The Impacts of Workplace Design on Cognitive and Emotional Responses in Neurodivergent Individuals

by

Sophia N. Blatnik

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Thesis Committee:

Siobhan Rockcastle, Chair

Kyuho Ahn, Member

Mark Fretz, Member

University of Oregon

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THESIS ABSTRACT

Sophia N. Blatnik

Master of Science in Architecture

Title: The Impacts of Workplace Design on Cognitive and Emotional Responses in Neurodivergent Individuals

This thesis investigates the impact of architectural design conditions on environmental perception and cognitive performance through the lens of sensory sensitivities and neurodiversity. While inclusive design has traditionally focused on physical accessibility, limited research has examined how architectural interventions support cognitive accessibility and occupant experience. Using immersive virtual reality simulations, participants evaluated five office environments incorporating privacy screens, breakout rooms, flexible seating, and a combination of these interventions, compared against a baseline open-plan condition. Perceived environmental quality was assessed through questionnaire responses and cognitive performance was evaluated using a Stroop Test. The combination intervention received the strongest preference for individual work and the greatest agreement with statements related to comfort, calmness, productivity, and reduced distraction. In evaluating Stroop Test performance, participants reporting sensory sensitivities demonstrated longer completion times than those without sensory sensitivities. These findings support the integration of sensory-informed design strategies to create more adaptable, cognitively accessible workplace environments.

CURRICULUM VITAE

NAME OF AUTHOR: Sophia N. Blatnik

GRADUATE AND UNDERGRADUATE SCHOOLS ATTENDED:

University of Oregon, Eugene
Miami University, Oxford

DEGREES AWARDED:

Master of Science, Architecture, 2026, University of Oregon
Master of Architecture, 2025, University of Oregon
Bachelor of Arts, Architecture, 2023, Miami University

AREAS OF SPECIAL INTEREST:

Human-Centric Design
Environmental Psychology
Evidence-Based Design
Cognitive Accessibility

PROFESSIONAL EXPERIENCE:

Research Assistant, Institute for Health in the Built Environment
University of Oregon, Eugene, 2026

Graduate Teaching Fellow, Department of Architecture
University of Oregon, Eugene, 2024-2026

Technical Intern, Phius
Chicago (Remote), 2024

Teaching Assistant, College of Creative Arts
Miami University, Oxford, 2023

Architectural Intern, ThenDesign Architecture
Willoughby, Ohio, 2021-2023

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CHAPTER 1 – INTRODUCTION

1.1 Statement of Problem

The conversation around neurodiversity has grown in recent years into a critical framework for rethinking inclusivity in both social and spatial contexts. Neurodivergence is an umbrella term that encompasses neurological conditions both experienced from birth and acquired, such as Autism Spectrum Disorder, Attention-Deficit/Hyperactivity Disorder, dyslexia, and Post-Traumatic Stress Disorder (Weber et al., 2022). It is estimated that over 20% of the population self-identifies as neurodivergent (Weber et al., 2022). Despite this substantial number, adults who identify as neurodivergent often find that their workplaces are not designed with their sensory or cognitive needs in mind (Riordan et al., 2024). This number is expected to grow as an increase in screening and broader diagnostic criteria, greater public and clinical awareness, and improved access to assessment lead to more individuals being accurately identified.

The design of indoor spaces profoundly influences how individuals experience and perform within indoor environments. With people spending around 90% of time indoors (Klepeis et al., 2001), the design of workplace environments is increasingly important. The vast majority of buildings were designed for neurotypical users, and spatial conditions reflect this assumption. Characteristics such as lighting, acoustics, spatial density, views, and lack of privacy may cause sensory overload, stress, and decreased concentration for neurodivergent populations (Megari et al., 2024). For example, high visual clutter or unpredictable stimuli may trigger sensory overload in individuals with autism, while incoherent spatial arrangement and lack of flexibility may increase cognitive fatigue in those with ADHD (Finnigan, 2024). This may hinder job performance and overall wellbeing. Conversely, environments that offer sensory modulation and

adaptability can support calmness, enhance focus, and reduce stress responses across neurotypes (Calabrese, 2018).

