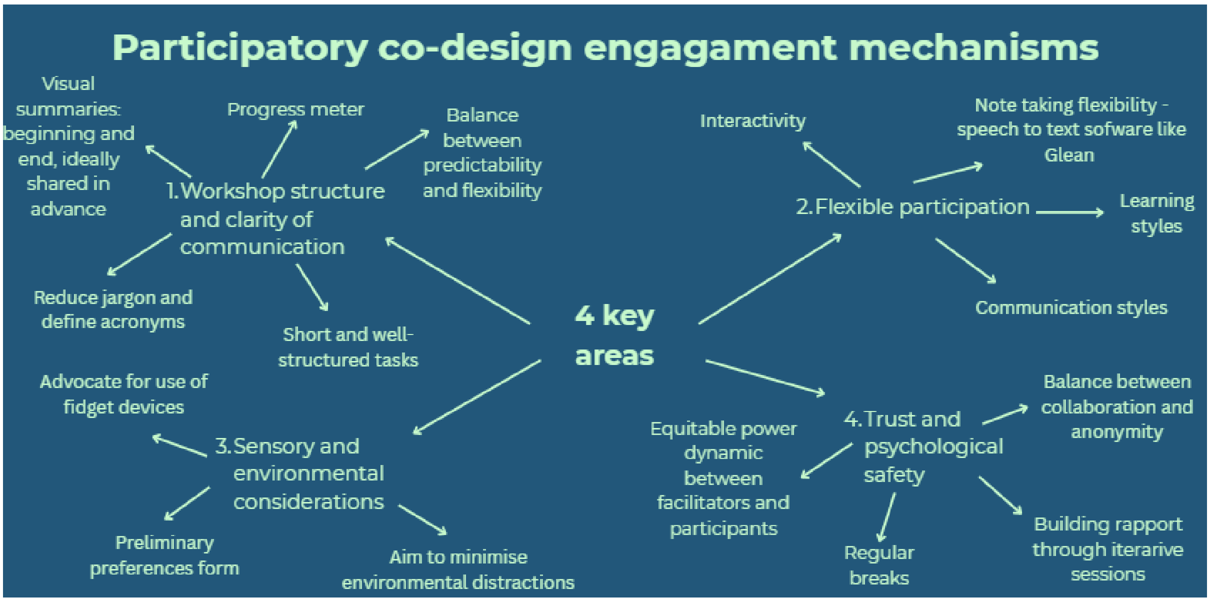


Figure 3. Visual summary of recommendations for increasing inclusivity and accessibility of DRI participatory co-design workshops for stakeholders with ADHD.

3.2.1 Workshop structure and clarity of communication

Although participatory codesign emphasises shared decision-making, stakeholders with ADHD may benefit from clearly structured workshops to reduce executive functioning demands. For example, Fekete and Lucero (2019) recommended explaining the session's structure and agenda at the beginning with a visual schedule and finishing each session with a visual debrief summary. The schedule could also be provided in advance to reduce cognitive load during the workshop. Knowledge of the itinerary can reduce uncertainty, supporting planning, task initiation and time management.

As mentioned in section 3.1.2, breaking information into manageable segments can reduce strain upon executive function, supporting working memory (Seery et al, 2025, Milbergs, 2025; Tcherdakoff et al, 2025). As with DRI instructions, speech-to-text software may also support working memory in co-design by providing instant written summaries of verbal information. Short and well-structured tasks are recommended, i.e., no longer than 10-15 minutes for each task (Fekete and Lucero, 2019) to facilitate sustained attention. However, flexibility in e.g., pacing and break timings is also important to maintain responsivity to participants' needs. Overall, a balance between predictability and flexibility of structure would support collaborative design.

