Co-Designing Research Priorities in Developmental Neuroscience: A Community-Based Participatory Approach

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Abstract

Children and adolescents, the primary participants in developmental neuroscience research, are rarely consulted or included in the research design process. By neglecting their perspectives and needs, we risk limiting the relevance and effectiveness of translational research that might emerge from such research. Here, we report on a process of co-development with adolescents in the UK city of Bradford to inform the generation of a new developmental neuroimaging research programme. We employed a two-study community-based participatory approach and used mixed methods to identify the research priorities of this community. In the first study, 79 secondary school students from four schools were introduced to fundamental neuroscience concepts during five one-hour workshops. In groups, they then designed research studies, centred around topics they deemed imported, and were asked to present their ideas on posters, role playing as neuroscientists. Reflexive thematic analysis was conducted on these posters, extracting ten key themes. In the second study, 387 students from four schools ranked the ten extracted themes in order of importance. Mental health and stress consistently emerged as the highest priorities across groups. Exploratory analysis revealed that the priority for themes exploring healthy routines and understanding anti-social behaviours varied across schools and the importance of mental health, and topics related to video gaming varied significantly between genders. This work provides an illustration of how a place-based participatory approach can inform the design of developmental neuroscience programmes, improving both equity and translational relevance.

Introduction

Co-design in health research is a collaborative approach that involves researchers, healthcare professionals, and community members as equal partners throughout a project (NIHR, 2024). From initial planning through to generating new insights, all partners share authority and decision-making. This process can help align scientific goals with community needs and increase the chances of producing outcomes that have real-world impact (Tembo et al., 2021). Such approaches have had demonstrable success global health contexts (National Institute for Health and Care Research Global Health Research Unit on Global Surgery, 2023).

While its advantages are clear, co-design is rarely employed in developmental neuroscience. This limited community engagement reflects a broader concern about the restricted diversity of neuroimaging research, where samples are not only dominated by WEIRD (Western, European, Industrialised, Rich, Democratic) populations (Ricard et al., 2023; Webb et al., 2022) but also tend to under-represent marginalised and structurally disadvantaged communities *within* those same settings. A recent review highlighted the minimal use of community-based participatory research (CBPR) methods in this field, particularly regarding equity, diversity, and inclusion (La Scala et al., 2023). This is striking given that calls for stronger cultural competence, improved transparency, and the active involvement of marginalised groups throughout the research process were made over a decade ago(Mikesell et al., 2013), underscoring that more remains to be done to ensure research priorities genuinely reflect the needs and perspectives of communities that are most often overlooked.

By integrating CBPR principles into the process, from the early stages of planning and design through to sharing the findings, researchers could build genuine partnerships with communities. This approach has the potential to not only strengthen collaboration but also help researchers develop cultural awareness and understanding (Toenders et al., 2024). In the long run, it can could a step toward addressing the longstanding inequalities that continue to affect developmental neuroscience research.

Examples of such involvement frequently uncover possibilities that might be overlooked when adults work alone (Abraczinskas & Zarrett, 2020), and demonstrate how co-design can shape the research process (Clark et al., 2022). One such example comes from the Kids Interaction and NeuroDevelopment (KIND) lab, where informal conversations with pre-adolescent Latina girls revealed an association between minority ethnic status and internalised social anxiety. As a result, the lab shifted its focus to explore how Latina mothers' discussions about ethnic and racial identity influence their children's emotional expression and regulation (La Scala et al., 2023). The authors incorporated the participant feedback to alter themes and questions within their surveys and recruitment strategies to better capture mental health outcomes in Latina youths.

Adolescents, while clearly central for developmental neuroscience research, have been largely excluded from influencing research agendas. Adolescence is also a time marked by extensive brain development in regions including the prefrontal cortex and limbic system, areas associated with mental health vulnerabilities (Paus et al., 2008). The rising prevalence of mental health challenges among adolescents, exacerbated by academic pressures, social media further emphasises the potential value in engaging this group (Orben & Przybylski, 2019; Pierce et al., 2020; Twenge et al., 2018).

Involving adolescents in co-design could also addresses a key developmental need to contribute, which is often overlooked (Fuligni, 2019), while also ensuring that study goals and methods remain highly relevant to their lived experiences (Ryan et al., 2024). Adolescents who participate in research are reported to gain skills and a sense of purpose as they see their input shape real decisions, echoing findings that co-produced youth involvement can build confidence, insight, and shared ownership (Pavarini et al., 2019). Evidence from evaluations of young people's advisory groups shows similar benefits, with adolescents reporting belonging, skill development, and confidence, while researchers gain perspective and refine their methods through reciprocal learning (Brady et al., 2023). Such authentic input can strengthen research design and foster trust and enthusiasm between young people and researchers (Ryan et al., 2024; Warraitch et al., 2024).

In youth settings, adolescent perspectives become especially important for designing research with greater resonance, as local knowledge and lived experiences enhance the depth and real-world applicability of findings (Marschall, 2004). Collaborating with adolescents in this way can align with evidence that combining institutional resources with active stakeholder participation strengthens the validity and policy relevance of research (Ostrom, 1996). The Born in Bradford Age of Wonder project (Shire et al., 2024), a seven-year project capturing the journey through adolescence and adulthood for all teenagers in Bradford using health, social and education data, is a living example of these benefits, showing how young people's involvement can not only improve research quality but can also facilitate skill development and empowerment (Ryan et al., 2024). These were gauged primarily through iterative "reflection circles" and qualitative feedback from the young co-researchers themselves. The process enabled participants to refine critical thinking and problem-solving skills, as they were actively involved in addressing real-world issues and making decisions that directly impacted the research outcomes. In these sessions, participants described how much they felt responsible for steering research decisions (ownership) and their confidence in shaping outcomes (self-efficacy). These perceptions were then checked across multiple inquiry cycles to capture changes over time, if, for instance, participants reported growing comfort in contributing ideas and observed their suggestions being integrated into the research design. This cyclical approach provided direct, evidence-based insights into how and why co-design enhanced adolescents' sense of agency.

Here, building on this work, we report on a structured, multi-study community-based participatory approach to co-develop research priorities for a new developmental neuroscience programme with adolescents. Our approach involved interactive workshops designed to introduce adolescents to fundamental neuroscience concepts and actively engage them in shaping research agendas through creative, collaborative exercises. We had two aims: (1) to illustrate a methodological framework for participatory priority-setting in developmental neuroscience; and (2) to report the specific research priorities that adolescents themselves identified as important.

General Methodology

The neighbouring cities of Bradford and Leeds in West Yorkshire reflect the UK's diverse social and economic landscape. Bradford is England's fifth most deprived district, with 40% of children living in poverty higher than the regional and national averages (City of Bradford Metropolitan District Council, 2023). This poverty restricts access to quality education, nutrition, and stable housing, heightening risks of cognitive delays, emotional difficulties, and mental health problems. Some Bradford schools, however, have received national recognition for innovative, community-based education programmes focused on inclusion and resilience (Ofsted, 2021). Leeds has a more varied economy, but still faces pockets of severe deprivation, especially in former industrial areas (Leeds City Council, 2023). Many schools in these neighbourhoods contend with similar challenges, including food insecurity, housing instability, and limited access to early intervention services, while more affluent districts benefit from ample resources and some of the highest academic attainment in the country (Office for Students, 2022). These contrasts highlight the importance of place-based approaches to education and child development. Building on local infrastructure and partnerships through the Centre for Applied Education Research (CAER) in Bradford and the Child Health Outcomes Research at Leeds (CHORAL), we engaged adolescents to explore their priorities for a new neuroscience research programme.

Note that we describe our approach as co-design rather than co-production. This distinction is intentional. Co-production typically implies that stakeholders are involved across all stages of the research cycle, from identifying priorities, shaping methods, collecting and analysing data, through to dissemination and implementation (NIHR, 2024). We use 'co-design' to refer to participatory processes where community members hold meaningful influence over research priorities.