The growing field of neuro-inclusive design seeks to address these disparities by designing for neurological differences as a form of diversity within universal design frameworks. This follows the recent broader design shift towards emphasizing flexibility and adaptablility in the design of environments, supporting a variety of user needs. While inclusive design has historically focused on physical accessibility (Candido et al., 2024), neuro-inclusive design encompasses sensory, cognitive, and emotional accessibility. Two key outcomes that are evaluated through this study are stress and cognitive performance. Chronic exposure to environmental stressors, such as harsh lighting, excessive noise levels, or spatial crowding, has been linked to heightened physiological stress responses and impaired cognitive function (Finnigan, 2024). For individuals with neurodivergence, who might have heightened sensory sensitivity or lower thresholds for environmental stressors, poorly designed spaces can exacerbate these effects. However, recent studies suggest that neuro-inclusive spaces offering adaptability and sensory regulation options can lower stress responses while enhancing task efficiency (Zhan et al., 2024).

By quantifying the relationship between architectural design and cognitive-emotional outcomes, this research contributes evidence to the growing advocacy for neuro-inclusive design. The findings aim to inform architects and designers of strategies to promote well-being, reduce stress, and enhance productivity for all users, acknowledging neurodiversity as a fundamental design consideration for occupants.

1.2 Research Objectives

The overall objective of this thesis is to advance the understanding of how architectural design can inform frameworks for cognitive accessibility. Specifically, it is looking to further research comparing the current standards of office design against proposed design interventions. This leads to more specific research questions of:

- How can architectural design support cognitive performance for those with sensory sensitivities?
- How can architectural design better support the comfort and sensory experiences of neurodivergent individuals within workplace environments?
- Will occupant perceptions of the environment differ significantly between open-plan and intervention-based environments?
    - How do spatial configurations with incorporated privacy elements influence perceptions of comfort and productivity within an office environment?

1.3 Research Significance

Building upon the existing body of research, this thesis investigates the relationship between architectural design and perceptions of environmental quality through the lens of sensory sensitivities. By integrating immersive virtual reality simulations with physiological and subjective measures of emotional response, the study contributes an evidence-based approach for evaluating how architectural environments are experienced by occupants. This research addresses a gap in the current literature by examining sensory considerations within workplace design while exploring methods for addressing their influence on occupant experience.

The findings have the potential to expand current understandings of occupant comfort and inform the development of neuroinclusive approaches to architectural design. More broadly,

this research contributes to ongoing discussions surrounding cognitive accessibility by demonstrating how sensory considerations can be incorporated into architectural evaluation and decision-making. Ultimately, this study provides empirical evidence that may support architects and interior designers in creating workplace environments that are more responsive to the diversity of human sensory experiences.

1.4 Research Scope

The scope of this study is defined by the experimental setting, immersive simulation design, available technology, workplace typology, and the examination of auditory and visual-spatial sensory sensitivites.

This thesis investigates the relationship between architectural design and environmental stimuli as they relate to auditory and visual-spatial sensory sensitivities. Although sensory processing encompasses a broader range of sensory experiences, the experimental analysis is intentionally limited to these two sensory domains. Daylighting, electric lighting, and materiality are incorporated into the immersive simulations to create a realistic architectural environment, however, these elements remain constant across all simulation conditions and are not evaluated as independent variables.

While neurodivergence encompasses a broad spectrum of conditions and lived experiences, this study does not examine individual diagnostic categories. Instead, it considers sensory sensitivities commonly reported across neurodivergent populations, recognizing that sensory experiences exist along a continuum and are not exclusive to any single neurotype. Accordingly, the focus is placed on informing architectural design responses to self-reported sensory variation rather than diagnosis-specific design recommendations.

1.5 Thesis Overview

The remainder of this thesis is organized into six chapters. Following this introduction, Chapter 2 reviews the literature on neuroinclusive design, sensory sensitivities, neuroarchitecture, measures of emotional response, and immersive virtual reality. Chapter 3 outlines the research methodology, including the experimental design, data collection procedures, and analytical methods. Chapter 4 presents the results of the experimental analysis, while Chapter 5 discusses the findings in relation to the research questions and existing literature. Finally, Chapter 6 concludes the thesis by addressing its limitations, contributions, and opportunities for future work.