3.2.2 Flexible participation

Flexible participation involves supporting both varied communication styles and varied learning styles. Supporting variation in communication styles means accommodating diverse ways of contributing, which may begin with, where possible, offering a choice between in person and online focus groups according to preferences (Le Cunff et al, 2023). Additionally, diverse communication styles could be facilitated by offering a choice between speaking, writing, or drawing during discussions. For example, Tolani and Venkatesan (2025) describe comic art as 'graphic medicine' for ADHD; drawing lived experiences can serve as a powerful medium to visualise invisible aspects of living with ADHD, potentially helping neurotypical colleagues increase solidarity to foster a more supportive workplace. Previous co-design workshops for a supportive app for neurodivergent users benefitted from a 'sketch and share' approach, where participants sketched their response to open-ended questions and were then encouraged to describe and reflect on their drawings in an open discussion (Kalantari et al, 2025). This was effective at gaining a detailed understanding of their experiences, though it was important to reassure participants that the artistic quality of their drawings is not a concern.

Increasing interactivity may facilitate engagement and sustained attention. In addition to 'sketch and share' approaches, interactive methods can include sticky notes, dot voting, and polls, as well as combinations i.e., writing ideas on sticky notes and then voting on them afterwards (Lam and Vang, 2021). These methods can either be implemented in person or online using software such as menti (for anonymous polls) or miro and mural (digital whiteboards for collaborative visualisation and brainstorming). Gamification or reward systems adapted for participatory workshops may also increase motivation as discussed in section 3.1.3. For example, if there will be multiple sessions, Fekete and Lucero (2019) suggest a 'tangible reward that is not yet complete' can be effective in encouraging participants to attend every session to complete it, though this study's participants were children therefore the findings may not be generalisable to adults.

As detailed in section 3.1.4, various learning styles and information processing preferences can be accommodated through multimodal communication, i.e., sharing information through various sensory modalities. For instance, written instructions could be complemented by visual elements (Fekete and Lucero, 2019). Kinaesthetic tasks may also increase engagement; previous research suggests movement and hands-on interaction can reduce the cognitive load of sustained verbal discussion (Kastamonitis, 2025). For example, journey mapping, which is when participants create a visual timeline of a user's experience from beginning to end of using a product (Stevens, 2023), could be completed using sticky notes on walls, encouraging active participation. Alternatively, card sorting is a common kinaesthetic task in education and could be applied to DRI co-design via e.g., asking participants to rank the features that are most important to them. However, a crucial limitation is that kinaesthetic activities generally require in-person engagement, which could exclude users who need to join virtually.

3.2.3 Sensory and environmental considerations

Sensory processing refers to the way that individuals manage incoming sensory stimuli. While the presence of sensory processing differences is not central to the diagnosis of ADHD, strong links have been uncovered between ADHD traits and sensory hypersensitivity and/or hyposensitivity (Panagiotidi et al, 2018). In participatory co-design workshops, sensory sensitivities could stem from environmental conditions such as intensity of lighting, smells and sounds, or from distractions such as other people passing through if the workshop is in an open-plan location. Sensory processing differences are important to account for as they can potentially lead to information overload, overstimulation and anxiety (Irvine et al, 2024), which could hinder engagement with co-design conversations.

Sensory sensitivities vary hugely on an individual basis; a potential accommodation in participatory co-design is to send out a questionnaire beforehand (Fekete and Lucero, 2019) with a line prompt asking about sensory preferences, e.g., noise and brightness levels, along with other accessibility considerations such as mobility or level of technical expertise. An additional sensory accommodation is advocating for the use of fidget devices (Tcherdakoff et al, 2025); repetitive tactile or kinaesthetic input can reduce physiological stress and restlessness/ understimulation, supporting sustained attention (NeuroLaunch, 2024c). If the task requires quiet focus, giving participants the option to modulate auditory sensory input e.g., via listening to music through earphones while they complete the task may assist with attentional filtering (Irvine et al, 2024). If in person, the workshop should ideally take place in a private room rather than an open-plan location to minimise external distractions. For virtual co-design workshops, it is recommended to ask participants to turn off their microphones when not in use to minimise distractions to others.

