How can we design workspaces more inclusively?

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Abstract: Accessible design within the built environment has often focused on mobility conditions   12
and has recently widened to include mental health. Additionally, as 1 in 7 are neurodivergent (in-   13
cluding conditions such as ADHD, autism, dyslexia, and dyspraxia) this highlights a growing need   14
for designing for 'non-visible' conditions in addition to mobility. Emphasized by the growing disa-   15
bility pay gap and Scope's 2018 study highlighting the Disability Perception Gap, people with dis-   16
abilities are still facing discrimination and physical barriers within the workplace. This research   17
aims to identify key ways of reducing physical barriers faced by people with a disability and thus   18
encourage more comfortable and productive use of workspaces for all. Analysis of key inclusive   19
design guidance documents highlights the lack of assistance when designing for non-visible disa-   20
bilities, and a clear gap in knowledge surrounding specific spatial needs. Literature was assessed   21
surrounding key performance-based goals (e.g., productivity and focus within a study space) and   22
prescriptive design features (e.g., lighting, furniture, and thermal comfort), whilst also considering   23
the inclusivity of these features. A survey was then circulated to students and staff at a large uni-   24
versity in the UK (working remotely from home) with the aim of understanding how people have   25
adapted their home spaces and what barriers they continue to face. Quantitative and qualitative   26
results were compared to the literature read with key issues emerging, such as separating work and   27
rest from spaces in bedrooms. The key conclusion establishes that to achieve maximum benefit it is   28
important to work with the users to understand specific needs and identify creative and inclusive   29
solutions.   30

Keywords: inclusive design; well-being; workspaces; accessibility; neurodiversity; disability; social   31
sustainability; interior design; environmental design   32

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1. Introduction   34

To ensure the built environment contributes to an equal and inclusive society, we   35
need to ensure our spaces are being designed to be accessible and inclusive. Until recently,   36
the discussion regarding equality in the use of the built environment focused on physical   37
access; as this has improved, the discussion has only just widened to address mental   38
health and neurological conditions.   39

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"If you do not intentionally, deliberately and proactively include, you will unintentionally   41
exclude"– Jean-Baptiste, (1)   42

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Leading on from understanding the user, it should be noted that there is a strong   44
relationship between inclusive design and sustainability. As mentioned, successful   45

integration of inclusive design within the design process contributes to the overall usability of the space, and thus improving the overall sustainability of infrastructure (2). Similarly, by following the Social Model of Disability, designers must aim to remove barriers experienced by the user, hence shifting the responsibility onto the designer to actively design a better space. This responsibility shift is similarly seen in designing purely for environmental sustainability; for example, designers actively implementing on-site renewables to reach net-zero. This appears to be a 'big-picture' approach, vital to including and integrating sustainability and inclusive design into the overall process.

While sustainability can be quantified in physical terms, and therefore tools developed to support sustainable design, performance assessment of inclusive design requires the involvement of the user (3). Thus, the user should have a more prominent part in specifying inclusive design features, and hence a more effective balance between the opinions held by the designer and user would appear more effective.

Disability Rights UK recommend that employers need to create cultures in which people living with conditions feel more confident, and they should embed flexible working practices and thorough mental health services within companies (4). By creating more comfortable and flexible work environments, we are in-turn designing for the future; to create socially and physically sustainable spaces, contributing to long-term usability and economic viability (CEM, 2010) but also making best use of the workforce.

This paper aims to add to this discussion, by analyzing existing research on the design of workspaces from an inclusive design perspective, focusing on non-mobility conditions.

2. Inclusive Design & Workspaces

Workspace adaptations for people with disabilities, have often focused on physical adjustments for people with mobility related conditions, such as implementing ramps and lifts. Studies highlight that accessibility is an ongoing process that should be incorporated within policy. A key issue highlighted in research regarding the implementation of workspace adaptations is the dependence on good-will and a dedicated senior leadership team (5, 6). This implies stricter inclusive regulations to improve the overall baseline (ibid.).

Within the last year, research has been published specifically identifying workplace adjustments for people with autism (7, 8). Nevertheless, there is still a large gap in research regarding neurodivergent workspaces. While studying autism is a large step in designing inclusively, it still disregards a spectrum of conditions aligned to the term neurodivergence. Overall, improving and assessing the baseline in regulations and policy, by considering neurodivergence, can help to improve inclusive design.

2.1. Inclusive Design applied in the Built Environment

As shown in the FRS data, the demand for accessible and inclusive spaces has been prominent for many years. Although the Equality Act imposes duties to make reasonable adjustments and provide equality of service, it does not say how the built environment should be altered. This is provided through the Building Regulations; approval of these regulations is mandatory for all new buildings, extensions, and material changes. This is currently one of the ways inclusive design is integrated into the built environment. Fig. 1 below shows a breakdown of key laws, standards, and organizations that further feed into integrating inclusive design into the built environment within the UK.
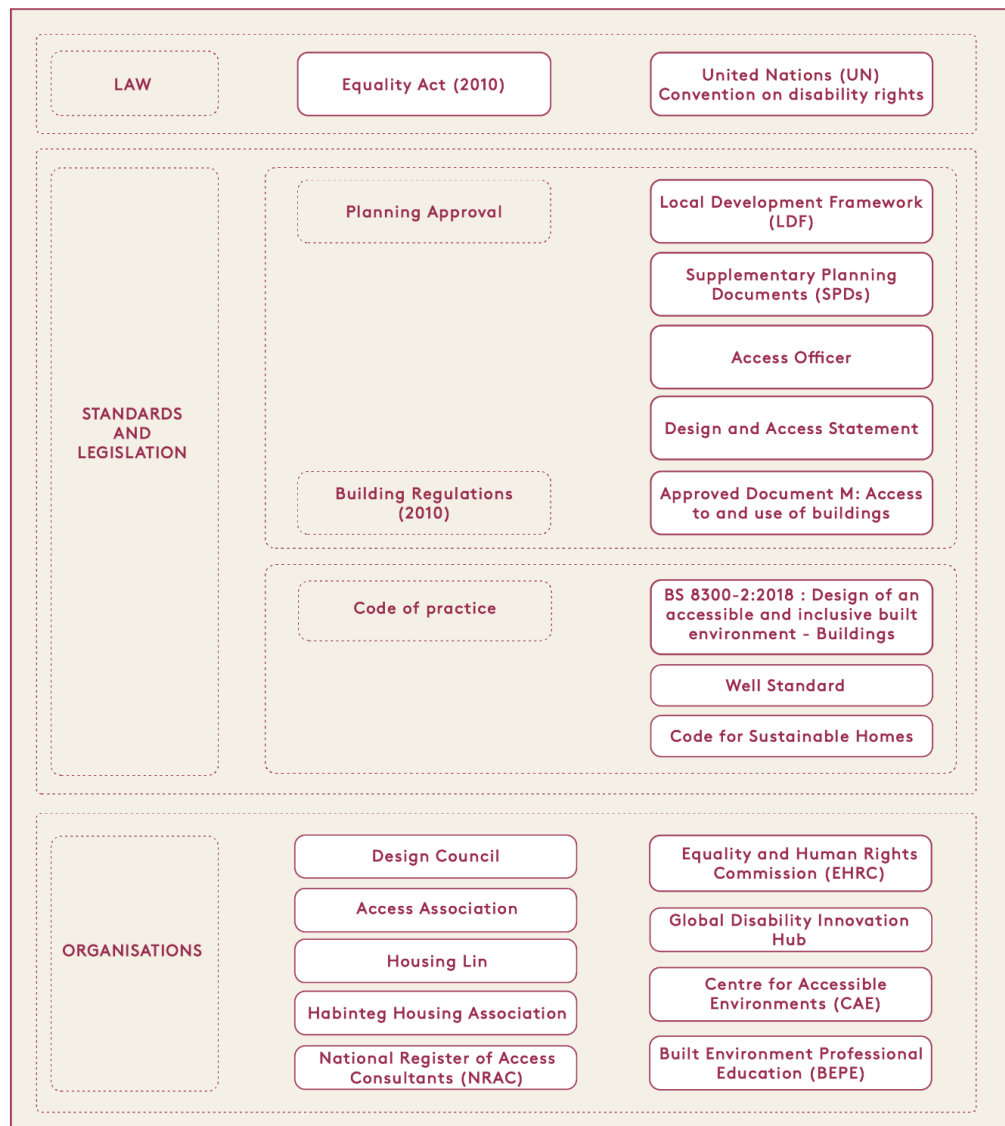
Figure 1. Overview of influential Inclusive Design organisations, guidance, and legislation.

As shown in the diagram, there are many standards and guidance documents that aid adjustments within the built environment. The Approved Documents are a series of guidance documents in the UK that provide practical advice on ways to comply with building regulations, and access and inclusive design professionals most commonly refer to Approved Document M: Access to and use of buildings (ADM), often also referring to BS 8300-2:2018 that provides additional guidance.

These guides are useful at providing minimum criteria for the design of buildings, and are largely developed via lived experience. For example, after the Grenfell Tower disaster, the government issued a review of the building regulations and fire safety (9), which would not have occurred without the tragedy and the lives lost. These building

regulations have been described as the 'least acceptable solution' (10) and seem to largely hold issues at their creation; as Imrie states:

"*The regulation is based on a **medical** conception of disability that assumes that the primary problem for disabled people, in gaining access to dwellings, resides **with their impairment**" –* (Imrie, 2004, p.421)

This describes a sense of blame to the person with the disability; an idea that Imrie goes on to highlight as a widespread view amongst the industry, hence disregarding of the Social Model of Disability.

It should be noted that designing for wellbeing is not prominent in the approved documents; terms such as 'well-being' and 'mental health' were searched for throughout ADM, finding no occurrences. Furthermore, terms used to represent some non-visible disabilities, including conditions such as 'autism' and 'dyslexia' also found no occurrences. This highlights a clear lack of mandatory guidance surrounding non-visible conditions.