CHAPTER 2 – LITERATURE REVIEW

2.1 Background

This section provides a collection of prior research related to the key components of the research questions addressed in this thesis.

2.2 Neurodiversity in Human-Centered Design

Architectural design shapes how individuals perceive, interpret, and interact with their surroundings. The concept of neuro-inclusive design and the need for a framework reimagining the built environment to accommodate neurodiversity is imperative for design advancement. The theoretical foundations of neuro-inclusive architecture draw from environmental psychology, cognitive neuroscience, and universal design. Goldhagen (2017) argues that the built environment continuously influences cognition, emotion, and social behavior. This positions architecture as an active contributor to psychological well-being. Similarly, Calabrese (2018) emphasizes that designing for mental wellness requires deliberate consideration of cognitive and sensory diversity, framing the built environment as an active participant in human mental health.

Empirical research further demonstrates the importance of sensory experience and environmental control within architectural design. Kinnaer et al. (2016) examined autobiographical accounts written by autistic authors to better understand how architectural environments are perceived and experienced. Through analysis that considered both external environmental characteristics and internal sensory experiences, the study explored responses to spatial configuration, perception of safety, and overall well-being. The findings suggest that environments offering greater opportunities for personal control can enhance comfort and positively influence users' perceptions of architectural space.

Similar themes emerge within workplace research focused on neurodivergent adults. Adamou et al. (2013) convened an international committee of researchers and practitioners from the UK, Europe, and UAE to examine the workplace experiences of adults with ADHD. Common challenges included distractability, difficulties with time management, and frequent task shifting. These challenges were all heightened by characteristics of the physical work environment. Workplace culture and expectations were explored in an attempt to understand how ADHD symptoms present in workplace settings, specifically in the historical disadvantage of standard office settings for people with ADHD. The discussion highlights how design interventions, such as acoustical control and flexible workspaces, can reduce environmental barriers and better support neurodivergent employees.

As research on neurodiversity continues to expand, questions surrounding diagnosis have become increasingly relevant. Van Rijswijk and Curșeu (2025) investigated this issue by surveying 357 people across a range of neurotypes to examine cognitive styles, decision-making processes, rationality, and self-awareness of neurodivergence. The study found that self-identification was a meaningful predictor of neurodivergent cognitive characteristics, supporting its use alongside formal diagnoses in research contexts. These findings are particularly relevant for application within study of the built environment, where lived sensory experiences may be more informative than diagnostic categories alone.

Collectively, this literature suggests that neuroinclusive architecture is less concerned with designing for specific diagnoses than with creating environments that support a diversity of sensory and cognitive experiences.

2.3 Architectural Design for Cognitive Accessibility

Despite growing conceptual and empirical interest, neuro-inclusive architectural design remains an emerging field with several critical research gaps. While foundational frameworks have established important principles for sensory-responsive design, no universally accepted framework currently addresses the full spectrum of neurodiversity. Existing design standards continue to prioritize physical accessibility, often overlooking sensory and cognitive inclusion (Weber et al., 2022). Most of the research surrounding neurodiversity currently focuses on children or educational settings (Bruce et al., 2025). This leaves adult populations in workplace environments comparatively underrepresented (Riordan et al., 2024). As a result, further investigation is needed to understand how neuroinclusive design can better support productivity and well-being throughout adulthood.

One of the earliest and most influential frameworks for sensory-responsive architecture is Mostafa's (2015) ASPECTSS model, which introduced design strategies to reduce sensory overload within the built environment. The framework identifies key environmental considerations, including acoustics, spatial sequencing, escape spaces, transitions, compartmentalization, sensory zoning, and safety. Although originally developed for autism-sensitive design, these principles have since informed broader neuroinclusive design strategies, recognizing a wider range of sensory profiles (Weber et al., 2022). These works situate neuroinclusive design within the larger context of accessible design.