3.2.4 Building trust and psychological safety

Building rapport is essential to support genuine collaboration in participatory co-design. Since the approach relies on participants openly sharing their opinions, facilitators should cultivate a psychologically safe environment where community board members feel comfortable expressing their views, including when these differ from those of others (Motti, 2019; Le Cunff et al, 2023). A plethora of interacting factors synergise to influence sense of psychological safety, which can require particular attention when working with individuals with ADHD who may have experienced stigma or have internalised ableism. For example, Halpin et al (2025) found participants with ADHD in coding education often held themselves to exceptionally high standards and focused blame on themselves for their mistakes and struggles rather than the lack of clarity in the software they were using. Emerging literature has also highlighted the concept of 'rejection sensitive dysphoria', which denotes a predisposition to expect, sense and react strongly to harshly delivered criticism (Schmalacker, 2024; Sandland, 2025). While empirical evidence remains limited, the concept has gained traction within neurodivergent communities and may help explain why some participants with ADHD may be particularly hesitant to voice opinions in group settings, highlighting the importance of actively building trust and rapport throughout the co-design process.

Anonymity is one method of fostering a sense of psychological safety. For example, Le Cunff et al (2023) maintained anonymity between participants by having them communicate directly with the research team, who in turn would share anonymised contributions with the rest of the research group. This enables confidentiality; some participants may be unwilling to disclose their neurodivergent identity since this could lead to potential discrimination or other challenges in a workplace setting (Kalantari et al, 2025). Participants could also be assured that they will remain anonymous in any outputs/ reports that come from the co-design workshop, along with providing them with a detailed transparency report of how their feedback will be used by the design committee (Le Cunff et al, 2023). While anonymity can be easily achieved in online settings, maintaining anonymity in in-person sessions may necessitate methods such as anonymous polling systems e.g., Mentimeter, or one-to-one interviews. However, previous research also suggests psychological safety can arise from a sense of belonging and connection (Miller et al, 2024), presenting a trade-off between collaboration and anonymity. Ideally, a balance between confidentiality and collaboration could be achieved, e.g., by having participants complete a written or verbal code of confidentiality agreement. This way, participants would not have to formally disclose their neurodivergence, only discuss their experiences in a confidential small group.

Co-design is often reported to reduce power differences between researchers and participants (Lipton et al, 2025). Equitable power dynamics between facilitators and participants can build trust; it may also be beneficial to acknowledge the value of their lived experience for the co-design process, as well as clarify their status as co-creators whose opinions are equally valuable as the designers. Another way to achieve equitable power dynamics could be to engage participants as early as possible in the design process to maximise their influence (Kalantari et al, 2025).

Emotional support may also take the form of accommodating support needs mentioned in section 3.1. For example, regular breaks may help maintain motivation and attention (Le Cunff et al, 2023), emphasising the importance of explicitly informing participants they can take a short break any time on their own terms. Supporting participants remotely may involve providing the option to turn off their camera, potentially helping them engage more comfortably by reducing visual overwhelm and alleviating the pressure of masking. Masking refers to behaviours used to conceal one's ADHD traits in social situations, fulfilling societal expectations and potential safety needs (e.g., to protect themselves from discrimination) to the detriment of other important psychological and relational outcomes (Mylett et al, 2026). For example, participants reported camouflaging their ADHD resulted in feelings of reduced closeness and connection with others as well as mental fatigue from intense self-monitoring (Mylett et al, 2026), both of which likely constrain contributions to co-design. This emphasises the importance of fostering a psychologically safe workplace environment where individuals feel understood. Workplace understanding could be achieved through e.g., neurodiversity awareness training courses orchestrated by those with lived experience, though it is important not to burden researchers with ADHD with expected responsibilities to educate neurotypical colleagues.