3. Neurodivergence and the Workspace

The need for accessible workspace design can be justified by considering demographics, and thus the users to design for and with. For example, in England, Scotland, and Wales, and under the Equality Act 2010, a person is considered to have a disability if they have a physical or mental impairment that has a 'substantial' and 'long-term' negative effect on their ability to do daily activities. The Family Resources Survey (FRS), an annual report providing statistics about the incomes and living circumstances of households and families in the UK, reported that in 2019/20, 22% of people reported a disability, roughly equivalent to one in five (12). Mobility conditions appear to prevail, with mental health conditions rising from 25% to 29% of the total reported cases. Thus, the sector of people that have reported a mental health related disability is very large, equating to approximately one in fifteen of the population. Designing without proactively considering the broad range of disabilities, is therefore, not acceptable.

Furthermore, the breakdown per age group shown in Fig.2, highlights, in more detail, the distribution over 'visible and non-visible' disabilities, i.e., mobility and mental health conditions, respectively. It concludes that for working-age adults (16-64), 42% reported a mental health condition; further emphasizing the need to provide inclusive workspaces. The age groups also do not add to 100%, implying respondents reported more than one condition; reinforcing a need for intersectional and broad inclusive design.
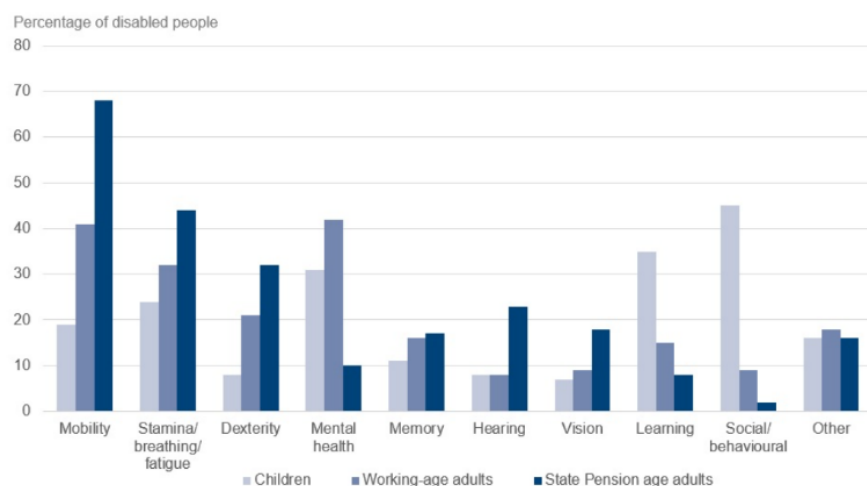
Figure 2. Family Resources Survey, 2020, Percentage of people with a disability per age and condition. (12)

When considering workspaces, we should also consider neurodiversity. This term refers to the different ways our brains work and interpret information; most people are neurotypical, which means their brain functions in the way society expects it to. About 1 in 7 people are neurodivergent (13), meaning that their brain functions, learns and processes information differently; this includes attention deficit disorders (ADD or ADHD), autism, dyslexia, and dyspraxia. It should be noted that most forms of neurodivergence are experienced along a spectrum; the associated characteristics vary from person to person and can change over time (ibid.). Beyond the large number of people reporting being neurodivergent, most neurodivergent people are highly functional individuals, occupying different roles in the workforce, hence this is relevant in the design of workspaces. Considering the limited research on the way in which neurodivergent people operate in workspaces designed for neurotypical people, it is essential to explore this further.

3.1.Perception and the Social Model of Disability

Additional to the physical environment, social attitudes regarding disability must be considered to improve workspaces. As mentioned by Disability Rights UK, the perception of a disability is still a barrier faced by many people with disabilities. The disability equality charity, Scope, published a report in 2018 (14), highlighting the Disability Perception Gap. Their research shows the public continuing to stereotype and negatively view people with disabilities; it reported, one in three people see disabled people as being less productive than non-disabled people (14). Furthermore, one in three disabled people feel that they face a lot of prejudice, however, only one in five non-disabled people say there is a lot of prejudice towards disabled people (ibid). Scope states that workplaces must tackle attitudes and misconceptions to encourage more disabled people in work.

One way Scope proposes to tackle these attitudes is using the Social Model of Disability which is part of their 'Everyday Equality Strategy', aiming to change attitudes towards disabled people. Scope describes it as follows:

"The model says that people are disabled by barriers in society, not by their impairment or difference. Barriers can be physical, like buildings not having accessible toilets… removing these barriers creates equality and offers disabled people more independence, choice and control". – Scope, 2018

This highlights the importance of removing barriers within daily life; and thus reflects the mentality that designers should embody when designing. Thus, a key principle of design is to create spaces where such barriers are removed, this is how designers think of ergonomic features or systems that aid the occupants (ex. lifts, lightning, acoustics, etc.). So, while the principles of design are not being changes, most of these features need to be reconsidered in a more inclusive way.

3.2. Recent Trends in Workplace and Library Design

To identify the inclusivity of current workspace design, a consideration must first be made regarding current trends in workplace and library design, identifying the overlaps between obtaining optimum productivity and happiness, with a focus on inclusivity.

The design of workplaces aims to improve work performance both in quantity and quality (15). The most recent feature of most contemporary offices is the increase of open plan working and 'hot-desking'. Open-plan working, where smaller office spaces have expanded to encompass open grids of desks, (16) has shown negative and non-inclusive impacts; work performance in terms of information flow and cooperation became less pleasant and workers missed their privacy (17, 18). Similarly, hot-desking, where employees can work wherever a space is available, also shows negative impact on employees due to the uncertainty when seeking a new space each day (19), the lack of personalisation of a space and increased levels of distraction and distrust amongst colleagues (20). Re-

emphasising its lack of inclusivity, additional to the induced high levels of stress and mobility demands of moving regularly through the space. Similarly, this implies a lack of spatial efficiency, refraining from maximising the current layout effectively, impacting the overall sustainability of the internal space.

Promisingly, serious considerations of different student learning styles has begun to influence the interior design of libraries (21); such as the importance of creating comfortable, quiet and safe environment for self-regulated learning activities (22). Li et al, also suggest separating self-study areas into purely reading and purely working, this feature is representative of the recent trend of quiet spaces in building design, which aim to tackle stress and sensory overload (8). Sadia (8)also identifies that there are contradictory user needs; this aligns with the College of Estate Management (2010):

*"For example, dropped kerbs, **essential** for wheelchair users, can **confuse** visually impaired people unless tactile surfaces or audio signals are incorporated."* – (CEM, 2010, p.4)

Although both papers (Sadia's and CEM's) identify the conflicting nature of designing for specific needs, Sadia's report is driven by the mentality of designing with a specific end user, whereas CEM speaks to the broader picture (with examples such as the one above). Sadia has thoroughly analysed responses from people with autism in designing quiet spaces, however this has detached the qualitative nature of responses and has relied more on quantitative values, reducing the personalisation and adaptability provided by individual thoughts and comments.

3.3. Individuality and Spaces

As mentioned in the design of libraries and workplaces, there is a demand for personalisation and privacy. Similarly, when considering the goal of maximum inclusion and work performance, the importance of individuality when achieving these goals must be noted; every person works and studies at different speeds.

Bossaller et al, proposes that the two concepts of 'ba' and 'flow' should be used to design library spaces based on the human need for concentration. 'Ba' describes the ideal physical and mental conditions for knowledge management; representing a contextual space where knowledge is exchanged and shared and relationships emerge (23) and 'flow' (24, 25) describes the state of absorption and intense concentration (26). Together they identify a positive and productive performance criterion. An important physical takeaway from this research is the importance of 'zoning' and its relevance to individual workspace and play (27).

However, the effort assigned to a task is ultimately subjective; it is representative of multiple factors including physical and cognitive abilities, and well-being of the person carrying out the task. This raises the question of how we can create and understand spaces for a spectrum of needs. One way of developing our understanding of people and space is through working with people with a disability. For example, a phenomenological inquiry into how people with a visual impairment use their space highlighted key details that may not have been reached by someone without this condition; key conclusions were met, such as the person's reliance on familiarity of a space to use it more comfortably, and installing a window upside down for ease in opening (28). Familiarity of a space is also a need for many people with dementia (29); hence the transferability of inclusive design.

Conclusively, understanding the spectrum of needs and barriers experienced by people is most effectively reached by working with the end-user and recognising that achieving optimum inclusion and work performance is achieved through individuality and adaptability.

3.4. Future of Workspaces

Spending a prolonged amount of time within a space ultimately impacts how the space is used. Due to the COVID-19 pandemic, many bedrooms and living rooms have been adapted to be home offices and study spaces. From a business perspective, home-based 'teleworking' (remote-working using technology) has become an urgent solution with minimal cost (30), however it thoroughly depends on the type of activity, ex. activities that require model-making may require access to specific equipment in a workshop. It is too early to identify whether this will continue into the future, however many offices are beginning to propose flexibility in work environments; over 87% of people stated their desire to work from home for at least part of the working week (31).

Furthermore, from a spatial design perspective, the post-pandemic office and home space may adapt, with the increased demand for more garden spaces and internal partitions (32). To understand this further, two approaches have been taken; a thorough identification of relevant literature and a survey understanding how people have adapted their spaces. Through these, alignment, and conclusions can be drawn (see section 7, Analysis and Discussion).

Looking forward at the ways in which inclusive design and accessibility are changing in the digital world provides an interesting exploration into the mentality of the design process. This will update the design process to actively promote inclusive design and reframe how disabilities are displayed.

3.5. Persona Spectrum

The concept of the 'persona spectrum' is commonly used in digital design and could lead to a positive impact that aligns with the design of physical spaces. In summary, the Persona Spectrum is a mentality and method of considering a range of users to inform solutions. Microsoft's Inclusive Design Toolkit (33) reinforces the idea that 'points of exclusion' (i.e. where users may find difficulty in using a product), helps designers to generate new ideas and design inclusively, mentioning that:

"*Designing with constraints in mind is simply designing well*" – Shum et al. (33)

To reiterate: this focuses on mapping human abilities on a spectrum to inform solutions that inevitably benefit everyone, as shown in Fig. 3 (34).
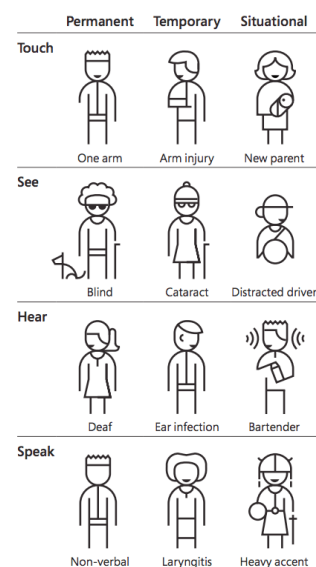

Figure 3. Persona Spectrum – Microsoft's Inclusive Design Toolkit (33)

This focus on studying user-interaction is replicated in community consultations that take place in the design of physical spaces. The aspect that seems to demand improvement in consultations is this understanding that studying the strategies and solutions developed by people with disabilities and those in the persona spectrum, can stimulate the design process and is vital in promoting innovative and effective spaces (2); conclusively what we design is a result of how we design (33). Potentially, we need to re-assess the regulations provided a spectrum of users and scenarios; leaning into the realistic wider range of users we design for.