Recent case studies further demonstrate the potential of multisensory environments to support neurodivergent users while also highlighting the limitations of current implementation. Bruce et al. (2025) describe the development of the Well-being in Student Education (WISE) Room at Northumbria University in response to student reports of sensory and inclusion-related

challenges. This space incorporates visual imagery and multisensory features designed to facilitate sensory regulation and well-being. While the project demonstrates the value of immersive multisensory environments, it also reflects a broader critique within the literature: neuroinclusive design is often implemented as a specialized intervention rather than being integrated into everyday architectural environments (Grace, 2020). This distinction highlights the need to embed neuroinclusive design principles within workplace design rather than relying solely on designated sensory spaces. Although sensory rooms demonstrate benefits of sensory-responsive environments, relatively little research has explored how these principles can be incorporated into conventional workplace architecture.

2.4 Workplace Design and Sensory Experience

The workplace environment has a substantial influence on employee well-being, concentration, and productivity. Research on open-plan environments consistently identifies overheard speech as a common source of distraction that negatively affects cognitive performance. In a study examining whether open-plan offices support or hinder productivity, Haapakangas et al. (2014) and Hua et al. (2011) found that overheard conversations significantly reduced task performance while increasing mental fatigue. Similarly, a systematic review comparing open-plan and cellular office environments reported that open-plan layouts were associated with greater distraction, higher stress levels, and lower job satisfaction. These outcomes were largely attributed to increased noise levels and reduced privacy (James et al., 2021). These characteristics are particularly relevant when considering neurodivergent populations, as open-plan workplaces are frequently associated with heightened sensory and spatial challenges (Riordan et al., 2024).

Recent workplace research has increasingly emphasized the role of environmental design in supporting employee well-being and organizational performance. In *The Routeledge Handbook of High-Performance Workplace,* Candido et al. (2024) identify inclusivity and accessibility as essential charateristics of high-performing work environments. This reinforces the established relationship between inclusive design and psychological well-being. Building on this perspective, Weber et al. (2022) conclude that opportunities for sensory regulation and access to privacy control are among the most influential environmental factors affecting neurodivergent employees. However, their review also highlights a limitation in the existing evidence base, noting that empirical research remains limited and that many workplace design standards continue to reflect predominantly neurotypical assumptions.

Qualitative research further illustrates how these design limitations are experienced in practice. Riordan et al. (2024) investigated the sensory and spatial experiences of self-identified neurodivergent staff and postgraduate students within academic workplace environments at the University of Melbourne. Participants identified primary sensory challenges and barriers to inclusion in a standard office setting. Interview results shared the variation in sensory preferences while emphasizing the importance of flexibility, individual choice, and access to a range of space typologies that support different sensory needs. Collectively, these findings indicate that effective workplace design depends less on accommodating a single sensory profile and more on prioritizing adaptable environments capable of accommodating diverse sensory experiences.

2.5 Sensory Sensitivities and Indoor Environmental Quality

Central to neuroinclusive design is the recognition that architectural environments influence sensory experience and that sensory sensitivites should be considered throughout the

design process. Research consistently demonstrates that architectural environments influence sensory regulation, cognitive functioning, and psychological well-being, particularly for individuals with heightened sensory sensitivities. Finnigan (2024) found that participants with sensory sensitivities, many of whom identified as neurodivergent, experienced architectural environments with heightened awareness. Predictable, coherent spaces incorporating biophilic elements were associated with feelings of calmness and cognitive restoration. Alternatively, overstimulating environments frequently elicited anxiety. These findings reinforce Weber et al.'s (2022) conclusion that the opportunity for sensory regulation is an influential factor affecting well-being of neurodivergent individuals.

Qualitative workplace research further emphasizes the importance of balancing sensory stimulation with privacy and opportunity for individual adaptability. Riordan et al. (2024) found that neurodivergent adults working in academic workplaces frequently experienced difficulties arising from conventional open-plan layouts. This was particularly noted in the lack of flexible spaces that could accommodate diverse sensory preferences. Participants emphasized the need for environments that support individual adaptation. Although these experiences may be particularly pronounced for neurodivergent individuals, the desire for environments that facilitate concentration, privacy, and sensory comfort extends across neurotypes. This suggests that greater environmental flexibility may benefit a broad range of users.