A two-study mixed-methodology approach was implemented. In the first study, seven workshops were undertaken with 79 secondary school students across three schools, where students designed their own neuroimaging studies and identified priorities for research. In the second study, ten priorities derived from previous workshops and 370 students from four different schools were asked to rank these priorities from most important to least important. The data collected were analysed to identify common themes and priorities among the students. Deprivation profiles of participating schools were mapped using the Indices of Multiple Deprivation (IMD), as shown in **Error! Reference source not found.**. Darker blue shades represent higher levels of deprivation, offering a visual overview of the socio-economic contexts surrounding each school.

To mitigate power imbalances, facilitators positioned adolescents as experts of their own experiences, with researchers acting as collaborators rather than evaluators. Students were explicitly told their input would inform our research programme. After workshops, schools received feedback reports summarising findings, closing the loop of participation.

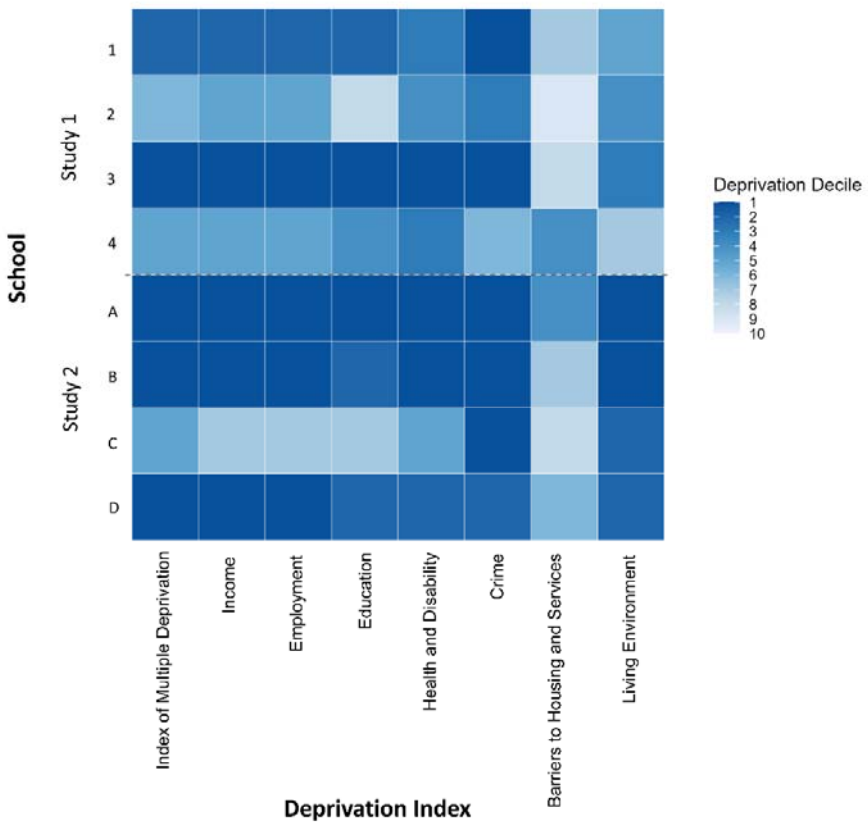

Figure 1: Illustration of sociodemographic profile, represented by the Indices of Multiple Deprivation (2019) for participating schools in Study 1 (1, 2, 3 4), in which school generated priorities and Study 2 (A, B, C, D), in which students ranked priorities. Index deciles are presented for overall Index of Multiple Deprivation, Income, Employment, Education, Health and Disability, Crime, Barriers to Housing and Services and Living Environment. In the figure, a darker colour represents a higher deprivation decile (1 = most deprived, 10 = least deprived), taken from Indices of Multiple Deprivation (2019) and therefore, a lower sociodemographic marker for that school area. The variability in shades indicates the diversity of the involved schools within and between indices.

Study 1: Priority Setting

Methodology

Workshops were conducted wherein students from four year groups (Year 7, Year 8, Year 9 and Year 12) from three schools across the region were tasked with designing a research study, as if they were neuroscientists. Each workshop session lasted one hour and was structured into three components. The workshop began with a brief introduction to the fundamentals of neuroscience and neuroimaging, aimed at equipping students with the foundational knowledge needed for meaningful participation in the subsequent activities. This segment was integrated to promote participants' self-efficacy and self-advocacy (Smith et al., 2021) in the session.

Within this “Introduction to Neuroscience Fundamentals”, students were introduced to the plans for a new adolescent neuroimaging study, where the goal is to use EEG to explore adolescent brain health and development in Bradford and Leeds. Following the introduction, students were divided into groups to design a neuroimaging study. Students were informed that their ideas may be used to define the priorities of the research programme.

As the introduction focused on EEG as the neuroimaging technique to be employed in the forthcoming programme, students were encouraged to design the study integrating the fundamentals of EEG they had learned in the session with their personal interests. The workshop concluded with a “Dragon's Den” style format, based on the popular UK TV show (analogous to Shark Tank in the US), where each group pitched their study designs to the class through a short presentation. Students explained their research ideas, justified their methodologies, and responded to questions from peers and facilitators, providing a platform for critical feedback and discussion.

Following the presentation, students were tasked with designing a poster to present their research ideas. Students used materials available at the school, primarily pens and paper, while one school, with access to a computer lab, produced digital posters that were printed. No specific prompts or templates were provided for the design, except for the requirement to include a title, identify the problem they aimed to address, propose an EEG-based research solution, and explain the societal benefits of their research.

Used in teaching and learning, posters can be used to give an idea of information prioritisation (Lane, 2001), an insight into what students deem to be important and may be in the form of colour, text formatting or sectioning. The process of creating a poster facilitates independence (Mackey, 2004) and serves as an effective medium for students who may struggle with articulating complex scientific concepts verbally or in writing. They allow these students to visually represent their ideas and understanding, promoting the development of critical thinking skills and aiding in the comprehension and communication of challenging material (Hasio, 2015).

Results

Data Preparation and Analysis

Posters created by students were scanned and uploaded to NVivo 14 (Lumivero, 2023). Reflexive Thematic Analysis, following Braun & Clarke's (2019) reflexive approach, was used in the co-design of research documentation and applied to code generation of visual files. Reflexivity was considered throughout, with coders documenting their own positionality (e.g. disciplinary background, prior experience with adolescent co-research). Disagreements were resolved through discussion rather than consensus coding to preserve interpretative depth.

Figure 2 shows the findings of a reflexive thematic analysis, providing a conceptual representation of primary themes, sub-themes, and their interrelationships. These themes: Health and Well-Being, Anti-Social Behaviour, Everyday Routines, and Social Media Use, reflect adolescents' interest in understanding the neural mechanisms underlying their daily experiences, concerns, and behaviours. Within each theme, students identified specific sub-themes, highlighting areas where they believed neuroscience research could provide valuable insights. We explore these subthemes next.