4. Summary of Design Features

To further aid the methodology, a summary of the most commonly addressed factors relevant to the design of an inclusive workspace and the relevant literature have been listed below.

4.1. Interior Design

Furniture

The relevance of furniture within inclusive design lies heavily in the study of ergonomics i.e. the interaction of people and elements of a system (35). For example, a good ergonomic chair would have an adjustable seat and arm rest that aids comfort and promotes wellbeing (36). These features are important when considering the intersection of disabilities and designing for adaptability (adjustability and independence).

Furthermore, the design of workspace furniture can impact health. For example, the distance to a computer monitor affects eyestrain, and poor chair design/setup can lead to incorrect posture and musculoskeletal problems (37). It should be noted that the standard IS0-9241 – which covers the ergonomics of human-computer interaction – has been criticised for not including the expected variation in body size among user populations, being too abstract and not representing an inclusive mindset (38).

Layout

As mentioned earlier, the familiarity of a space is vital for certain user needs. People with dementia are known to benefit from a sense of familiarity (39, 40). This is similar for those without dementia – a familiar environment filled with physical memories '*promotes a sense of coherence… supporting the continuation of self*' (40). This importance of familiarity with physical memories (such as photos and memorabilia) reiterates the earlier mentions of the value of personalisation in a space.

There's also a demand for separation through the introduction of partitions to divide specific spaces for specific uses (22). Colour can be used to create this separation by painting borders or presenting clear signage; this is important for wayfinding and informs people of how to use a space (41). It is also suggested to incorporate multiple types of signage, i.e., text should be provided alongside an audio option, and/or tactile labelling; for a range of sensory impairments as well as temporary and situational needs (see Persona Spectrum, Fig. 3).

Room Decoration

Similarly, to the familiarity of space provided through memories and objects, calming images and artwork can influence wellbeing. A study in 2003 of chemotherapy patients who were exposed to rotating art exhibitions, showed reductions of 20% in anxiety levels and 34% in depression (42). It should be noted that people could experience sensory overload depending on the colours and contrast used in the artwork (43), hence involving users in these decisions is vital.

Furthermore, biophilic design (using nature to increase user connectivity to the natural environment) has appeared to positively impact work productivity; a report in 2018

showed a decrease in negative emotions and better short-term memory performance (44). Sadia's study of quiet spaces as mentioned earlier, also shows preferences for nature-orientated quiet spaces for people with autism (8), re-iterating the calming impact of biophilic design.

4.2. Environmental Design

Lighting

As lighting affects our circadian rhythm (the natural internal process that regulates sleep-wake cycles), when unregulated, it can induce fatigue and mental drowsiness. Replicating the typical daylight rhythms proves to be most effective at creating productive environments by regulating the circadian rhythm (45). Recreating daylight with artificial light is still under-developed, however certain settings, amounts and temperature of light can be used to emulate daylight, though it still emotionally impacts occupants (ibid.) due to its artificiality.

There are also positive effects of having control over the lighting of a space; in a study where a company gave full control to the employees over the internal environment, productivity increased by approximately 15% (46, 47). Similarly, this sense of independence and autonomy is re-affirmed by individual conflicting preferences; someone may prefer to work in cooler light as opposed to warmer, hence returning to the earlier point of the value of personalisation within a space.

Thermal Comfort

Similarly to Kroner's study of control, the ability to open windows for natural heating and cooling, as well as ventilation, also showed positive impacts on productivity and reduced stress (45). However, this could lead to conflict in the workplace due to differing temperature desires; although, like lighting, individual appliances (such as lamps and radiators) could accommodate for this. Similarly, Grigoriou describes the conflicting feeling from hot and cold spots near glazing, similarly below certain parts of a HVAC system.

Expected air temperatures can then be used to plan workplace areas, where this is also clearly signed to ensure people are aware of the differing temperature. For example, people experiencing menopause or who are sensitive to temperature imbalance may desire clear signage of how the internal environment has been set and where they could work comfortably. Furthermore, a study carried out in 2013 showed that the majority of women working through menopausal symptoms found hot flushes particularly difficult and impacted their work performance, similarly a sense of discomfort when disclosing this to managers (48). This provides evidence to improving independence and control within the workplace, whilst also improving perceptions of conditions.

Acoustics

Sound appears to largely impact learning; lower background noise levels increases speech audibility and clarity, and this can be implemented by avoiding high ceilings and reverberant surfaces (49). A study into the effect of sound on office productivity further affirms the importance of lowering background noise; it found that as a whole, limiting the sounds of doors closing and human activity can improve productivity (50). As mentioned in the limitations of the study, hearing impairments across age was not considered, however, the results showed less environmental impact on productivity of the younger age group (ibid.).

Although silence appears to prevail regarding acoustic design, recent research into the idea of 'sound masking' poses a second option to 'mask' the typical murmur of HVAC systems with calming sounds to also increase sound privacy (51). This is confirmed by a study into the restorative quality of nature; by highlighting the improved wellbeing of enjoying biophonic sounds (52). However, this can be distracting and confusing for people with a visual impairment or who rely on their hearing for wayfinding.

5. Methodology

5.1. Overview and Goals

Following on from the literature review highlighting how we work and study, and how our space can further support this, the aim of this study is to better understand our demands of our work/study spaces, and how we can independently adapt them. Given the prolonged period people are spending within their remote-working spaces during the COVID-19 pandemic, this provides an abundance of information regarding how we independently adapt our spaces. This method is very similar to a study carried out in 2018 titled 'How do you work?'; understanding user spatial needs within a university (53). The researchers sent out a survey with a mix of open-ended and multiple-choice questions, to aid the design of a library. However, the analysis was largely quantitative and fell short of qualitative analysis; reaching the conclusion that their library could be anywhere, although contradictory to the greater separation/zoning effect presented by a library.

In this study, a mix of qualitative and quantitative survey questions was sent to various members of staff and students at a large university in the UK; to allow for further understanding of attitudes and drivers. From this, a sequence of coding (the process in which words and/or themes are taken from the qualitative data and used as 'codes' or labels to categorise and organise data) was undertaken, to extract themes and quotes, and analyse conclusions into prescriptive and performance design factors; to aid the design of inclusive workspaces.

5.2. Method of Data Collection

5.2.1. Survey Overview

The full survey can be seen in Appendix A and the survey received institutional ethics approval. As mentioned in the overview, the main goal was to increase understanding of users and further confirm the literature findings. A Mixed Method approach has been taken, with both quantitative and qualitative results. This is due to the likelihood that many parts of the results will contradict themselves (54) and so having the original thoughts and text, aids the quantitative results.

Two samples have been collected; both consist of people either working or studying, mostly remotely (as opposed to on campus) as per UK Government guidelines. Sample A consists of 60 students and staff within the same department. Their relevance to the main goal applies to understanding users and their work/study setting.

Sample B consists of 15 members of staff at UCL, who are part of the Neurodivergent Staff Network (the members of the network identify as autistic or dyslexic, have Tourette syndrome or ADHD) and Enable@UCL (a staff network open to any disabled person working at UCL as well as non-disabled person with an interest in promoting disability equality at UCL). Choosing a variety of networks allows a larger scope for identifying conflicts between disabilities and user needs, there is also a noticeable gap surrounding research of neurodivergence and the built environment.

The survey was circulated via the course administrator and the individual network contacts listed on their university page. Both surveys were circulated once and closed after three weeks, to reduce the risk of fatigue and prevent duplicates (although these were removed in the first stage before assembling results). 63% of respondents from sample A work/study in their bedrooms; this is different to the spread demonstrated by sample B. However, this may be related to the demographics of the samples and the comments made; Sample A consisted largely of 18-24 year olds who, based on the circulation of the sample, are likely to be students in family homes (as many universities have switched to remote-learning) (55).

5.2.2. Method Strengths

The mixed method approach should prove effective at ensuring answers are thorough and relevant to the question; the quantitative results (e.g. lighting impacting wellbeing the most) will be compared to the qualitative (e.g. how certain levels of lighting keeps the respondent feeling awake and alert) allowing more succinct user understanding. Similarly, the method of cross evaluating these responses with literature should highlight key factors going forward into the design of workspaces and understanding how we work. Thus, another strength is the sample size; Sample B allows for a thorough analysis due to fewer responses. The questions focus more on attitudes as opposed to physical design features as these are largely covered within the literature. Although this makes it more difficult to find alignment in the abundance of literature surrounding these features, it explores a relatively new angle to the overall design of workspaces (focusing on performance as opposed to prescriptive goals).

The two samples also have a diverse set of expected activities: ranging from working to studying to creative tasks. This additional information provided by recognising the value in individual responses is new, due to the limited exposure to this level and intensity of remote working.

5.2.3. Survey Questions

As mentioned, the full list of survey questions can be seen in Appendix A. The survey questions were aligned to the goals of the methodology.

When creating the survey, it was also important to consider survey response fatigue, a sense of overwhelm due to a growing demand for responses, and survey taking fatigue, which occurs during the survey and a result of very long surveys with little application from the respondent (56–58) . To avoid this, shorter survey questions and mixed methods are suggested, this is to reduce the open-ended questions and ensure the survey is doable in five minutes. From an inclusive design perspective, it is also important to be mindful about the questions being asked and the language used, and provide reasons regarding demographic questions (59).

Appendix A Table A.1 shows a breakdown of the questions regarding the overall theme (with a brief reasoning) and question details and type. As the table shows, there are more multiple-choice questions (to avoid fatigue) and they are also used to break up the open-ended questions. Multiple choice questions are also used to ease the respondent into the survey to understand the overall scope without unconsciously impacting their response; later in the survey, specific spatial features such as acoustics, furniture and thermal comfort are used to generate more ideas and space-evaluation. Similarly, the demographic questions are placed at the end as this is in line with the Social Model of Disability; this information is additional to the main understanding of their space as opposed to being the focus.