Icebreaker activities may be a useful tool to promote engagement and participation via providing opportunities to connect with other participants to build a sense of belonging (Sasan et al, 2023). However, it is important for the Icebreakers themselves to be accessible, low-stakes and non-threatening. 'Low-stakes' essentially refers to prompts which avoid heavy topics, are open-ended and have no wrong answers, for example asking everyone 'what is the best food you have tried this week' or 'if you could have any superpower for just one day, what would it be?' (Mik, 2026). Non-inclusive and inaccessible icebreakers can result in feelings of stress, anxiety, isolation or feeling unheard or unseen. These negative experiences may then permeate the rest of the session and leave individuals feeling unable to contribute (Learning Design Team, 2024). For example, icebreakers could be made predictable by sharing the prompt in advance (Danquah, 2025), which may reduce cognitive load. Allowing individual participants to opt-out of activities that do not meet their needs is an additional reasonable adjustment. Building on the sensory preferences preliminary questionnaire described in section 3.2.3, additional questions could ask participants about their preferred communication style and level of technological expertise so that sessions may be better tailored to their participants.

3.2.5 Case study: Community Conversations

Insights gained from the literature were summarised as a set of best practise guidelines in Table 4. To answer RQ2.1 (section 1.1), the NC-UK case study 'Community Conversations' (section 2) was then evaluated against these guidelines, noting strengths in Table 5 and potential areas for improvement in Table 6.

Table 4. Summary of key considerations when planning participatory co-design workshops with users who have ADHD in mind and best practices to address these considerations. Best practices are not comprehensive; improvements are an ongoing process.

Consideration	Best practices to address consideration
Clarity and structure (section 3.2.1)	• Visual summaries of schedule at beginning and end of session, ideally also shared in advance. • Progress indicators, e.g., bar at the top of presentation slides showing what stage of the agenda the workshop is up to. • Aim to achieve a balance between session predictability and flexibility. • Define jargon and acronyms.

	• Short and well-structured tasks, ideally no more than 15 minutes. Longer tasks could be broken into smaller sub-tasks.
Flexible participation (section 3.2.2)	• Interactivity options e.g., dot voting, polls, 'sketch and share', collaborative journey mapping. • Cater to a variety of communication styles, i.e., offer options to join remote or in person, flexibility to write, draw or verbally discuss ideas. • Consider different learning style preferences and aim for information to be conveyed in multiple sensory modalities e.g., reading, writing, visual, audio, and kinaesthetic tasks.
Sensory and environmental considerations (section 3.2.3)	• Advocate for use of fidget devices. • Aim to minimise environmental distractions and choose location carefully if the workshop is in person. • Preliminary sensory preferences questionnaire. • Turn off audio for non-speakers during online meetings.
Trust and psychological safety (section 3.2.4)	• Aim to achieve a balance between collaboration/ sense of belonging, and anonymity. Consider that disclosing ADHD in a workplace setting may lead to stigma therefore anonymous co-design or confidentiality agreements may be necessary. • Offer regular breaks and assure participants they can step out at any time if needed. • Establish equitable power dynamics between facilitators and participants e.g., by involving them as early in the design process as possible. • Build rapport through iterative sessions where possible.

Table 5. Existing accessibility strengths of Community Conversations for participants with ADHD.

Key consideration	Strength of Community Conversations for participants with ADHD
Clarity and structure (section 3.2.1)	Slides are visually very clear, including using flow diagrams.
Clarity and structure (section 3.2.1)	Agenda shared at the beginning with a visual.
Trust and psychological safety (section 3.2.4)	Anonymity is clarified.
Flexible participation (section 3.2.2)	Video demonstrations are provided for tools alongside written information.
Sensory and environmental considerations (section 3.2.3)	Sessions were online, giving participants control of their own environment.
Clarity and structure (section 3.2.1)	Acronyms are defined.