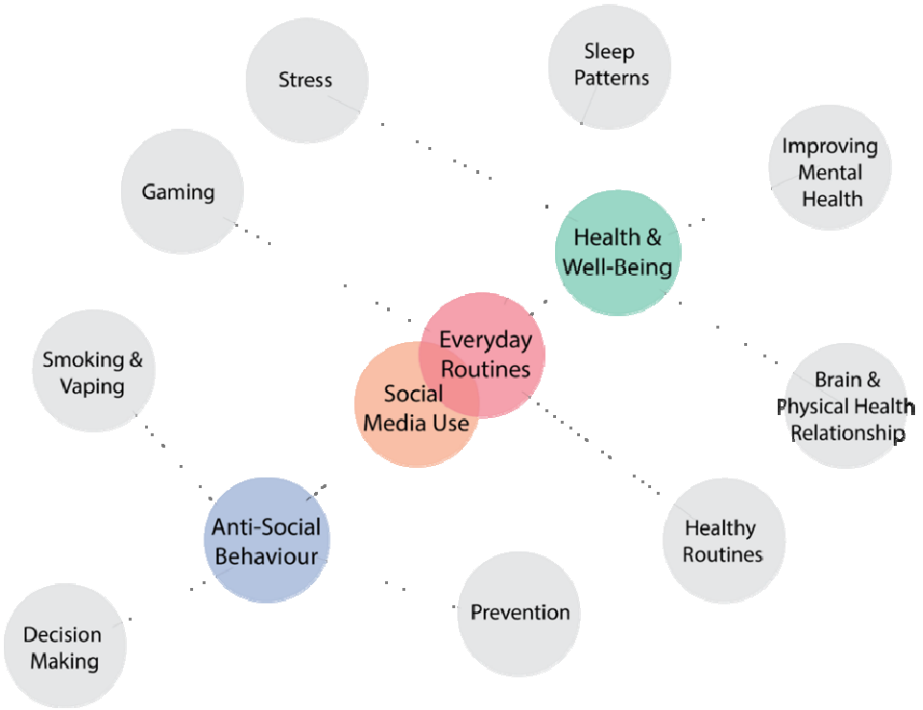

Figure 2: Presentation of poster presentations by West Yorkshire students derived using reflexive thematic analysis. Map highlights adolescent experiences through a developmental neuroimaging lens. Four main themes emerged: Everyday Routine (red), Social Media Use (orange), Health and Well-Being (green), and Anti-Social Behaviour (blue), each with subthemes (grey). Solid lines represent students' perceptions, while the positioning and overlap of subthemes reflect alignment with existing research.

Theme: Health and Well-Being

Participants conceptualised well-being as a broad construct that integrates mental health, stress, and physical health. Their posters reflected a keen interest in the relationship between brain activity and external stressors, emotions, and lifestyle factors.

Stress emerged as a prominent sub-theme, with particular emphasis on exam-related stress. Students were concerned about the impact of academic pressure on brain function and proposed research comparing brain activity across different exam conditions. They suggested exploring whether stress responses vary depending on age and academic stage. Additionally, they speculated that neuroimaging techniques, such as EEG, could be used to identify unconscious stress triggers in students who may struggle to articulate their experiences.

Beyond academic stress, students considered the influence of social perception on brain activity. They hypothesised that external factors, such as clothing and social environments, could shape students' self-perception and stress responses. Some proposed comparing brain activity in different social contexts to investigate whether these effects vary by gender or age group. They saw potential for such research to inform the development of supportive school environments that mitigate stress.

Mental health was also a major concern, with students expressing a desire to understand the neural basis of conditions such as anxiety, depression, and phobias. Many saw neuroimaging as a tool to uncover how emotional states are represented in the brain. Some students extended this interest to broader societal issues, proposing research into the neural mechanisms of racial bias and prejudice. They speculated that identifying patterns of brain activity associated with bias could help inform strategies for reducing discrimination.

Physical health was another key area of interest, particularly in relation to exercise and its impact on brain activity. Students proposed comparing brain responses across different exercise types, fitness levels, and time points surrounding physical activity. Some explored the idea that physical activity could interact with factors such as energy levels and stress, influencing cognitive function. They were particularly interested in how these relationships might vary by age and whether neuroscience could offer evidence-based insights into the benefits of exercise for brain health.

Theme: Investigating Anti-Social Behaviour

Concerns about risk-taking behaviours and their neural underpinnings were central to this theme. Adolescents focused on decision-making processes, substance use, and the role of social influence in shaping behaviour.

Decision-making was identified as a critical developmental process. Students proposed creating controlled environments in which adolescents are presented with moral dilemmas or risky choices while their brain activity is monitored. They believed this could provide insight into impulsivity and

help develop interventions to support better decision-making. Some students extended this interest to criminal behaviour, suggesting that research could explore whether certain brain activity patterns are associated with criminal tendencies.

Social influence was another key consideration. Adolescents were particularly interested in how peer pressure affects decision-making and morality. They hypothesised that social environments shape neural responses and suggested using neuroimaging to examine how individuals respond to social pressure when making choices.

Substance use, particularly smoking and vaping, emerged as a major concern. Students were curious about the impact of nicotine and other substances on adolescent brain development. They speculated that EEG could be used to investigate the neural mechanisms of addiction and to identify potential intervention strategies. Some extended this interest to broader issues of substance abuse, including alcohol and other drugs, proposing that neuroscience might offer insights into prevention and treatment.

Theme: Everyday Routines

Participants also recognised the importance of structured routines in shaping cognitive and emotional well-being. Their posters reflected an interest in how everyday habits, such as sleep and gaming, influence brain function.

Sleep was a particularly prominent sub-theme. Students wanted to investigate the factors that affect sleep quality, duration, and latency, considering environmental variables such as temperature, noise, and bedding. Many proposed comparing the sleep patterns of different individuals to identify best practices for improving sleep. Some students also speculated about the potential of neuroimaging to visualise dreams, questioning whether brain activity patterns could be used to illustrate dream content without verbal input.

Gaming was another area of interest, with students reflecting on their own experiences with video games and their potential effects on brain development. They hypothesised that different game genres and design features, such as colours, haptics, and music, might have distinct effects on neural activity. Some were particularly interested in whether gaming influences mental health or contributes to antisocial behaviours, such as gaming-related aggression.

Theme: Social Media Use

Social media was recognised as both a distinct theme and a component of adolescents' everyday routines. Students considered its impact on self-perception, mental health, and cognitive function.

Online interactions and self-perception were key concerns. Students discussed how social media influences their self-image, particularly in relation to gender differences. They speculated that exposure to social media might shape brain activity linked to self-perception and emotional responses.

Some suggested that these effects might be moderated by factors such as screen time and age, warranting further investigation.

Mental health was also a central focus surrounding social media. Adolescents were concerned about the potential for social media to contribute to stress, anxiety, and mood fluctuations. They were particularly interested in whether neuroimaging could reveal patterns of brain activity associated with digital well-being.

Thematic Intersections

Beyond overlaps within themes, several overlaps were evident across themes, highlighting the interconnected nature of adolescents' concerns. The intersection between gaming and mental health was a recurring topic, with students questioning whether video games contribute to emotional regulation difficulties or antisocial behaviours such as aggression. Similarly, stress and sleep were frequently discussed together, as students recognised that academic stress could disrupt sleep patterns and affect cognitive function.

Another notable intersection was between social media use and self-perception, where students hypothesised that online interactions influence stress, decision-making, and broader mental health outcomes. They suggested that these relationships might be particularly pronounced during adolescence, given the importance of peer validation.

The findings from this analysis reflect adolescents' curiosity about the neural basis of their lived experiences and their desire for research that directly relates to their daily challenges. Their research priorities indicate a strong interest in using neuroscience to inform interventions that improve mental health, decision-making, and overall well-being.

Study 1 Discussion

Mental health emerged as a consistently significant theme, highlighting its universal importance across different school environments and demographic groups. Adolescence is a critical period for mental health development, with stress playing a central role in shaping brain structures such as the hypothalamic-pituitary-adrenal axis, amygdala, and prefrontal cortex (Casey et al., 2018; Lupien et al., 2009). Persistent stress can interfere with these processes, leading to difficulties in emotional regulation and decision-making (Paus et al., 2008). Electroencephalography (EEG) has been shown to provide insights into the neural mechanisms underlying mental health conditions such as anxiety and depression (Boby & Veerasingam, 2025; Elnaggar et al., 2025; Gkintoni et al., 2025). Understanding these mechanisms could inform targeted interventions to improve adolescent well-being.