5.3. Method of Analysis

As a mixed method approach, two overarching methods of analysis are used, one for the quantitative questions and one for the qualitative. The quantitative analysis method would encompass the multiple choice and checkbox questions, and the qualitative analysis method will focus on the open-ended questions.

The quantitative analysis method largely focuses on demographics and identifying extremities regarding user preference, e.g., their age and highlighting what aspects of their space contributes the most to their wellbeing. This method quantifies the responses, to show whether there is correlation in what features respondents want most in their spaces or the overall adaptability of their space, these will then be graphically presented to see trends (see section 6, Results).

The qualitative method focuses on the open-ended questions; using 'coding', also known as labelling the data, to identify key repeated themes (54). Through labelling the

data, key mutual themes are identified that describe relationships between the survey responses. There are multiple ways to do this; either quantifying repeated words across all responses, or intuitively reading and extracting themes (ibid.).

The first cycle of coding (i.e. the researcher's first level of reading and analysing the data) is to typically quantify the repetition of themes or words, although this may be more time-efficient for the larger sample, it risks limiting users to numbers as opposed to specific experiences and thoughts. Thus, it is more beneficial, especially for sample B, to keep the original content and search for alignment in addition to quantification; this is done by counting and providing corresponding examples. This is known as 'In Vivo coding', using the participant's own language as the code (ibid.). The second cycle of coding aims to identify key conclusions and more critical evaluation; by reconsidering new themes and alignment from the quantitative results. This is done by comparing codes from the first cycle and condensing into smaller units such as themes and concepts; focusing on questioning the results of the first cycle to aid explanations or patterns. The data will also be compared to the literature read to identify whether there is clear alignment with previous research and reinforce conclusions.

Furthermore, there will be significant overlaps and contradictions between data due to the overlapping themes mentioned in the survey (60); and hence the importance of the mixed-method approach and considering the responses from both quantitative and qualitative analysis (61). The qualitative data is presented as explanations or patterns, whereas the quantitative is visually represented through graphs and figures; ultimately when analysis takes place and the methods are integrated, one takes slight priority of the other (likely qualitative for a more user-focused approach) (62). The mixing of the approaches occurs in the study design stage at the start, and during the interpretation of the outcomes of the entire study during discussion (ibid.).

5.3.1. Potential Limitations

The abundance of data from sample A (60 respondents) may prove difficult to analyse; the literature review highlights the importance of individuality in workspace design, however this larger sample risks generalising experiences (63). Although this allows for a larger scope of information for the quantitative responses, it limits the attention each person receives (64, 65). Creating a personalised approach, much like the Persona Spectrum, could be more effective. Overall, this can be mitigated by spending more analysis time on evaluating the qualitative data and extracting key quotes using the method explained above.

Some of the questions are also broad; although this prevents survey fatigue, the responses are limited by the restraint implied by the question. For example, having a more response-based survey may be more effective, i.e., if the respondent states lighting as most impactful to their wellbeing, asking more related questions specifically to this. This also suggests a focus group approach, however, would require more time from the participant.

6. Results

For fluidity in presenting the results, the themes have been arranged in the same order to Appendix A, Table A.1. Furthermore, chart formatting has additional labels and outlines, different levels of bar darkness in the charts, with clear section themes, for improved clarity. Discrepancies in total percentages are due to ± 1% rounding error.

6.1. Spatial Context & Overall Use

The survey first interrogated where the participant worked and if they worked at home, they were then asked where in the home they worked. As shown by Fig. 4 and 5, most respondents in sample A worked in a bedroom at home, whereas in B, there was more diversity in where they would work. The quantitative data is missing information regarding overall room availability, however participant responses to 'why have you

chosen this area?' (Table 1 and 2) should highlight personal availability. Furthermore, comparing the left and right graphs shows that regardless of available space (i.e. the multiple rooms in a house), most participants in Sample A work/study in their room. Overall, the location is less the purpose of the study than understanding how the space, even if limited, is used.
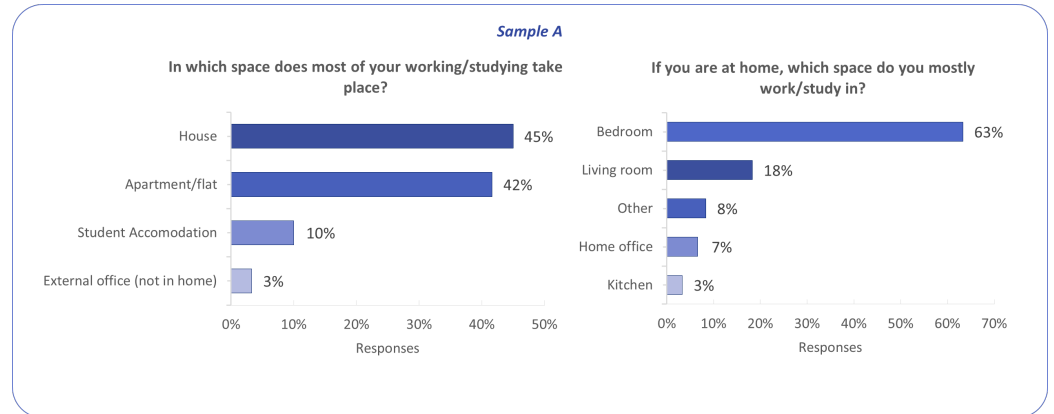
Figure 4. Location of work/study amongst respondents. (Sample A)
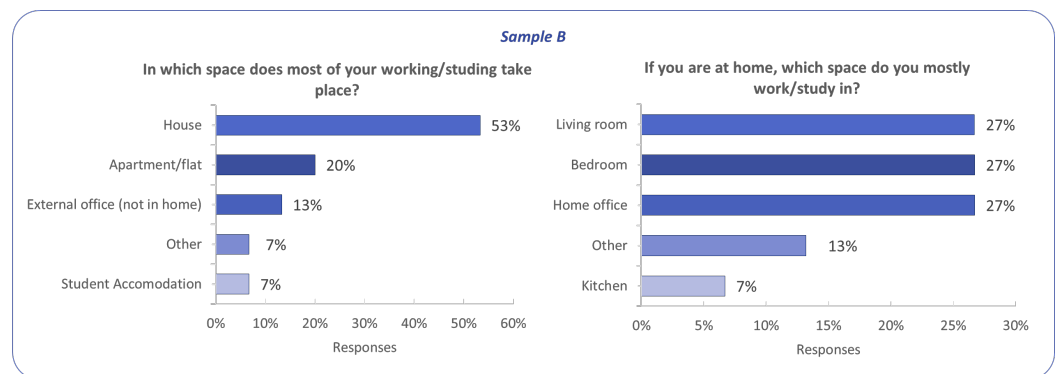
Figure 5. Location of work/study amongst respondents. (Sample B)

Most of the participants did not vary where they work (Fig. 6 and 7) i.e., remained in the same space for most of the day; again, this may link to limited availability. In the 'other' category, a respondent mentioned occasionally working in the library if available. Most also did not share this space with anyone, highlighting a desire for privacy and solitude.
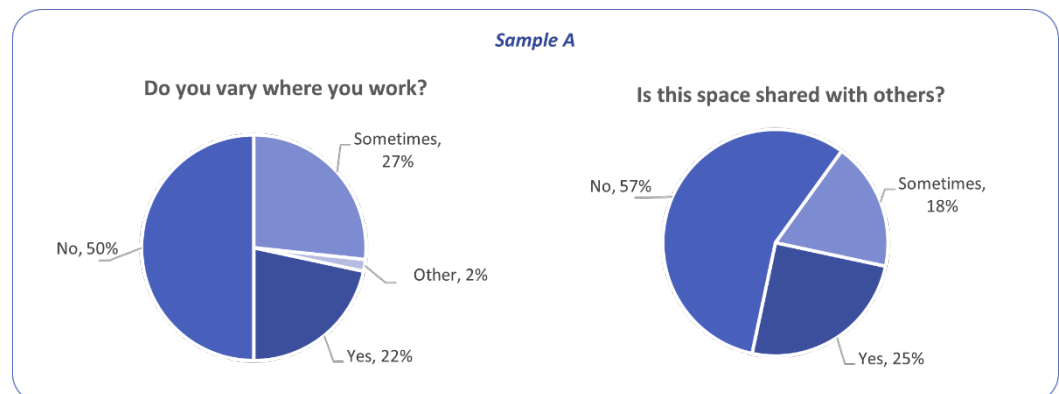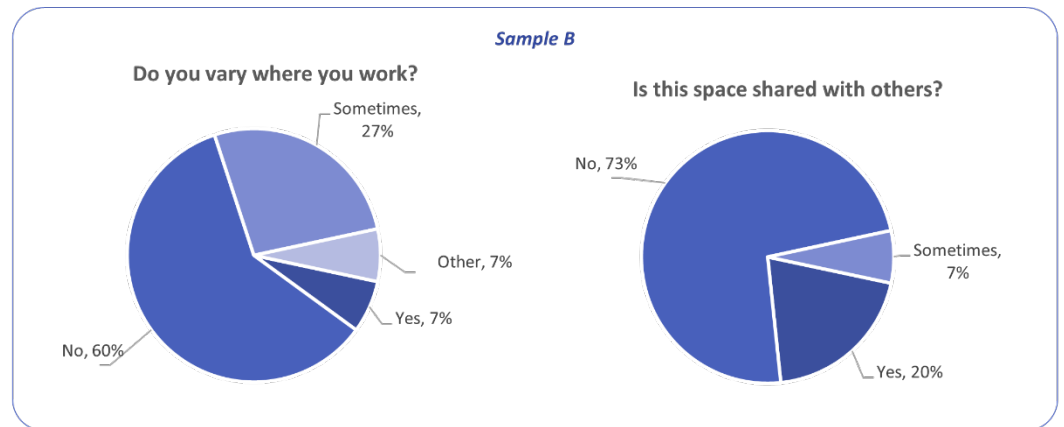
Figure 6. Further context regarding overall space. (Sample A)