Weber et al. (2022) further contextualizes these findings by examining sensory processing across multiple neurodivergent populations. Their review incorporates both user experiences and methodologies of mitigating environmental stimuli in regards to hypersensitivity, experiencing exaggerated response to stimuli, and hyposensitivity, experiencing lack of response to stimuli. Several sensory domains were identified as common considerations

in neuroinclusive design. These include visual, auditory, tactile, olfactory, spatial, and vestibular sensory domains. As individuals may experience multisensory sensitivities, effective design should support opportunities for individualized sensory regulation by promoting individualized environmental control, privacy, intuitive wayfinding, and conditions that facilitate optimal levels of sensory stimulation.

The importance of these environmental characteristics extends beyond neurodivergent populations. A post-occupancy evaluation examining occupant satisfaction in relation to indoor environmental quality identified acoustic conditions, spatial organization, lighting, thermal comfort, and opportunities for environmental adjustment as key contributors to perceived comfort and workplace satisfaction ("Chartwell School – EHD Bulding Scorecard," 2009). These factors closely align with those identified throughout the neuroinclusive design literature, suggesting that principles such as flexibility, user control, and environmental adaptability contribute to positive experiences for a wide range of occupants.

While neurodivergent individuals may experience sensory challenges more intensely, environments that provide greater flexibility have the potential to enhance comfort, well-being, and cognitive performance across diverse user populations. Architectural design should recognize and account for sensory sensitivites and their relationship to indoor environmental quality and comfort as legitimate design considerations.

2.6 Physiological Measures of Emotional Response in Architecture

Neuroarchitecture is an interdisciplinary field that examines the relationship between the built environment and human cognition, emotion, behavior, and physiological response (Valentine, 2024). A central premise of neuroarchitecture is that architectural environments can evoke measurable psychological and physiological responses, providing insight into how

individuals experience space. Accordingly, this review focuses on physiological indicators that have been used to evaluate emotional responses to architectural environments, including galvanic skin response (GSR), heart rate variability (HRV), blood pressure, and stress-related biomarkers.

Physiological measures are utilized in architectural research due to the ability to provide objective indicators of emotional arousal. One commonly used measure is galvanic skin reponse (GSR), which quantifies changes in the elctrical conductivity of the skin (Sharma et al., 2016). These changes result from variations in sweat gland activity controlled by the autonomic nervous system and are measured through electrodes placed on the skin. Due to the rapid physiological response to emotional stimuli, GSR has become a widely used measure of emotional arousal within studies of human-environment interaction.

Heart Rate Variability (HRV) provides an additional measure of physiological response by reflecting autonomic nervous system activity during changing environmental conditions. Tiwari et al. (2021) identify HRV as a useful indicator of stress and emotional strain while acknowledging that it is influenced by numerous physiological and contextual factors. Despite these limitations, the review supports HRV as a valuable measure for assessing stress responses associated with environmental conditions.

Research comparing multiple physiological measures further demonstrates the value of biomarker-based assessment. Fernandes et al. (2014) evaluated blood pressure and galvanic skin response during experimentally induced stress to determine their effectiveness as indicators of physiological stress. Their findings suggest that GSR provides a more immediate and sensitive measure of emotional arousal than blood pressure, supporting its application in studies investigating human responses to environmental stimuli. Generally, this research demonstrates that physiological biomarkers provide objective measures of emotional responses to

environmental conditions. Within architectural research, these measures offer an opportunity to evaluate how characteristics of the built environment influence occupants beyond subjective perceptions alone, supporting evidence-based approaches to human-centric design.

2.7 Virtual Reality as a Tool for Architectural Evaluation

Virtual Reality (VR) has emerged as a valuable research tool for investigating how architectural environments influence cognitive, emotional, and physiological responses. Unlike studies conducted within existing buildings, VR enables researchers to systematically manipulate individual environmental variables while maintaining experimental control over the surrounding conditions. This capability has made VR an increasingly important methodology for evaluating the effects of architectural design decisions.