Stress and physical health were also ranked as important themes, whilst revealing some variation across schools and gender groups. This suggests that while these concerns are widely recognised, their

perceived relevance may be shaped by local contexts and demographic factors. Research indicates that chronic stress can have lasting effects on neurodevelopment, particularly in areas governing executive function and emotional processing (Suleiman & Dahl, 2017), Similarly, disruptions to sleep-another key concern raised by students-have been shown to negatively impact cognitive, emotional, and physical well-being (Born in Bradford, 2024). Adolescents are particularly vulnerable to sleep deprivation due to biological shifts in circadian rhythms, compounded by academic and social pressures (Beebe, 2011).

Anti-Social Behaviour emerged as a distinct theme. Students highlighted the behavioural implications of excessive digital media consumption, linking it to reduced face-to-face interactions and lower social empathy. The scientific literature supports these observations, associating heightened digital engagement with social withdrawal and decreased interpersonal sensitivity (Twenge et al., 2018). Similarly, social media use was highlighted as both a standalone theme and one intersecting with everyday routines. Students acknowledged its substantial influence on their daily schedules, decision-making processes, and peer interactions. There is a growing body of research showing that excessive social media use can disrupt essential routines, impair cognitive function, and contribute to emotional instability (Orben & Przybylski, 2019). Furthermore, social media has been linked to anti-social behaviours, including cyberbullying and social withdrawal. The dual categorisation of social media illustrates its role as both an essential daily activity and a source of socio-behavioural challenges.

The theme of Everyday Routines surfaced prominently in students' reflections, with subthemes such as Gaming and Sleep Patterns frequently mentioned. Students described gaming as an integral activity influencing time management, social engagement, and concentration. However, research suggests that excessive gaming can also precipitate anti-social behaviour by reducing real-world social interactions (Przybylski & Weinstein, 2017), though potentially moderated by the type of game (Greitemeyer, 2022).

Participants in Study 1 frequently presented ideas spanning multiple themes and sub-themes, demonstrating an awareness of the complexities of development and the interconnected nature of cognitive, emotional, and social processes. Their proposals often linked mental health to sleep, stress to decision-making, and gaming to social behaviour, reflecting an intuitive understanding that brain development does not occur in isolation. This overlap suggests a strong curiosity about how different aspects of their experiences interact at a neural level, highlighting their interest in exploring multifaceted relationships between behaviour, environment, and brain function.

Study 2: Priority Ranking

Themes generated in Study 1 were translated into ten survey items for Study. This step ensured continuity between qualitative and quantitative studies while preserving adolescents' original phrasing where possible. Two subthemes (e.g. mental and physical health) were expanded, while no themes were dropped.

Methodology

Participants

A total of 387 participants were included. Demographic data were partially missing, with valid information available for 325 participants (gender), 332 participants (ethnicity), and 297 participants (age). Missing data was due to varying session formats, as some participants were involved in wider sessions without collection of demographic information, or due to personal choice. The mean age was 16.85 years (SD = 1.97, N = 297). Reported gender was primarily female (n = 197) and male (n = 122), with one participant identifying as non-binary/third gender and five who opted to not disclose.

The largest ethnic group identified as English, Welsh, Scottish, Northern Irish or British (n = 155). Other reported ethnicities included Pakistani (n = 51), Indian (n = 23), African (n = 19), any other White background (n = 28), "any other Black, Black British, or Caribbean background" (n = 11), White and Asian (n = 9), "any other Asian background" (n = 8), Chinese (n = 3), White and Black African (n = 3), White and Black Caribbean (n = 2), Caribbean (n = 2), Arab (n = 2), Irish (n = 2), Bangladeshi (n = 1), and "any other ethnic group" (n = 1). A further seven participants described mixed or multiple backgrounds across variants, and five selected "prefer not to say."

The participants came from four schools (A, B, C, D in Figure 1) in Bradford and Leeds, though demographic data for School A was unavailable, due to its private, independent status. Socioeconomic indicators varied across schools. School B had the highest proportion of students eligible for free school meals (over 45%), exceeding both School C and the national mainstream average (approximately 25%). School B also reported the highest rate of student absences (nearly 20%), while School C had a lower absence rate but remained above the national average. Academic attainment, measured by the percentage of students achieving Grade 5 or above in key subjects, was highest in the national mainstream average, followed by School C, with School B showing the lowest performance. These variations in socioeconomic background and academic outcomes provide crucial context for interpreting student perspectives in this study.

Approach

Sessions were delivered within classroom environments for a duration of a timetabled lesson (~1 hour). Each session followed a structured format. In the first segment of the session, students received a brief introduction to the basic concepts of neuroscience. This included an overview of brain structure and function, as well as the relevance of neuroimaging in understanding brain activity. Following the introduction, students were given a demonstration of electroencephalography (EEG) technology. This demonstration included an explanation of how EEG works, its applications in research, and a live demonstration of EEG data collection. After the demonstration, students were presented with a list of ten research priorities that had been extracted from themes identified in Study 1: Mental Health, Stress, Relationship between Brain and Physical Health, Decision Making, Anti-Social Behaviour, Social Media, Healthy Routines, Gaming, Sleep, Smoking and Vaping.

The decision to split the broad 'Health and Wellbeing' theme into subdomains (mental health, physical health, stress) was based on its dominance in Study 1 and our intention to capture nuances adolescents themselves highlighted within posters. This subdivision enabled a more precise analysis of how health-related priorities were ranked.

Analysis

Responses were collected through a survey administered in paper or online via the Qualtrics platform. Participants were asked to rank a set of research priorities extracted from Study 1. Their responses, including demographic information such as gender and school postcode, were recorded and digitised. Data were aggregated to calculate the mean ranking for each research priority. This aggregation was performed both for the combined dataset of all participants (**Error! Reference source not found.**). Visualisation of the aggregated rankings was conducted using R (4.4.1).

As part of an exploratory analysis, we examined whether priorities varied according to Gender and School.

Results

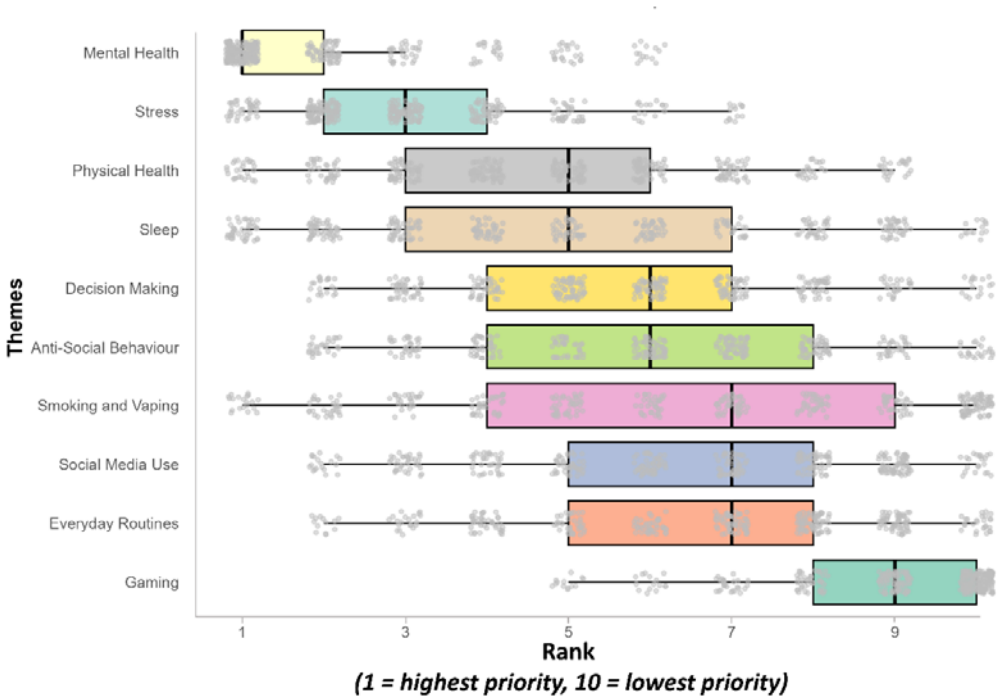

Figure 3: Average rank of priorities across Schools and Genders. Grey dots represent individual data points. Themes are ordered from most important priority (1) to least important priority (10).