Figure 7. Further context regarding overall space. (Sample B) 548

The respondents were then asked why they had chosen this space (Table 1 and 2). 549
These responses were split into a variety of themes ('codes' as described in section 5); the 550
most common being 'convenience' amongst A, and the 'location of furniture' for B. This 551
begins to answer the questions of availability raised earlier, and raises questions regarding 552
design drivers within workspaces, i.e. quiet space, natural light, views. 553

Table 1. Why have you chosen this space? (Sample A) 554

Category/key theme	Count	Examples
Convenience	14	Only free space in the house
		The only big enough space in the house, don't like being in a small room
		It's my only choice at the moment
		Little other choice
Lighting	11	Good natural lighting
		It has a desk and some natural light
		Larger room, big window: natural light
		Because of the view, natural light and privacy
Sound	10	Quietness and comfort
		It's the only quiet space that is not shared'
		well ventilation and lighting with low noise
Furniture	9	It has a large desk with a monitor to work at
		nice desk set up with extra monitor and mechanical keyboard
		It has a desk and some natural light
Solitude	7	most private space there is
		It's the only room in the house where I can be alone (no other people/pets to distract me). When I'm in London I work in my student accom bedroom as well.
		It's a room not used by other people in the house
Size of space	4	quiet and large space
		larger room
		it was a room not occupied by someone else. It also gives a lot of daylight and is spacious enough to work in.
Not being alone	2	space for desk, well lit, i prefer to be around others not alone
		Struggle to work alone so it's nice to be in the kitchen where people come and go. Also struggle to keep still so always moving between rooms

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Table 2. Why have you chosen this space? (Sample B)

Category/key theme	Count	Examples
Furniture	6	it has a table to work at – nowhere else does
		it has my enlarged monitor (I have a visual impairment)
		the living room is the only room in my flat with space to set up a desk
		already has a desk in it
Lighting	4	control over lighting
		natural light and no distractions
		it is at the top of the house, quiet with lots of natural light

6.2. Spatial Changes & Individual Use

Once easing the participant into contemplating their workspace; further questions were asked regarding their overall use. The respondents were asked whether any changes had been made over the past year (Fig.8), this identifies specific categories that hold barriers to the use of their space. By asking this, we also begin to learn the priorities of the user, identifying what they can physically change by themselves and what matters the most to them to change. The most common category was 'furniture' with 36 responses for Sample A and 13 responses for B.
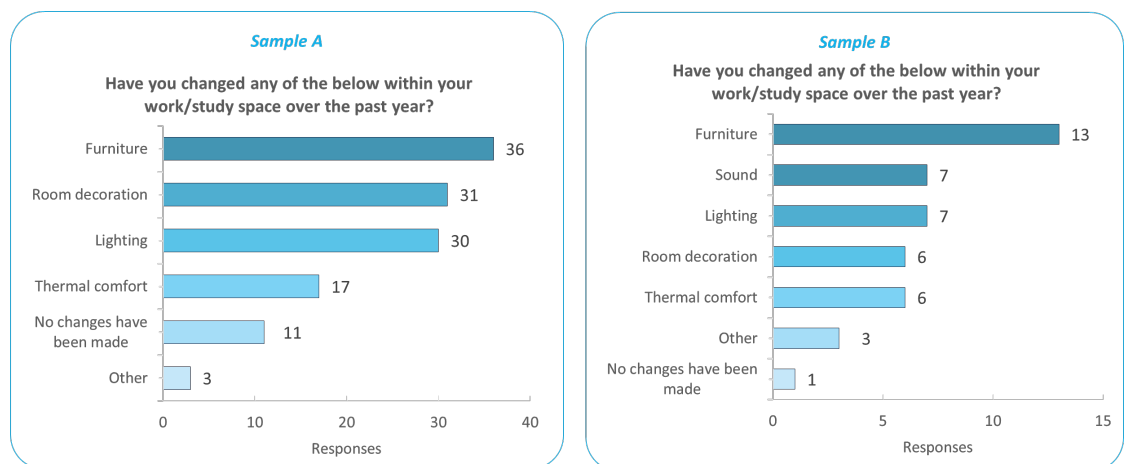

Figure 8. Recent changes made by respondents.

In-light of the previous question, respondents were then asked why they carried out these changes (Table 3 and 4). The most common driver from sample A was their mood; with the aim of becoming 'more motivated and concentrated to study' and improving their overall work efficiency. For sample B, furniture, room decoration and mood, played a larger factor in why they carried out changes. From this and the previous results, we begin to understand the user's beliefs in what generates a positive work environment, and how they have created this for themselves.

Table 3. Regarding the previous question, why did you carry out these changes? (Sample A)

Category/key theme	Count	Examples
Mood	28	more positive work environment
		improve work efficiency and health
		more motivated and concentrated to study
		to make it feel more like home
Furniture	14	furniture was added to accommodate ergonomic working conditions
		when I get bored I tend to rearrange my room
		less seating because no guests

Lighting	9	with online university, light was important for the camera
		lighting because it used to make me sleepy
Thermal Comfort	7	it was freezing
		a winter garden the room is not designed to sit still in all day during winter months, so a heater has been added to make up for that

Table 4. Regarding the previous question, why did you carry out these changes? (Sample B)

Category/key theme	Count	Examples
Furniture	3	Laptop stand to relieve neck and shoulder pain
		I changed my chair as I was very uncomfortable
		new office chair to help with back
Room decoration	3	Painted walls for a change in scenery and to brighten room up
		being able to see houseplants
Mood	3	to make the space more friendly and able to stay and work for longer periods
		to handle better the 'work in prison' setting (12m2)
Lighting	2	tend to only work with angle-poised lamp on next to me now, no overhead light
Thermal Comfort	2	Needed to buy a heater as it was freezing
Sound	2	noise-cancelling headphones to block out noisy neighbours either side

The respondents were also asked whether any barriers continue to exist within their space (Table 5 and 6). This question reiterates the Social Model of Disability, but also blatantly requests areas of improvement from the participant. The most common response for sample A was the separation aspect; 'can't seem to relax as my home is also where I work'. Sample B reiterated the previous answer with a focus on furniture.

Table 5. Similarly, are there any specific barriers you continue to experience in your space? (Sample A)

| Category/key theme	Count	Examples
Mood	13	distinction between work and relaxation
		staying in a single space makes me feel a bit constrained
		loneliness
		can't seem to relax as my home is also where I work
		motivating yourself to do work in the same space you sleep
		not a separate space where I can detach myself from others
Furniture	10	not enough space for me to be organised as I would want to be (additional cupboards, shelves, bigger bookcase)
		tiny desk
		chair is not very comfortable
		could use more desk space
Thermal comfort	6	still freezing
		no heating systems so can get quite cold
Sound	5	lack of complete quiet for studying (I live with other people)
		noise anywhere in the house
		sound clashes if me and my roommate are both in calls
Lighting	4	direct sun in eyes in the mornings
		too much daylight at times

Table 6. Similarly, are there any specific barriers you continue to experience in your space? (Sample B)

Category/key theme	Count	Examples
Furniture	3	Chair is uncomfortable and no room for proper office chair desk height isn't ideal either limited desk space
Lighting	3	There are also issues with the light from the window in my room at certain times of the [day]
Thermal Comfort	2	On the few cold days, we had there was the issue of heating coming off during a short window
Sound	2	noise, at home I have the three kids, 2 dogs and 2 cats making noise.
Mood	1	It's my bedroom so I sleep and work in the same space - it has a negative effect on my mental health

6.3. Wellbeing

The respondents were also asked about wellbeing within their space (Fig.9 and 10). Again, this aims to identify key personal drivers in improving wellbeing within workspaces. Lighting appeared to be the most influential within sample A's space, however for B, furniture prevailed, and lighting was one of the least influential. This contradiction refers to the previous raised question of priority; many of the qualitative responses from B focused on ergonomic work conditions as opposed to daylight. B were also asked which contributes the least, where room decoration was the most common. The data lacks comparison from both samples regarding the barriers to positive wellbeing due to the question only offered to Sample B. In 'other' both made references to having a 'fixed place to work' and having family around.
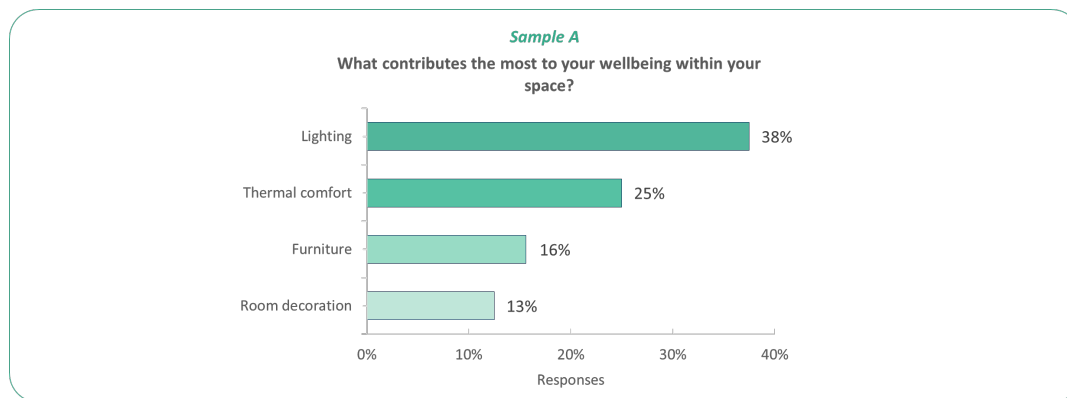
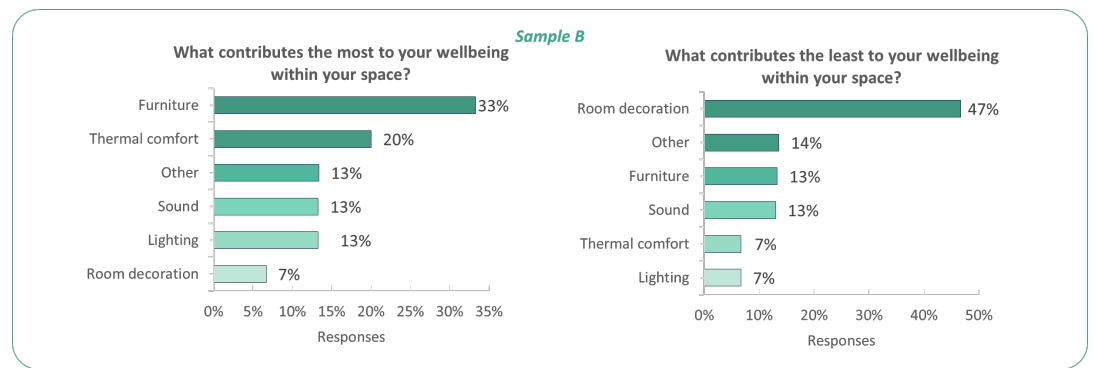**Figure 9.** Most impact on wellbeing (Sample A).