Recent research has demonstrated the effectiveness of VR for examining the influence of sensory stimuli on cognitive performance. Dahlstrom-Hakki et al. (2022) investigated how visual and auditory distractions within virtual enviroments affected task performance among neurodivergent students. The findings concluded that higher sensory loads reduced both processing speed and task accuracy. This demonstrates the capacity of VR to isolate specific environmental variables and evaluate their influence on cognitive performance under controlled conditions.

The integration of VR with physiological measures further strengthens its application within architectural research by linking subjective experience with objective measures of emotional arousal. Zhan et al. (2024) combiend immersive VR simulations of architectural regeneration projects with galvanic skin response measurement to assess physiological responses to different design conditions. Similarly, Yin et al. (2019) evaluated participants' stress responses and cognitive performance within a simulated office environment using VR alongside

measures of blood pressure, heart rate variability, and galvanic skin response. Within the virtual environments, participants were asked to complete tasks, in which the accuracy of the responses were measured. These studies demonstrate the feasibility of integrating immersive architectural simulations with physiological biomarkers to evaluate occupants' responses to the built environment.

As architectural environments are inherently multisensory, VR also provides an effective platform for investigating the interaction of multiple environmental stimuli. Marucci et al. (2021) explored how combinations of sensory inputs influenced stress and task performance within virtual environments. The conclusions of this study expressed that moderate multisensory stimulation enhanced users' sense of realism and engagement while supporting task completion. These findings suggest that VR can realistically represent complex environmental conditions while maintaining sufficient experimental control for research purposes.

Beyond immersion, VR offers the ability to selectively manipulate individual sensory conditions. Dahlstrom-Hakki et al. (2023) used VR to investigate the effects of auditory and visual environmental stimuli on cognitive performance. This study demonstrated that background noise differentially influenced attention and task performance among neurodivergent and neurotypical participants. By independently controlling sensory variables, the researchers were able to examine how specific environmental conditions affected cognitive processing. This level of experimental precision highlights the value of VR as a methodology for evaluating the influence of architectural design on occupant experience. The capabilities of controlled manipulation of environmental variables make VR particularly well suited for evaluating how sensory characteristics of architectural interventions influence emotional and cognitive responses.

CHAPTER 3 – METHODOLOGY

3.1 Background

This chapter explores the human factors component of this thesis, exemplifying the application of experimental design in advancing knowledge of the relationship between environmental stimuli and the human experience. It examines the perception and performance of individuals as they relate to architectural interventions in the workplace. This study specifically focuses on the influence of visual-spatial and auditory intervention on occupants' performance. Human-subject participation was imperative for this experiment in order to advance the human-subject research in this field.

3.2 Methodology Schematics

The setup of this thesis employs an experimental framework using immersive Virtual Reality technology simulating carefully designed office environments. The office environments were designed to be spatially representative of in-person office environments. The experiment consisted of a tri-part data collection: physiological-emotional response, cognitive performance, and subjective perception. Participants were fit with Virtual Reality headsets (Valve Index) and were immersed in a 360-degree view of the office environment simulations and corresponding office ambiance audio. Within the simulations, the first experimental task involved the verbal response of the participants' perception of the space, which provided subjective feedback on the quality of the simulated environment. Once the questionnaire was completed, participants were then asked to complete a cognitive performance task, in the form of the Stroop Color Word Test (Stroop Test) (Poguntke et al., 2019; Osimani et al., 1997; Gwizdka, 2010). This structure repeated in each of the five simulated office environments, in a randomized order. In combination with the collected physiological data, quantitative representation of cognitive and

emotional performance are evaluated within the experimental metrics. A visualization of the data collection procedure and methdology is presented in Figure 3.1.