Average Ranking

On average, participants ranked Mental Health as the highest priority (M = 2.39, SD = 2.08, *n* = 370), followed by Stress (M = 3.49, SD = 2.02) and Sleep (M = 4.90, SD = 2.72). Physical Health (M = 5.00, SD = 2.39), Decision Making (M = 5.59, SD = 2.31), and Anti-Social Behaviour (M = 5.93, SD = 2.41) were rated at an intermediate level of priority. Lower priority themes included Social Media Use (M = 6.25, SD = 2.47), Smoking and Vaping (M = 6.34, SD = 2.87), Everyday Routines (M = 6.51, SD = 2.34), and Gaming (M = 8.48, SD = 2.11).

Group Rankings

Mann–Whitney U tests with FDR correction showed that females placed significantly greater emphasis on Mental Health (U = 9601.5, p = .045, FDR-corrected), compared to males (M = 2.06, SD = 1.79, n = 194 vs. M = 2.80, SD = 2.31, n = 120). The associated effect size was small (rank-biserial r = .18; Cliff's δ = −.18), indicating modest gender differences. No other themes survived FDR correction. Although raw p-values suggested possible differences for Sleep (p = .021), Physical Health (p = .049), Smoking and Vaping (p = .026), Social Media Use (p = .019), and Gaming (p = .033), these did not remain significant after FDR adjustment (all p's > .05). Thus, after controlling for

multiple comparisons, gender-related differences were restricted to the prioritisation of Mental Health, with all other themes showing negligible to small effects.

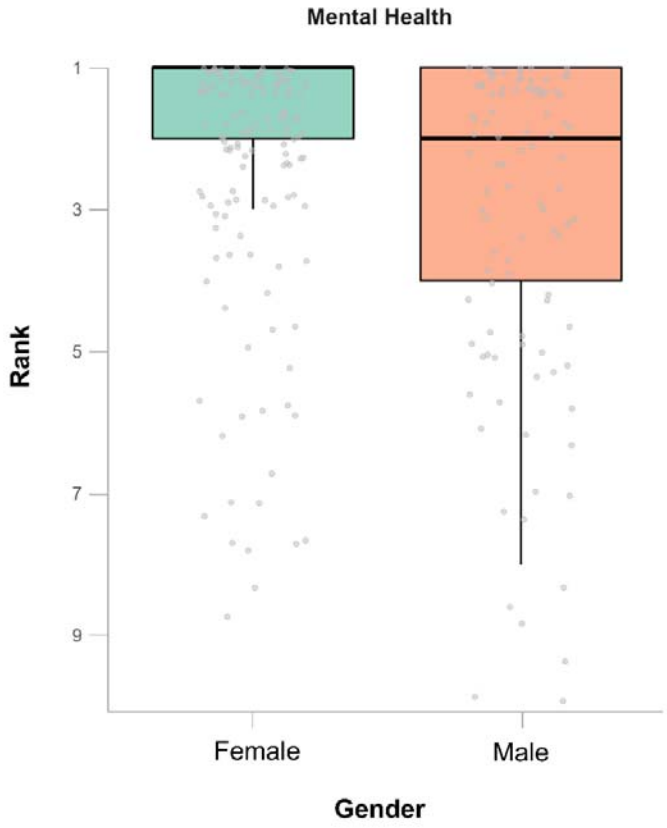

Figure 4: Boxplots of themes showing statistically significant differences between genders for Mental Health and Gaming from a Mann Whitney U test. Rank scores (lower values indicate higher priority) are presented for female (green) and male (orange) participants. Females ranked Mental Health and Stress significantly higher compared to males. Conversely, males ranked Gaming significantly higher compared to females, who displayed consistently lower ranks. Grey dots represent individual data points within each group.

A series of Kruskal–Wallis tests were conducted to examine differences in ranked research priorities across four schools (A–D). Significant effects were observed for Mental Health, $\chi^2(3, N = 387) = 14.66$, $p = .007$, $\varepsilon^2 = .03$; Anti-Social Behaviour, $\chi^2(3, N = 387) = 18.90$, $p = .001$, $\varepsilon^2 = .05$; and Everyday Routines, $\chi^2(3, N = 387) = 25.83$, $p < .001$, $\varepsilon^2 = .06$.

No significant differences were found for Stress, Physical Health, Sleep, Decision Making, Smoking and Vaping, Social Media Use, or Gaming (all ps > .05).According to recommended benchmarks (Tomczak & Tomczak, 2014), the observed effect sizes were small in magnitude, with no theme exceeding the threshold for a medium effect ($\varepsilon^2 \geq .06$).

Follow-up pairwise Dunn tests with Benjamini–Hochberg adjustment showed the following significant contrasts: *Mental Health* was ranked highest priority in School C (M = 1.54, SD = 1.00, n = 28) compared to School A (M = 2.39, SD = 1.63, n = 114), School B (M = 2.04, SD = 1.63, n = 27), and School D (M = 1.80, SD = 1.31, n = 177). *Anti-Social Behaviour* was given greater importance in School C (M = 5.53, SD = 2.29, n = 30) and School D (M = 5.74, SD = 2.18, n = 178) compared with School A (M = 6.75, SD = 2.28, n = 120). *Everyday Routines* was prioritised lowest in School D (M = 7.16, SD = 2.01, n = 180) relative to School A (M = 5.88, SD = 2.22, n = 121) and School B (M = 6.69, SD = 2.14, n = 29). No other pairwise comparisons were significant after FDR correction.

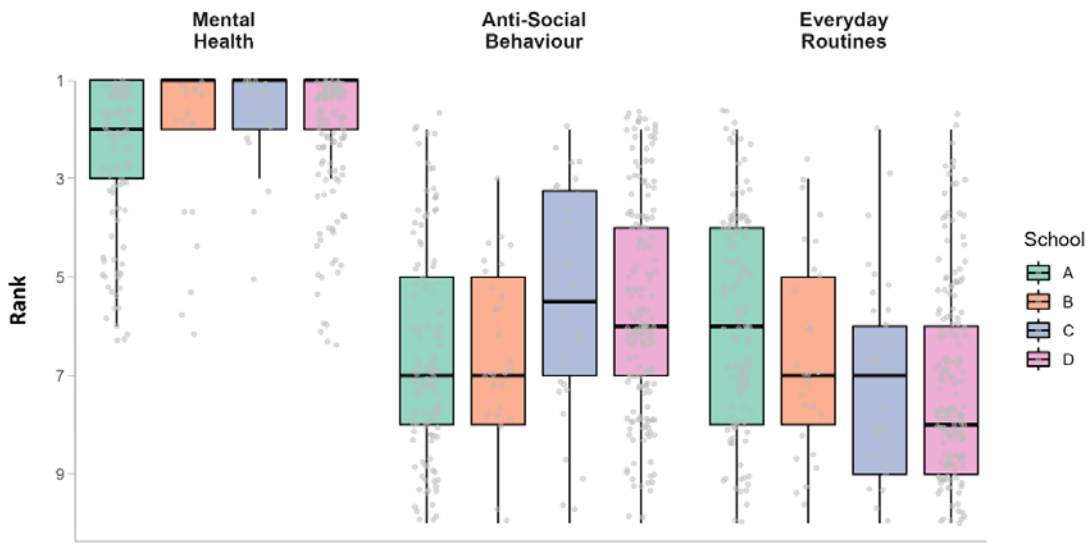

Figure 5: Statistically significant average rankings of priorities of adolescent neuroscience research. Each subplot represents the distribution of rankings for a specific theme across three schools: A (green), B (orange), C (blue) and D (pink). Rankings are displayed on a scale from 1 (most important) to 10 (least important), with lower rankings representing higher preferences.