Figure 10. Most and least impact on wellbeing (Sample B).

6.4. Flexibility/Adaptability

Respondents were then asked about the adaptability and flexibility of their spaces (Fig.11 and 12). This was varied across all results; largely both samples did not describe their space as adaptable, however sample A appeared to be more in favour of more adaptability than B. This is contradictory and Tables 7-10 aim to further analyse this.
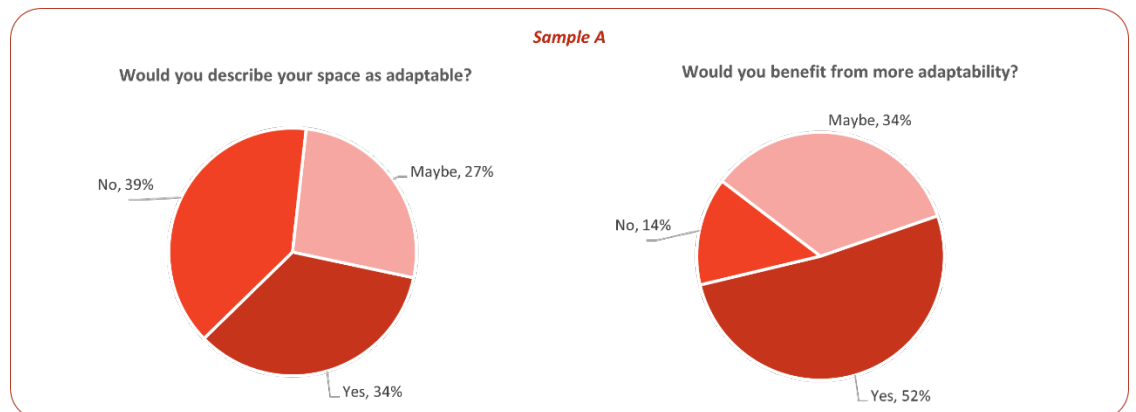
Figure 11. Adaptability within their space (Sample A).
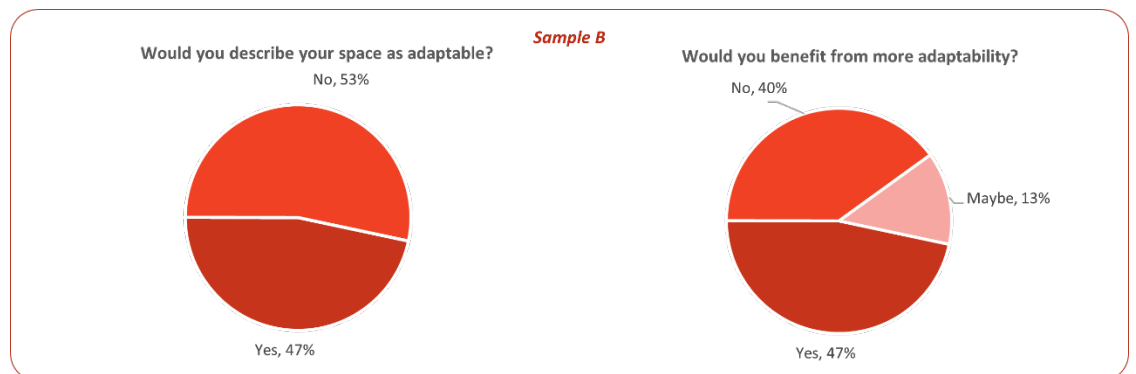
Figure 12. Adaptability within their space (Sample B).

The next question then asked the respondent to expand on this; asking why they thought their space was flexible/inflexible (Tables 7-10). This was largely to do with the furniture within this space, and the moveability amongst a fixed room size; 'limited configurations', using furniture to 'compartmentalise', 'restrictive space for moving furniture'. Although these results do not reassure the previous question, it begins to highlight innovative spatial considerations that improve flexibility (such as furniture with wheels)

as well as further determines barriers in achieving adaptability (such as room size or furniture weight).

Table 7. If yes, what makes it flexible/adaptable? (Sample A)

Category/key theme	Count	Examples
Furniture	23	desk can be altered, moved the fact that the room has a rectangular size and not a squared one helps much more to make it more flexible/adaptable I can push my furniture to the corners move the desk as it's quite portable
Mood	2	three walls are openable glazing…for an indoor/outdoor feeling it's personal so I can make more changes to it
Lighting	1	can add more lights

Table 8. If no, what makes it inflexible/unadaptable? (Sample A)

Category/key theme	Count	Examples
Furniture	20	heavy and large furniture bed and desk and shelves are all fixed I can't really move the desk around as there's limited space limit configurations of furniture in the space
Lighting	2	desk must stay close to the window in order to get enough daylight
Mood	1	simple/minimalist design

Table 9: If yes, what makes it flexible/adaptable? (Sample B)

Category/key theme	Count	Examples
Furniture	6	it is technically very open plan so I use furniture to compartmentalise wheels and ability to move the table sometimes I sit on the other side of my (centrally located) table just for a change!

Table 10: If no, what makes it inflexible/unadaptable? (Sample B)

Category/key theme	Count	Examples
Furniture	8	the table and chair cannot realistically be moved restrictive space for moving furniture around and there's quite a few pieces of furniture that would need to be moved including a double bed had repetitive injury and eyesight problem because there was not enough space for a monitor, office chair, larger desk.

Lighting	1	Lights are not dimmable
Sound	1	No door to room so cannot shut out noise

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6.5. Control

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A limitation of the previous questions regarding adaptability is the assumption regarding personal control over space. The respondents were then asked about the levels of control they had within their space (Fig.13). There appeared to be a consensus from both samples, identifying lots of control over their spaces; hence confirming the assumption.
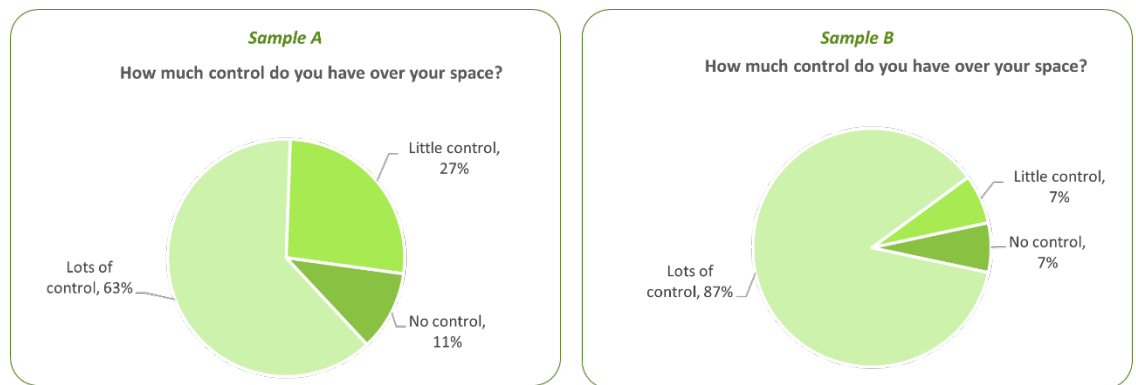
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Figure 13. Levels of control.

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6.6. Miscellaneous

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The last few overarching questions focus on what works well and overall comments (Tables 11-14). Furniture is the most common answer from both samples; 'height adjustable chair', 'nice setup easy to connect to my laptop', 'dedicated space for certain tasks'. At this point in the survey, we notice more repetition in responses; although this is beneficial in strengthening key design drivers, it may also be a sign of fatigue from respondents.

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Table 11: What works well in your work/study space and why? (Sample A)

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Category/key theme	Count	Examples
Furniture	40	Height adjustable chair makes things feel different when it's not Everything I need - bathroom, kitchen Can work in different locations, desk, floor, bed etc. which is nicer than sitting in one spot all day curtains to reduce distraction and lift up for relaxation room divider is used around my desk two tables between which I like to move around
Lighting	28	lights at night are warm coloured creating a beautiful atmosphere daylighting and privacy create a good study environment control over the thermal and lighting conditions in my space because I don't have to share the space with anyone else lamps … since they were put in different places on purpose… windows are double glazed and let a lot of light come in lots of natural light for day and lots of lamps for night
Mood	10	clear boundaries with others in shared spaces and quiet time when I have it to myself allows me to do work fixed and personal workspace… having everything set up exactly how I need/want it

		works well since it is a personal space and less distractions
		well-being: plants, bird sounds from outside, nature view from my window
Thermal Comfort		good comfortable temperature
	10	once the heating is up it is a pleasant space to inhabit
		own control over the thermal and lighting conditions
Sound	3	quiet enough to focus

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Table 12: What works well in your work/study space and why? (Sample B) 651

Category/key theme	Count	Examples
Furniture	9	a nice setup easy to connect to my laptop large desk space is vital. I also have another desk area for creative work so I can split my brain! It is hard to break tasks down as a dyslexic so dedicated space for certain tasks is key for me. As is two large screens. I need the desktop space for organisation. Desk arrangement by window - enables taking visual rest breaks and changing focus from screen to distance. Having raised monitor screens
Lighting	4	French doors to one side that allows natural light in lack of windows (it is a basement room) means daylight doesn't create glare I have natural light which helps my conditions
Room decoration	2	dark wall colour cuts down on glare in space Having art and plants nearby which bring me moments of joy and inspiration
Thermal Comfort	2	I can control the temperature Being close to heater for when it's very cold which counteracts the draught for the window at the same time.
Mood	2	My resilience and positivity and capacity not to focus on material circumstances. I have a lot of creative activities in the same space when I am off. Being on my own rather than coping with the nuisance of colleagues around me works definitely well.
Sound	1	I have the room to myself so I can control the noise levels