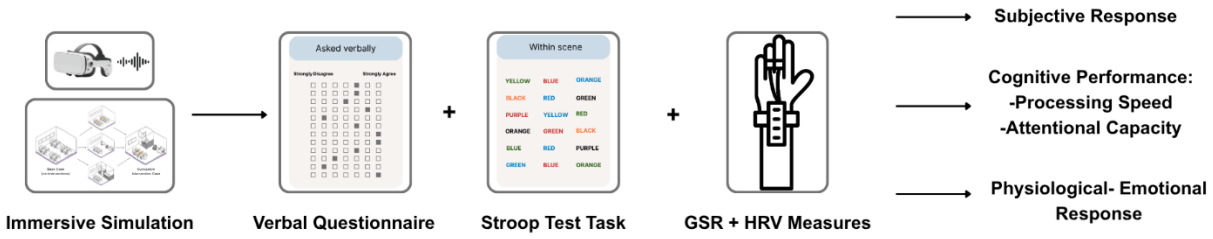


Figure 3.1 Experimental Methodology Schematic

3.3 Simulation Model Development

A digital model was developed to represent an interior office environment, with additional simulations incorporating targeted design interventions. The model was created at a level of detail sufficient to represent key architectural and interior conditions, including furnishings and consistent surface finishes across all simulation scenarios. Autodesk Revit was used for architectural modeling, with the TwinMotion plugin utilized to enhance visual realism. The resulting simulations were rendered for direct viewing within a virtual reality environment through TwinMotion. Participant perspectives were presented from an eye-level seated position, at an approximate 40 inches vertical height, allowing users to experience the space as they would within an in-person office environment. Participants were able to explore the full rendered environment by turning their head within the VR experience.

The virtual simulation model developed for this study represented a side-lit office environment measuring 65’L × 25’W × 12’H. The plan is further broken down into an open work space of dimensions 50’L × 25’W and a kitchenette of dimensions 15’L × 25’W through an 11’- 6”W open doorway from the office space. The three modular windows are along the Eastern wall, with dimensions 6’L × 6’H set 3’- 6” above the finished floor level. Spacing between the windows is 1’- 6” starting 1’- 6” from the northern side. This gives a window-to-wall ratio of

36%, with the rest of the walls being windowless. The office size was based on standard square-footage per employee for United States office spaces (Panero & Zelnik, 1979).

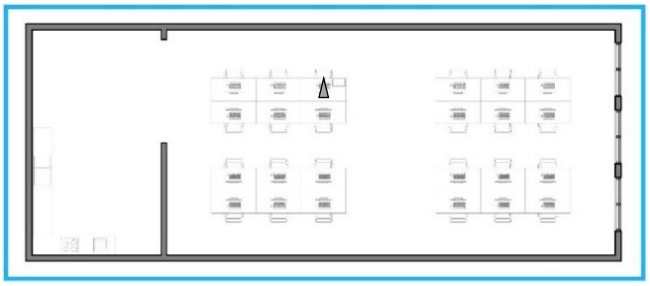
Each scene contains the same eleven characters of varying diversity within the scene, just situated differently due to the introduction of interventions. The same audio clip of office ambiance is played in each scene, with volume adjusted to match the applied intervention. The ambient volume was played at 100% volume for the baseline and added flexible seating simulations, while the added privacy screens, added breakout rooms, and combination intervention simulations had a 70% volume level. The audio clip contains snippets of conversation, a phone ringing, and a printer printing. Daylighting to the exterior of the model was set to 1200 lux at 5778K temperature, 15 degrees offset from North at 12:00 noon in July. Electric lighting interior to the model is set at an interval of 4x5 LED panels creating an overall lighting quality of 4000 lumens at color temperature 4500K. This is consistent across the scenes. The view external to the modeled space is the same view of an urban skyline in the background with a singular tree and brushery in the foreground.

3.3.1 Test Model Intervention Simulation Development

Five office space simulations were developed in response to literature reviews on sensory sensitivities experienced by neurodivergent individuals in the workplace. The interventions address visual and auditory stimuli in particular. By adding separate breakout areas and partitions, acoustical concerns are addressed, while screens address privacy concerns. Flexible seating addresses sightline and view obstruction concerns.