Flexible participation and psychological safety (sections 3.2.2 and 3.2.4)	From session 2 onwards, Mentimeter polls were used, providing an alternative, anonymous way to share information (writing rather than speaking).
Clarity and structure, trust and psychological safety (sections 3.2.1 and 3.2.4)	Clear visual representations of other participants' answers in anonymous format.
Trust and psychological safety (section 3.2.4)	Anonymous EEDI questionnaire and post-workshop feedback.
Psychological safety and trust. (section 3.2.4)	Report summarising the session was shared.

Table 6. Potential improvements to participatory co-design workshops specific to users with ADHD.

Key consideration	Potential improvement for participants with ADHD.
Flexible participation (section 3.2.2)	Alternative ways of communicating ideas other than open Q&As could be facilitated e.g., using Miro or Mural collaborative digital whiteboards. These not only appeal to different communication styles but also increase interactivity, which could help sustain attention.
Clarity and structure (section 3.2.1)	Agenda could be shared at least a day in advance.
Psychological safety and trust (section 3.2.4)	Numbers could constrain this, but inclusive icebreakers may help build a sense of belonging so that participants feel more comfortable sharing ideas. If there are many participants online, poll-style icebreakers could potentially be utilised.
Psychological safety and trust (section 3.2.4)	In person events in future could better facilitate collaboration by building a sense of community, though they come with their own challenges such as confidentiality.
Clarity and Structure (section 3.2.1)	Better pacing for tool demonstrations (suggested by participants when asked how inclusivity could be increased further) (Widdicks et al, 2026).
Sensory and environmental considerations (section 3.2.3)	If future sessions are in person, an optional preliminary sensory preferences form could be shared.

4. Discussion

Widening accessibility of DRI can broaden the diversity of perspectives that contribute to problem-solving in environmental science, which is especially important in a discipline which grapples with complex, ‘wicked’ problems (Weaver et al, 2023). To answer **RQ1.** ‘What potential barriers exist surrounding digital tools for individuals with ADHD and how can they be mitigated?’, barriers primarily related to interface designs that exacerbate demands on executive functioning (the cognitive processes that enable goal-directed behaviour e.g., planning, emotional regulation, memory and initiation of behaviour (Burgess, 2012)). Consequently, accessibility improvements involve externalising some aspects of executive function to alleviate pressure on its internal control (NeuroLaunch, 2024b), as well as emphasising customisability as there is no universal solution. As a result of historically paternalistic attitudes towards individuals with ADHD, current research frequently presents ADHD as a problem space for technology design (Spiel et al, 2022), which overlooks the fact that many accommodations may also improve usability for a broader range of users. Consequently, considering accessibility by default has a plethora of co-benefits for productivity and problem-solving and should be viewed not as a specialist adaptation but a core development principle. While adjustments may be beneficial for neurotypical people, they break down significant barriers for those with ADHD.

To answer **RQ2.** ‘What potential barriers exist surrounding participatory co-design engagement mechanisms for individuals with ADHD and how can they be mitigated?’, barriers were organised around four key themes: workshop structure and clarity, flexibility of participation, sensory and environmental considerations, and trust and psychological safety. Separate solutions are required to mitigate each of these barriers but ultimately share a common framework: facilitating an environment where participants feel cognitively and emotionally supported to share their lived experiences with using DRI.

To the best of current knowledge, this is the first review to investigate accessibility of environmental DRI for users with ADHD. Gaps in the literature linked to participant demographics limited the evidence base: much of the existing HCI accessibility research concerning ADHD focused on children in an educational context rather than adults in a workplace context (Fekete and Lucero, 2019; Burtschler and Gerling, 2024;

Morris et al, 2024). Many existing co-design studies concerned assistive technologies for managing ADHD in day-to-day life (Sonne et al, 2016; Kalantari et al, 2025) as opposed to co-designing DRI. Nonetheless, recommendations synthesised from these sources may be generalisable to DRI, though iterative evaluation from those with lived experience of ADHD is necessary to validate generalisability.