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The overall comments presented in Tables 13 and 14, provided a bit more clarity on 653
the rest of the responses, highlighting key features such as 'desk height' and the impact of 654
'online lectures' and 'ergonomic changes' in their remote working space. 655

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Table 13: Any other comments about your space? (Sample A) 657

Category/key theme	Count	Examples
Furniture	3	I do not find a need to adapt it since it has been well-designed and optimised for this configuration (e.g. outlets and lights/light switches in correct places) I find desk height makes quite a big difference on comfort as my desk is really quite low and so I'm always leaning forward and for hours at a time, so often have an achy back from it. developed RSI in hands, arms, elbows due to lots of computer works so had the desk, mouse and keyboard adapted to reduce pain when working online (which is always!)
Lighting	3	would be improved with more natural daylight

		online lectures…. Better when light is coming from the side or in front than behind me… quite a lot of glare on my computer screen
		not too much sunlight, it's very bothering specially when spending all this time in it
Mood	3	having too much control has made me change things more often than necessary to procrastinate from work
		very cosy and positive to be at home compared with at uni

Table 14: Any other comments about your space? (Sample B)

Category/key theme	Count	Examples
Furniture	2	I have recently made ergonomic changes like getting an external keyboard and mouse so I can position my laptop screen more effectively and that has been helpful. Biggest issue has been limited internet bandwidth available in my area and when my partner and I both have meetings so one of us has to move to a different space.
		I've been thinking about adapting the desk in my office to become a standing height worktable
Lighting	1	Other issue has been figuring out how to adjust lighting and computer screens to avoid triggering migraines - benefit of more flexibility but there is less lighting in general than on campus spaces which makes it harder for me to work in the evenings
Mood	2	It's not very nice working where you sleep
		I didn't choose to work here (i.e. only because of pandemic). I would prefer to be in my office so that I can have more separation between my personal and professional life

6.7. Demographics

Lastly a few details regarding the demographics for each of the samples (Fig.14 and 15), this reconfirms the original participant information and sample descriptions. Sample A was predominately 18-24 with fewer conditions, whereas B was more varied across age, with a majority of neurodivergent respondents.

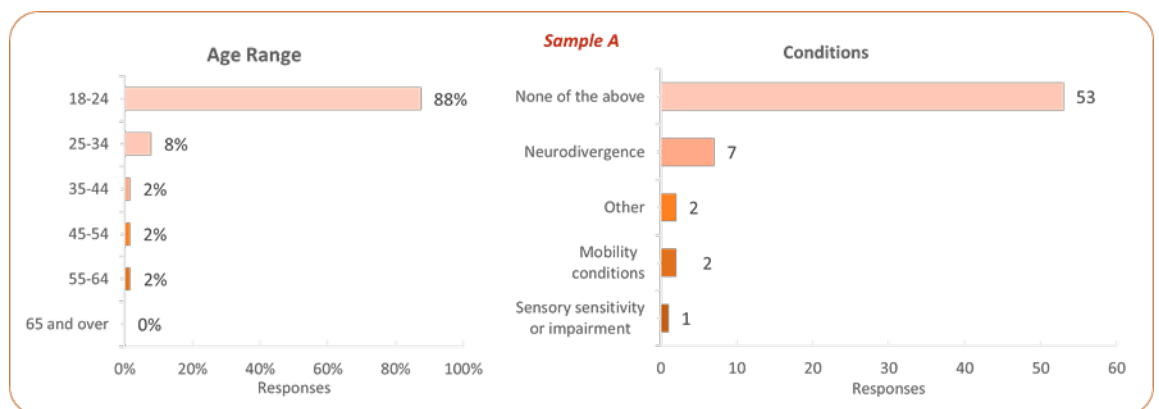**Figure 14.** Demographics (Sample A)

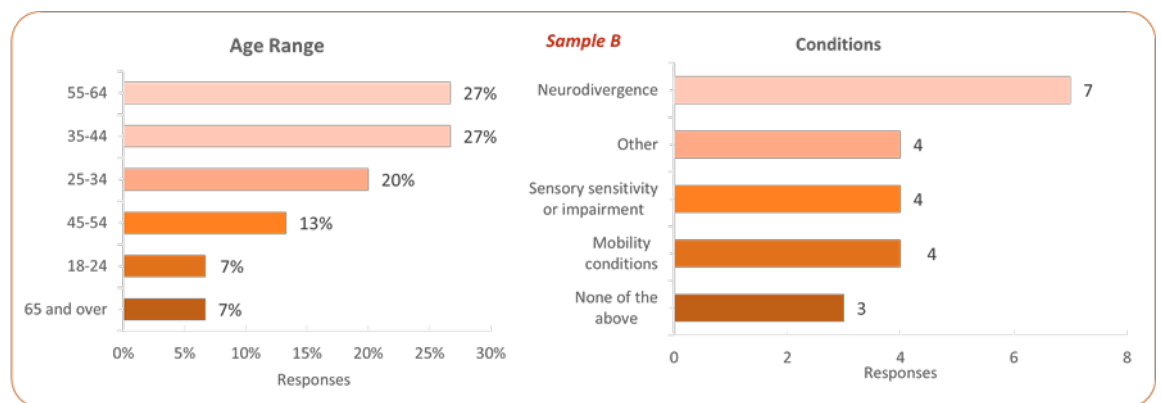**Figure 15.** Demographics (Sample B)

7. Analysis & Discussion

7.1. Interior Design

Furniture

The responses from Sample B heavily aligns with the literature findings; the most frequent responses regarding recent changes were related to furniture and specifically the repetition of ergonomic chairs and desks. This is further confirmed by Helander, describing the aid in comfort and wellbeing provided by adjustable seats and armrests (36). Furthermore, furniture appears to work the best in most respondent's work/study spaces, with many creative solutions such as 'curtains to reduce distraction and lift up for relaxation' and 'two tables between which I move around'.

Having an additional desk for a different purpose suggests a positive solution to hot-desking; rather than creating limitless options, perhaps allowing employees the option of switching occasionally. A respondent in sample B mentions 'I also have another desk area for creative work so I can split my brain! It is hard to break tasks down as a dyslexic so dedicated space for certain tasks is key for me.'. In terms of neurodiversity, research shows higher levels of creativity amongst neurodivergent individuals; creating this separation along with dedicated quiet and private spaces, encourages and supports more comfortable working environments (66, 67).

As the students in sample A appear to work on a variety of different activities that require a lot of material and space, the repetition of desk size is prominent.

Furniture contributed the most to the wellbeing of sample B. It does appear that although many positive responses were made for the furniture within their spaces, it was one of the most common barriers experienced; regarding 'limited desk space', 'desk height isn't ideal', 'not enough space for me to be organised as I would want to be'.

Room Decoration

Overall, how their rooms were decorated, contributed the least to both sample's wellbeing within their spaces (13% for sample A, 7% for sample B, with 47% of sample B also stating it contributes the least). Additionally, most of the responses directly related to room decoration were from sample B; one respondent mentioned how they 'painted walls for a change in scenery and to brighten room up'; although a creative solution to this sense of 'captivity', it could be a temporary solution requiring additional planning and mobility.

However, there are few mentions of plants, largely from sample B; 'the plant allows me to feel a sense of freshness', 'being able to see houseplants while I'm working makes me happy', 'having art and plants nearby which brings me moments of joy and inspiration'. Overall, the impact of plants does appear positive, aligning with biophilic research (44, 68, 69), however potentially the lack of specific questions regarding this may have prevented the respondents from delving into this 'joy and inspiration'.

Nevertheless, comparatively to the ergonomics of their furniture, the decoration of their room did not appear to influence their overall positivity as much, although did appear most acknowledgeable by sample B (potentially relating to the higher levels of creativity mentioned above).

Layout

There were frequent mentions across both samples of the lack of separation from work and rest; this confirms the influence of 'zoning' and its importance in achieving concentration and knowledge absorption (26). It was the most frequent response to barriers experienced within the respondent's workspaces, regarding the lack of 'distinction between work and relaxation' or the difficulty in 'motivating yourself to do work in the same space you sleep', and this creating 'a negative effect on my mental health'.

There appeared to be a few creative solutions like the curtain idea, in the sense of optimising all corners of a space to create a different environment; 'my height adjustable chair makes things feel different', 'the room is divided up into different sections through

furniture allowing one part to be adapted easily into a workspace whilst retaining its original purpose as well'. This use of furniture to stimulate different environments is conflicting as this could impact wayfinding; preventing clear routes through spaces and creating trip hazards which could increase stress when travelling around. However, creating this semi-open boundary provides safety and increases concentration (70); this separation barrier demands creative solutions due to its shared response across both samples.

7.2. Environmental Design

Lighting

Lighting contributed the most to the wellbeing of sample A. It was also one of the most common drivers across both samples for choosing a space; 'good natural lighting', 'natural light and no distractions', 'control over lighting'.

There were lots of conflicting comments regarding daylight, 'there are also issues with the light from the window in my room at certain times of the [day]', 'less lighting in general than on campus spaces which makes it harder for me to work in the evenings'. The second comment is interesting because although it's good to prevent long work hours due to the impact on well-being (70, 71), it suggests their 'flow' period is much later in the day. However, potentially more details regarding work/study schedules would be required to align daylighting and 'flow' periods.

Many mentioned conflicting opinions regarding workspace placement in relation to windows; 'glare into my eyes because it's next to the window', 'direct sun in eyes in the mornings'. One respondent suggested a holistic solution to glare by using a 'dark wall colour [to cut] down on glare in the space', this could also provide clear visual contrast between lighter furniture/flooring, supporting clearer wayfinding.

Lighting was also used to increase motivation and prevent tiredness; 'daylight really increases motivation at times', one respondent mentioned changing their lighting 'because it used to make me sleepy', 'daylight is very important to feel fresh and ready to work'. However, a conflicting comment 'not too much sunlight [as] it's very bothering especially when spending all this time in it', refers back to the external lack of control and prolonged exposure. Furthermore, this comment does contradict the literature that states the positive impacts on wellbeing from bright light (72, 73), highlighting the individuality of workspace design, and lack of inclusion considerations in previous research.