General Discussion

This study used a two-study participatory approach to identify adolescents' priorities for developmental neuroimaging research. Four broad themes emerged: mental health and wellbeing, antisocial behaviour, everyday routines, and social media. Mental health was consistently ranked as the highest priority across schools and genders, with stress and physical health also viewed as important. Gender differences were modest, with female participants placing greater emphasis on mental health. Differences were also observed at the school level, with variation in the prioritisation of mental health, antisocial behaviour, and everyday routines. Together, these findings suggest that adolescents' research priorities reflect both individual experience and the environments in which they live and learn, and demonstrate the value of participatory approaches for generating priorities that are scientifically relevant and grounded in lived reality.

In Study 1, posters prominently featured ideas related to health and wellbeing. Given the dominance of this theme, we examined it in greater detail in Study 2 by separating it into three subthemes: mental health, physical health, and stress. The gender-related differences observed in Study 2 reinforce the need to consider how research priorities may vary across groups. Female participants consistently ranked mental health as a higher priority, aligning with findings from community-based research in Bradford schools (Born in Bradford, 2024). Priorities related to stress, physical health, and social media were ranked similarly across genders, suggesting broad agreement on the importance of these topics.

These findings also highlight the importance of interpreting adolescent priorities in context. Neuroscience, and health research more broadly, must account not only for the data collected, but also for the environments in which those data are generated. As there is increasing recognition that race and ethnicity should not be used as crude proxies for socioeconomic position, given the potential harms this can cause through stigma and misattribution (Cardenas-Iniguez et al., 2024), alternative approaches are needed to characterise contextual variation. School-level socioeconomic and deprivation profiling may offer one useful lens for interpreting differences in ranked priorities. Schools located in areas of higher deprivation face structural challenges including economic hardship, lower educational attainment within the community, and higher exposure to crime. These broader conditions, alongside individual characteristics such as age and gender, can shape adolescents' engagement in participatory research and the issues they consider most salient (Thijssen & Van Dooren, 2016). Tools such as the Index of Multiple Deprivation (IMD), used for example in the Adolescent Brain Cognitive Development (ABCD) study, may therefore provide an exploratory framework for contextualising adolescent perspectives (Cardenas-Iniguez et al., 2024). In Study 2, we used publicly available data to characterise variation between participating schools. Notably, School A, a private fee-paying institution, ranked mental health as a lower priority than the other schools. One potential explanation is differences in school-based provision, as private schools typically have

greater access to dedicated wellbeing resources. While these patterns appear consistent with socioeconomic context, causal interpretation is not possible here, and future work should test such hypotheses through targeted sampling and more direct measurement.

Variation in how School B and School C prioritised antisocial behaviour may also reflect multiple interacting factors. While School B's higher deprivation index could plausibly signal heightened exposure or concern, adolescents in socioeconomically disadvantaged settings may also become desensitised to, or normalise, antisocial behaviours, which can reduce their perceived urgency (Bellis et al., 2015; Farrington et al., 2009). In contrast, students at School C may have been older on average, and adolescence is associated with developmental changes in cognitive and moral reasoning that can heighten sensitivity to social norms and fairness (Moffitt, 1993; Steinberg, 2008). These findings reinforce that socioeconomic deprivation provides an important backdrop, but cannot fully explain adolescents' priorities in isolation. Individual experience, school culture, and developmental stage are also likely to shape how adolescents interpret and prioritise issues such as antisocial behaviour. Integrating adolescents' subjective perspectives with contextual indicators may therefore offer a more comprehensive account of the relationship between socioeconomic environment and research priorities.

Embedding deprivation profiling within participatory methodologies may help researchers better understand how structural inequalities shape adolescents' perspectives and decision-making. A place-based approach situates data collection and interpretation within the cultural, socioeconomic, and environmental conditions of a defined setting, recognising that local context can meaningfully influence outcomes (Cummins et al., 2007). This framing may allow developmental neuroscience to move beyond broad demographic categories and instead attend more directly to the lived experiences of adolescents within particular communities.

Population-based neuroimaging programmes have the opportunity to explore these diverse community perspectives. By embedding co-design and iterative consultation early in research design, future studies can ensure that neuroscience research remains relevant and adaptable to diverse community needs. Without considering the broader research context, statistical outputs risk being misinterpreted or oversimplified (Staley, 2015).

There is a reported lack of co-production in child and adolescent mental health research (Norton, 2021). This absence of participatory approaches mirrors the current state of developmental neuroscience (La Scala et al., 2023), where young people remain largely excluded from influencing research priorities or study design. Despite continued policy rhetoric around inclusion, adolescents remain largely excluded from shaping research priorities or influencing study design. The existing evidence suggests that meaningful co-production remains rare, fragmented, and poorly

operationalised, indicating that further work is needed to ensure research agendas reflect the perspectives of those they are ultimately intended to serve.

When implemented well, however, co-design is associated with more tailored and broadly applicable interventions (Bovaird et al., 2015; Loeffler & Bovaird, 2016). Providing tangible feedback to participants is crucial to equitable practice. Future participatory neuroscience projects should consider the quality and intention of co-production as well as integrating feedback loops within these methodologies as a matter of ethics and rigour.

In the present work, adolescents were engaged intensively in the generation and prioritisation of research questions but did not take part in data analysis beyond the ranking exercise, nor in governance or authorship decisions. We, therefore, employ a co-design approach, situation within a CBPR framework. Embedding adolescents as co-researchers, co-analysts, and co-authors would represent the next stage in developing genuinely participatory neuroscience. This work represents an instal step of a new neuroimaging community-based project within Leeds and Bradford.

Taken together, these findings, alongside existing work, highlight the need for adaptable research frameworks that integrate co-design, flexible methodology, and ongoing community consultation. By bringing participatory approaches into developmental neuroscience, future work may be better placed to generate context-sensitive insights that support both scientific advancement and real-world impact. Such approaches could also help funders and policy makers prioritise adolescent-identified concerns within large-scale neuroimaging programmes, ensuring that investment decisions are responsive to lived realities.

Conclusions

This study highlights the value of involving young people in the design process as a means to achieve more equitable and impactful research outcomes in developmental neuroscience. Future developmental neuroscience should embed participatory priority-setting as standard practice, ensuring that the research agenda reflects not only scientific opportunity but also adolescent need.

Contributions

Conceptualisation: Katherine Hiley, Layla Kouara, Faisal Mushtaq. **Data curation:** Katherine Hiley, Layla Kouara, David Ryan, Katy Shire, Zarina Mirza. **Formal analysis:** Katherine Hiley. **Funding acquisition:** Faisal Mushtaq, Layla Kouara. **Investigation:** Katherine Hiley, Layla Kouara. **Methodology:** Katherine Hiley, Layla Kouara. **Project administration:** Katherine Hiley. **Resources:** Katherine Hiley and Layla Kouara. **Supervision:** Faisal Mushtaq. **Validation:** Faisal Mushtaq. **Visualisation:** Katherine Hiley, Layla Kouara and Faisal Mushtaq. **Writing - original draft:** Katherine Hiley, Layla Kouara, and Faisal Mushtaq. **Writing - review & editing:** Katherine Hiley, Layla Kouara, David Ryan, Katy Shire, Zarina Mirza, Faisal Mushtaq.

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Data Availability

All anonymised posters and raw ranking data generated during this study are publicly available on the Open Science Framework (OSF) repository. The data can be accessed at https://osf.io/f2eg3/?view_only=f7102e57a77f4ba9bd60a9659b163ddc.