4.1 Future recommendations for improving DRI and DRI participatory co-design

Currently, an array of automated web accessibility testing tools is available, such as the WAVE tool by WebAIM (WebAIM, 2026). The availability of such tools suggests an opportunity for future research into automated accessibility testing for DRI. However, current tools primarily assess compliance with universal accessibility standards (Persson et al, 2015) and may not sufficiently capture executive function demands and dynamic needs experienced by users with ADHD. Furthermore, automating accessibility testing is a preliminary step that requires evaluation from human users, which could be gained through iterative co-design.

ADHD accessibility recommendations synthesised from HCI and educational literature may provide a useful foundation but require validation within environmental research environments via iterative co-design workshops. Previous studies have evidenced the benefit of think-aloud methods for qualitative evaluations of digital tools for ADHD accessibility as they can support memory-related differences by reducing demand on participants to recall their experiences in detail after the session (Halpin et al, 2025; Seery et al, 2025). Multi-disciplinary teams comprising participants of diverse backgrounds are ideal, which may be achieved through EEDI questionnaires. Restricting participation to those with formal ADHD diagnoses risks excluding many stakeholders who remain undiagnosed because of lengthy diagnostic pathways and outdated criteria (Asherson et al, 2012; NHS England, 2025). Accepting self-diagnoses in addition to those officially diagnosed with ADHD could address this issue as well as potentially widen the number of available participants for co-design workshops.

Wider workplace culture surrounding attitudes towards neurodivergence may need to be accounted for to facilitate participation in co-design of DRI. Research suggests misconceptions about ADHD are still relatively common in workplace settings (Quintero et al, 2025). Neurodiversity awareness training courses could address these misconceptions but ideally would require input from or orchestration by those with lived experience of the neurotype to avoid paternalistic management. Along this vein, regular neurodiversity workgroups may provide a space for those with ADHD to provide continuous feedback on their experience with DRI. Discussions within these workgroups could support reflexivity salient in qualitative research, which is when researchers examine how their own identity, biases and beliefs may have affected the research process (Holland, 1999).

4.1.1 Improving representation

To build a more robust evidence base for accessibility recommendations, further research should account for the intersectional biases faced by neurodivergent individuals with overlapping marginalised identities (Crenshaw, 1989; Calvard et al, 2026). For example, neurodivergent people who identify as women or non-binary are frequently misdiagnosed with anxiety, mood or personality disorders due to historical diagnostic criteria developed with almost exclusively cisgender male participants (Tcherdakoff et al, 2025). In childhood, ADHD is around twice as likely to be diagnosed in boys than in girls, but for adults the ratio is almost identical (Fairman et al, 2017), likely owed to the tendency for women to be diagnosed later in life (Spiel et al, 2022). This discrepancy potentially limits access to support within the workplace (De Saram, 2025). Lack of consideration of neurodivergent support needs may amplify challenges already faced by women and gender non-conforming individuals when entering the computer science sector (Miliszewska et al, 2006; Vorvoreanu et al, 2019), one of the important disciplines involved in DRI use and development.

Furthermore, environmental science, particularly conservation, is one of the least ethnically diverse sectors in the UK (Rudzinskaite, 2024). Accessibility recommendations developed without considering minority ethnic experiences may fail to address barriers experienced by an already underrepresented stakeholder group. Drivers of this inequity are complex and multifactorial but potentially include historical biases and geographic discrepancies as well as less representation of role models from minority ethnic groups in both environmental media and academia (Ford et al, 2024). Intersectional stereotyping of neurodivergent individuals from minority ethnic backgrounds can unfairly impede their recruitment, performance evaluation and career progression (Gottardello et al, 2025), potentially limiting their ability to contribute their expertise to environmental problem-solving. For example, neurodivergent Asian interviewees mentioned disclosing their neurotype on their job applications tended to be viewed as inconsistent with the 'model minority' stereotype, which carries additional pressure and constraints despite its positive connotations, and Black neurodivergent interviewees reported examples of recruiters' presumptions and biases regarding their work ethic and behaviour being amplified if they disclosed their neurodivergence (Gottardello et al, 2025).