Control over lighting was extremely important, many respondents enjoyed having 'control over lighting' and by using 'lamps... put in different places on purpose'; 'lamps were installed to make it usable after dark'. Furthermore, one respondent mentioned 'the lights at night are warm coloured creating a beautiful atmosphere'.

Overall, lightning preferences and needs were related to individual factors, as opposed to the separate samples (i.e. daylight, workspace placement, motivation and control).

Thermal Comfort

The largest influence on thermal comfort across both samples was the increased levels of control; when asked what works well within their workspace, one respondent replied, 'I can control the temperature' similarly to another stating, 'I can control the heating so that it doesn't get too cold or warm which is useful as it keeps me awake and alert'. This confirms Grigoriou's suggestions mentioned in the literature review, that control produces positive impacts on productivity, however, this may only work well in an individual setting; within a larger workplace, shared with others, this could cause conflict (45).

Furthermore, across both samples, thermal comfort proved a large contributor to wellbeing; 'once the heating is up it is a pleasant space to inhabit'. Overall, both samples appeared homogenous in the impact of thermal comfort.

Acoustics

Quietness is prevalent through two respondents in sample B purchasing noise-cancelling headphones; one mentioning 'to block out noisy neighbours either side'. However, like thermal comfort and lighting, one respondent mentioned 'I have the room to myself so I can control the noise levels', this suggests limited background noise, and re-iterates the demands of 'solitude'.

A respondent (from sample A) mentioned a barrier that 'sound clashes if me and my roommate are both in calls', similar to respondents (across A and B) mentioning family members at home. This is similarly representative of the 'open-plan' office and could contribute to sensory overload. The idea of the semi-open cubicle to provide physical boundaries could be a feature integrated with additional acoustic panels, preventing sound clashing. Overall, the impact of acoustic design across both samples, emphasises the improvements in workspace design as improvements for all.

7.3. Summary and Implications

The survey within this research encouraged the respondent to personally consider their own workspace (due to the demand of remote working); the data from the survey allowed more succinct and individual responses, understanding the user.

Overall, the aggregation of both qualitative and quantitative data did prove contradictory but resulted in more indicative conclusions, such as the innovative solutions that arose from respondents who had optimized their space across both samples. Many suggested creative solutions to the issue of zoning, suggesting adding curtains to separate the space, or using different desks for different activities. This reinforces the effective practice of learning from the user, identifying what can be incorporated/removed from existing workspaces to productively remove barriers, improve perceptions, and achieve comfortable working conditions. This also enhances a balanced relationship between user and designer; through mutual under-standing and influence, a long-term, supportive, and comfortable space can be created and improve the sustainability of the project.

7.4. Methodology Evaluation

7.4.1. Researcher Bias Statement

During the analysis of the data, it is important to identify potential areas of bias. In the feedback question for the survey, one respondent mentioned that some of the questions seemed similar; this is noticeable from the repetition of the 'why' questions. This could lead to habituation bias; where respondents provide similar answers worded in similar ways (74). This effect was mitigated by shortening the survey to reduce fatigue; while making it stimulating enough to prevent the respondent from running out of energy. Nevertheless, this bias can lead to repetition of some of the results – providing further confirmation but extended analysis time.

There could also be wording bias (75); where the wording of a question impacts how a respondent replies. This may be the case in the examples provided in this survey, e.g., mentioning the movement of furniture in respect to flexibility in the room, did appear to impact the responses (see Appendix A for whole survey).

External to this there's researcher bias; many different variations of this exist such as confirmation bias, where a researcher's judgement and analysis is purely based on confirming a belief/hypothesis as opposed to evaluating and criticising (76). This shall be reduced by challenging pre-existing assumptions and re-evaluating responses.

7.4.2. Data limitations

A few questions appeared influenced by wording bias, specifically those focusing on adaptability with the example of moving furniture. Although the intention is to provide clarity to the question, this appeared to sway the answers. One improvement could be by providing images of typical 'adaptable spaces' and allow the respondent to be more visually stimulated (to prevent fatigue) and less influenced by specific words.

Overall, the stress of the global pandemic swayed many of the responses. This restriction is prominent amongst Sample A and there are many mentions of limited options; 'no other space', 'only place I have', 'there's nowhere else'. Similarly, one respondent mentioned that they would 'prefer to work at their office…but this is not allowed'. Regardless of spatial barriers, the overall influential factor appears to be a lack of control externally to their space.

8. Conclusion

Standards and guidance on the design of workspaces include methods to improve productivity and overall comfort; but contain limited information on inclusivity.

The Social Model of Disability holds designers responsible for creating or removing the barriers experienced by the user.

Quantitative data from surveys confirmed that lighting and furniture (specifically the ergonomics of furniture) had the greatest contribution to the wellbeing of participants, providing alignment with the literature.

Qualitative survey data presented more specific personal needs in relation to individual workspace, such as the relationship between mobility disabilities and ergonomics, and between neurodivergence and zoning/partitioning. The data also began to suggest positive responses to room decorations and layout to be related to creativity in neurodiversity.

The mixed-method approach highlights homogeneous responses between both samples and data; design features such as thermal comfort and acoustics require improvements that would benefit all, e.g. added thermal comfort control and acoustic panelling.

A major factor influencing workplace satisfaction across both samples was the control over one's environment. Participants used lamps and blinds to control lighting; and adjusted heating to keep them awake and alert. This reinforces the effective method of learning from the user.

The diagram below has been created, taking into account the responses and literature, to identify the prescriptive and performance needs emerging from this research. Prescriptive highlights key design features, many provided by respondents to the survey alongside literature, and performance relates to the demands mentioned in the survey and overall drivers for workspace design. Overall, the importance of interacting with users and understanding the drivers behind workspace design can provide clear solutions that actively include all users.
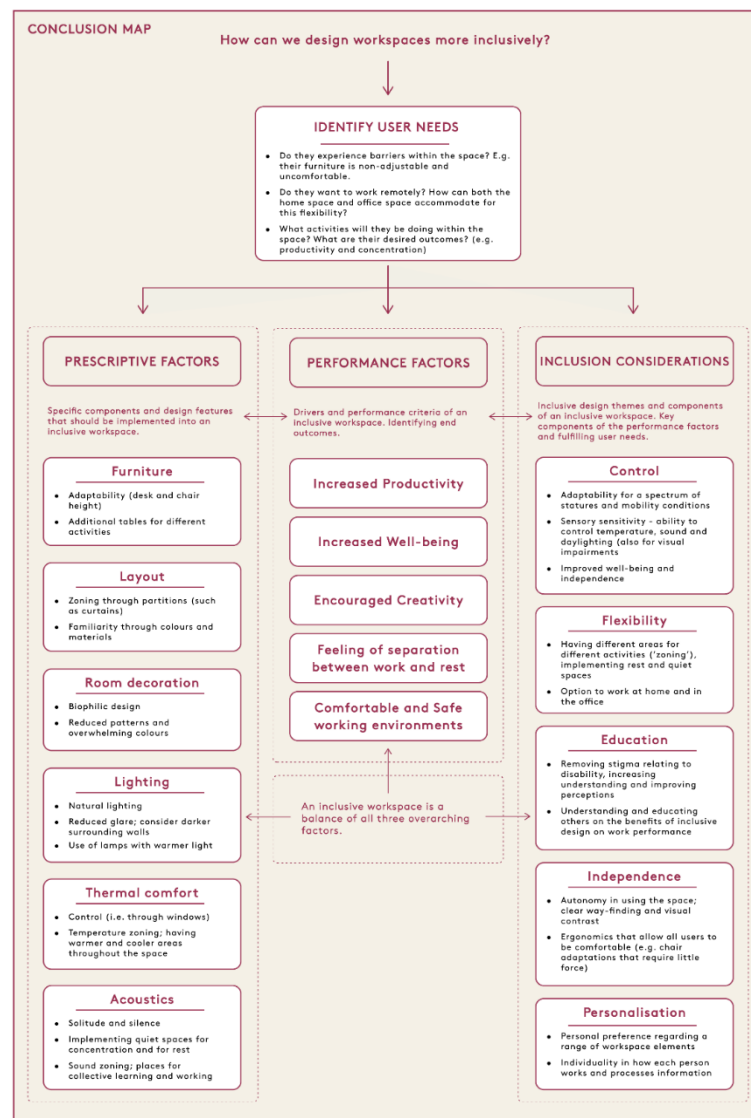
Figure 16. Conclusion map

Appendix A

Table A.1: Overview of survey questions and type.

Theme	Survey Question	Question Type
Spatial Context & Overall Use	In which space listed below does most of your working/studying take place?	Multiple choice
	Do you vary where you work?	Multiple Choice
	If you are at home, which space do you mostly work/study in?	Multiple Choice

(Context regarding location, what draws them to this space)	Is this space shared with others?	Multiple Choice
	How long have you been working/studying in this space?	Multiple Choice
	Why have you chosen this space?	Open-ended question
Spatial Changes & Individual Use	Have you changed any of the below within your work/study space over the past year?	Checkbox
(Regarding specific changes within their space, whether barriers exist that they cannot change)	Regarding the previous question, why did you carry out these changes?	Open-ended question
	Similarly, are there any specific barriers you continue to experience in your space?	Open-ended question
Wellbeing *(Identifying what brings them the most joy and happiness)*	Which contributes the most to your wellbeing within your space?	Multiple Choice
Flexibility/ adaptability	Would you describe your space as flexible/adaptable? I.e. can you adapt it to suit your needs?	Multiple Choice
(Extending on the barriers question, identifying whether they can change their space based on their needs)	If yes, what makes it flexible/adaptable?	Open-ended question
	If no, what makes it inflexible/unadaptable?	Open-ended question
	Would you benefit from more adaptability in your space?	Multiple Choice
Control *(Limitations include being in student accommodation, or mobility conditions)*	How much control do you have over adapting your space by yourself?	Multiple Choice
Miscellaneous	What works well in your work/study space and why?	Open-ended question
(Conclusive questions, any final comments)	Any other comments about your space?	Open-ended question
Demographics *(Could be relevant to previous questions regarding control and adaptability)*	Do you have any of the below? (This is to further understand any previous preferences mentioned) (relating to specific conditions)	Checkbox
	Which age range are you in?	Multiple Choice
Feedback	Any feedback on the survey?	Open-ended question

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