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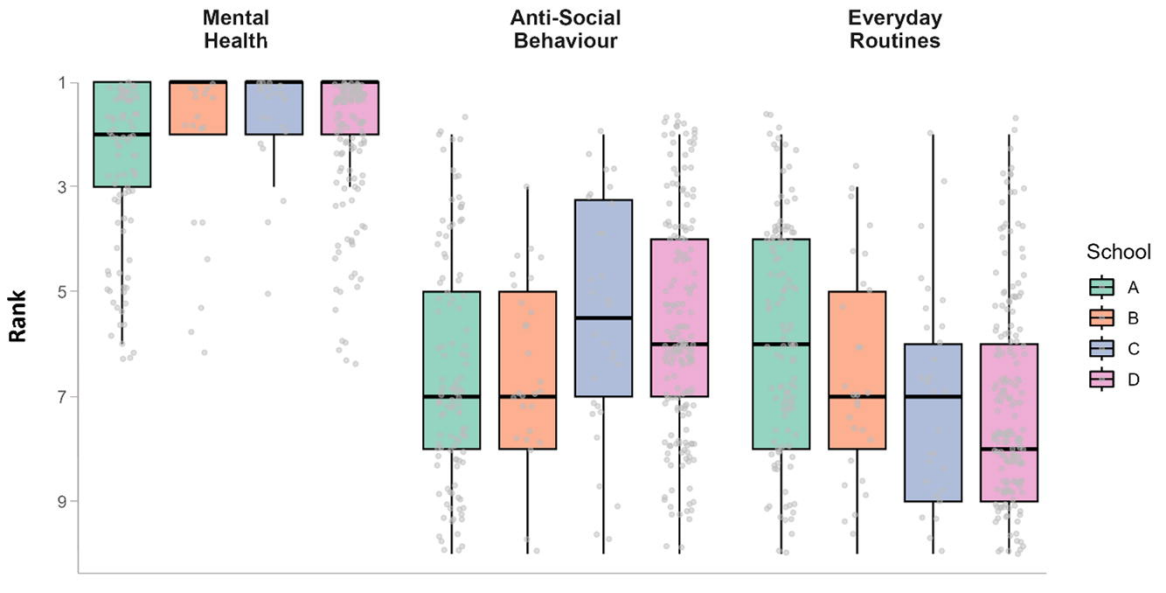
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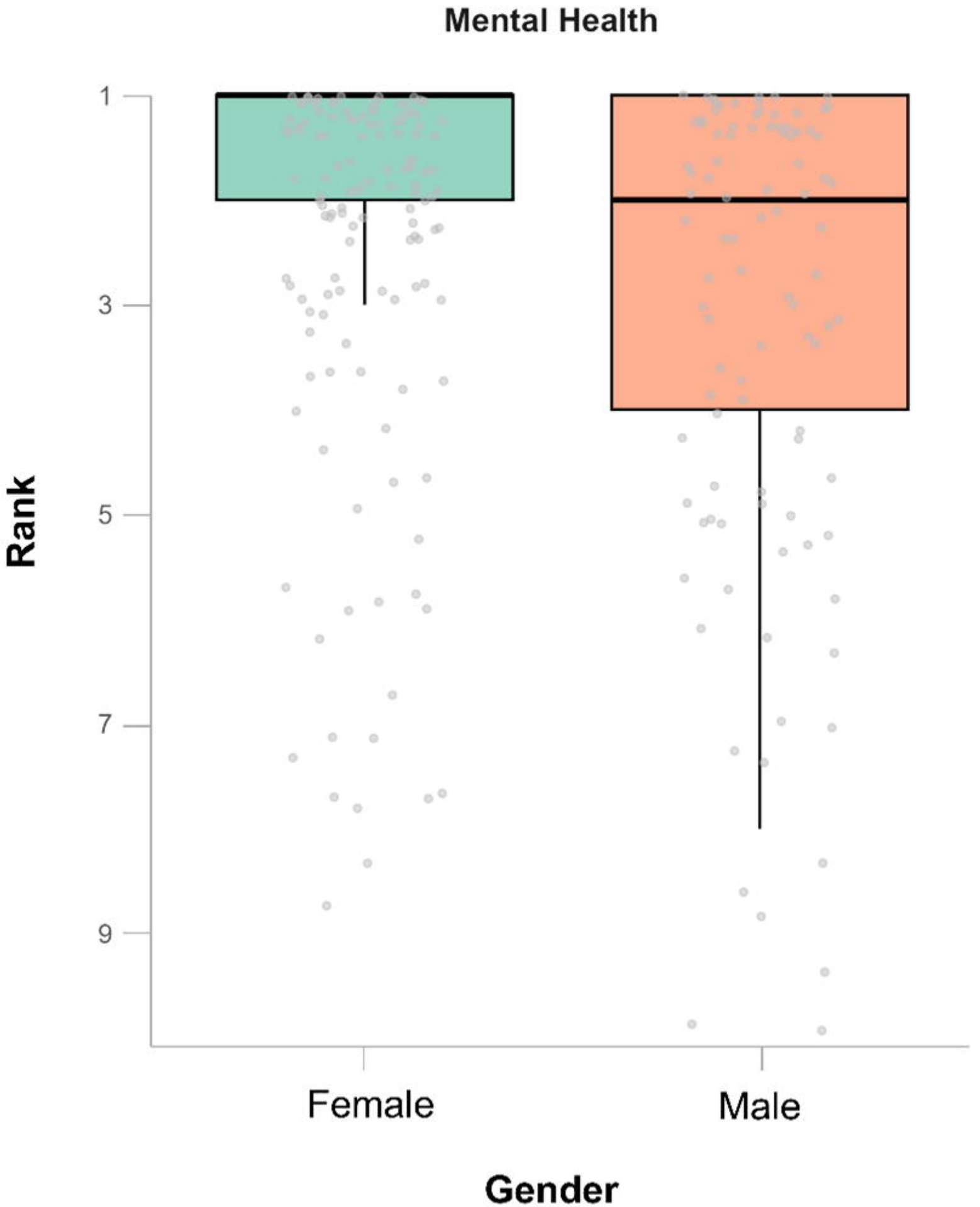
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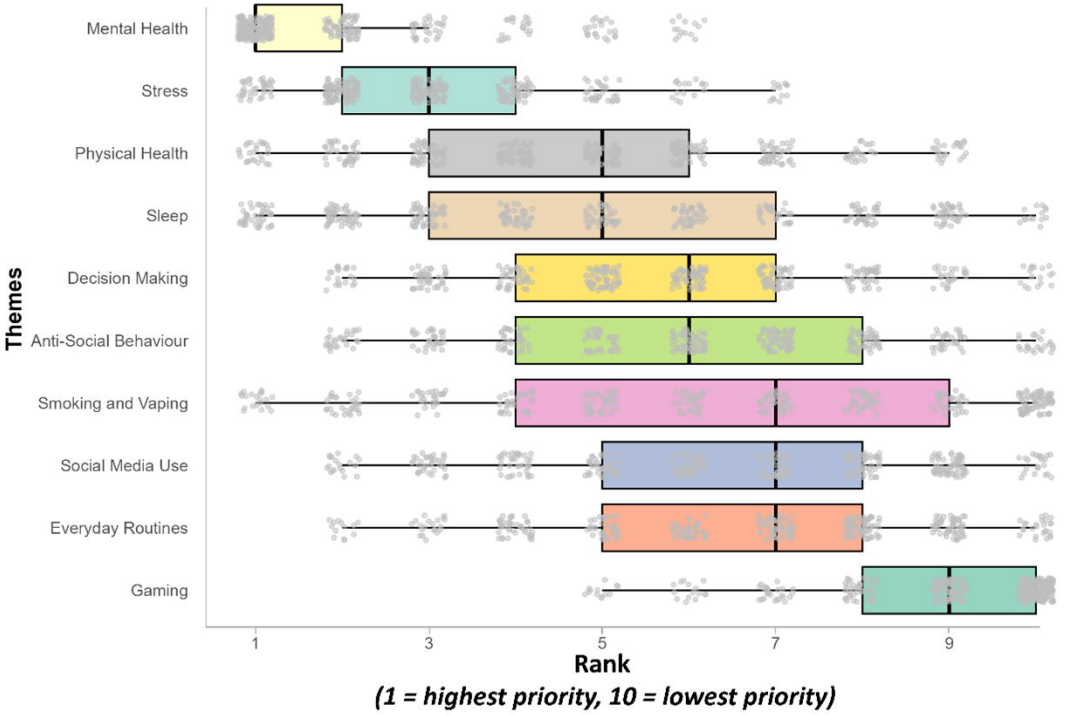