Additionally, there are significant barriers faced by working-class stakeholders in the environmental science sector (Dwyer, 2023). Without a financial safety net, the volunteer work experience that is widespread and expected for early-career environmental scientists (due to the underfunded, oversubscribed nature of the sector) presents higher risks (Vercammen et al, 2020, Heppenstall, 2021, Kreuser et al, 2023). Attention Deficit Hyperactivity Disorder (ADHD) diagnoses may be more prevalent in lower income families (Rowland et al, 2017) and these families may have less opportunities to access support than higher income families (Owens, 2020). A lack of support may lead to internalised ableism, potentially translating to disparities in self-efficacy between scientists with ADHD from different social classes, constraining their ability to utilise DRI and contribute to environmental problem-solving.

Furthermore, the experiences of those who navigate intersectional neurodivergence are important to consider; they may further enhance accessibility frameworks by challenging binary categories (Tolani and Venkatesan, 2025). For example, a meta-analysis of over 50 studies found a co-occurrence rate of ADHD with autism spectrum condition of 38.5% (Rong et al, 2021). This co-occurrence is widely recognised as 'AuDHD' and can present its own challenges due to conflicting traits resulting in internal struggle (May, 2024). Thus, these individuals may require different accommodations; incorporating their lived experience is essential for future accessibility endeavours.

4.2 Limitations of recommendations

A key limitation of recommendations is that accessibility features can involve trade-offs; some accommodations for those with ADHD might negatively affect another group of marginalised stakeholders. For example, streamlining visual clutter may impact users who are visually impaired and use screen readers. Additionally, the needs of one individual with ADHD may differ day-to-day, necessitating different accommodations. For example, Kasatskii et al (2023) found that depending on ADHD symptoms, different levels of perceptual load were beneficial for programming efficiency, and symptoms are often subject to within-person fluctuations (Schmid et al, 2016). Such trade-offs reinforce the value of striving to make DRI customisable (section 3.1.5).

Furthermore, a limitation specific to participatory co-design recommendations (section 3.2) is that they may place pressure on users to openly disclose their ADHD to have their experiences incorporated into the co-design process or if they need to advocate for their own support needs. ADHD is invisible; some may refrain from disclosing support needs due to perceived and lived stigma (Tcherdakoff et al, 2025). Previous experiences of, or expectations about, workplace discrimination could thus hinder participation in co-design, limiting the number and diversity of individuals who can input their perspectives. When viewing future work through a lens of intersectionality, additional issues with disclosure and confidentiality may arise as people with multiple overlapping marginalised identities may have amplified expectations/ past experiences of discrimination. Disclosure pressure presents further risk of making participants with ADHD feel othered or spotlighted. Consequently, diverse teams of both neurotypical and neurodivergent participants may be favourable in co-design. However, targeted and specific co-design events going forward, such as standardised role types/ disciplines, may also be beneficial to support cross-event analysis (Widdicks et al, 2026).

5. Conclusion

In conclusion, although direct evidence evaluating accessibility of DRI for users with ADHD remains limited, consistent themes centred on reducing executive function demand, supporting customisation and incorporating iterative participatory co-design. Findings suggest DRI accessibility for users with ADHD is less a matter of specialised adaptation and more a matter of universal usability improvements which reduce unnecessary executive function demands for a broad range of users. Neuro-affirmative viewpoints are important to challenge historical deficit-oriented perspectives (Tolani and Venkatesan, 2025) and therefore prevent exclusion of the talents and expertise of environmental scientists with ADHD from solving complex, ‘wicked’ problems via use of DRI. The complexity of accessibility means it is an ongoing commitment best informed by participatory co-design; future work should prioritise iterative co-design with diverse stakeholders to build evidence-based recommendations, aligning with the best practices guidelines in Table 4 for inclusive workshops.

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