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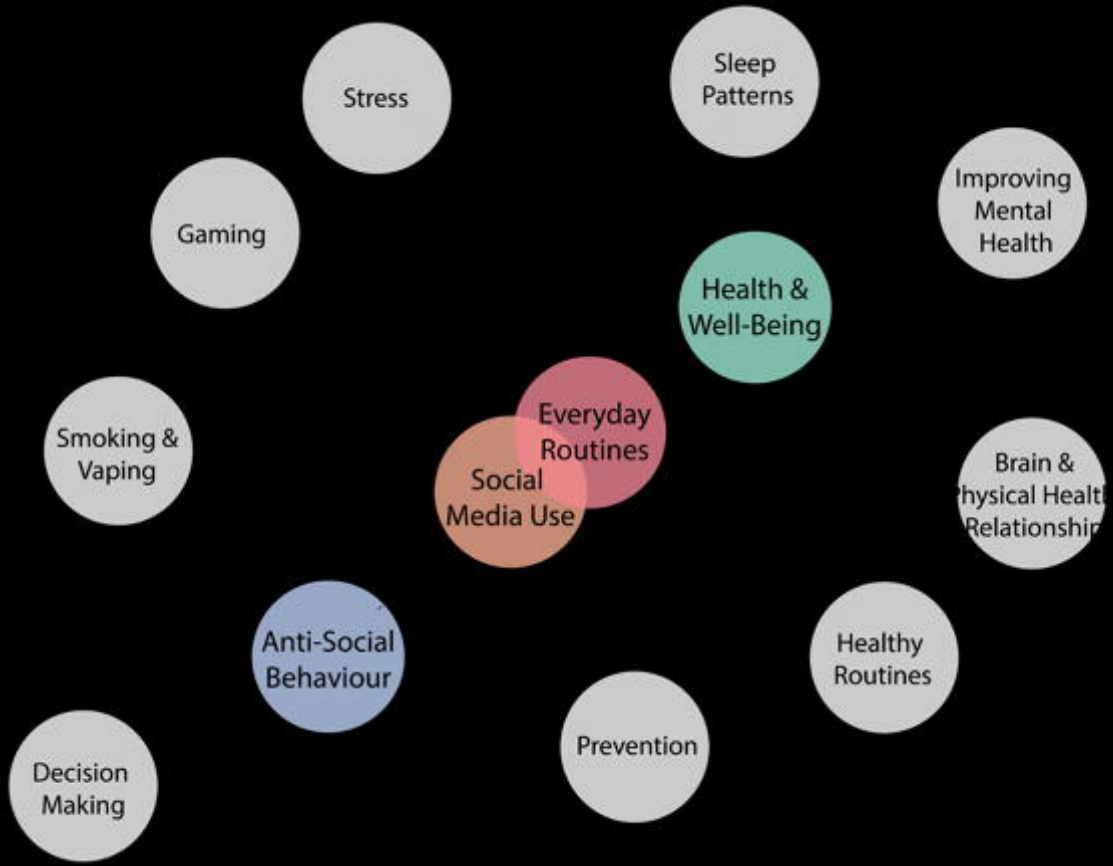
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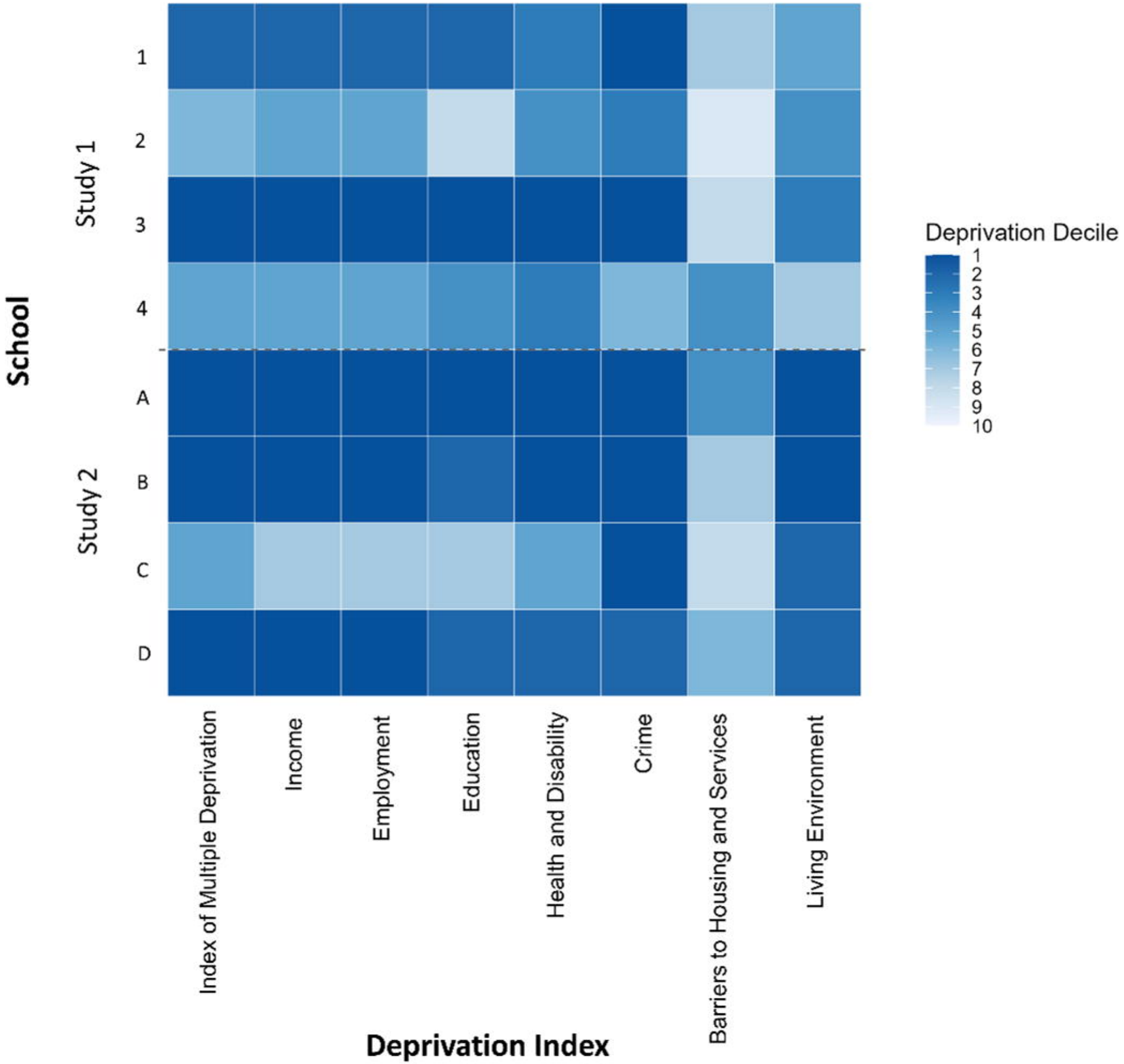
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Barriers to Housing and Services
Living Environment
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