The first simulation developed represented the baseline condition without targeted design interventions. This model depicted an open-plan office environment consisting of four sets of six paired-facing workstations. Each workstation followed a standard dimension of 5’ × 2’-5” and

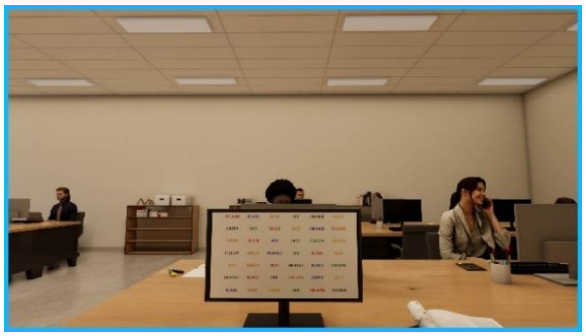
included a computer monitor and keyboard. This open-plan configuration represents a typical workplace arrangement intended to support individual work within a collaborative setting while allowing for occasional informal interactions. The architectural layout and pariticipant views of the scene are depicted in Figure 3.2.



Floor Plan



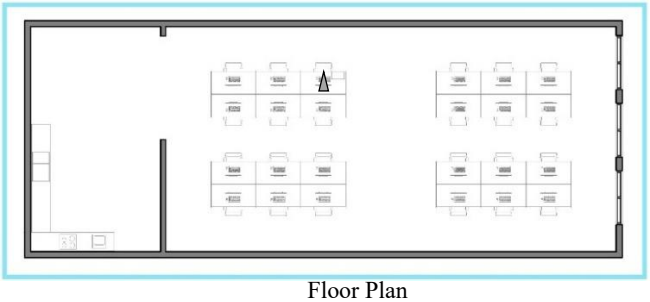
Panoramic View



Participant View

Figure 3.2 Baseline Office Condition Environment

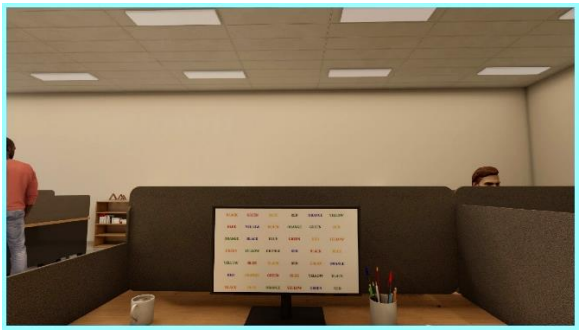
The first intervention simulation incorporated privacy screens around three sides of each workstation. The screen material provided some acoustic absorption, however the primary intent of this intervention was to reduce direct visual sightlines and increase individual privacy. This intervention maintained the existing open-plan spatial configuration while introducing an additional layer of occupant control within the workspace. The architectural layout and participant views of the scene are depicted in Figure 3.3.



Floor Plan



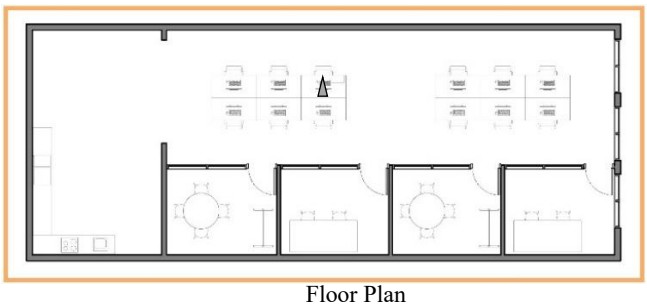
Panoramic View



Participant View

Figure 3.3 Added Privacy Screens Intervention Environment

The second intervention simulation replaced the second row of workstations with enclosed breakout rooms. Each breakout room measured 9’L × 8’H and incorporated a glazed intoerior-facing wall, while the remaining three walls were enclosed with opaque surfaces. The rooms were furnished desks and chairs to support individual work or small-group activities. This intervention introduced dedicated spaces for focused work and private conversations, reducing potential distractions while maintaining a connection to the surrounding open-plan environment. The architectural layout and participant views of the scene are depicted in Figure 3.4.



Floor Plan



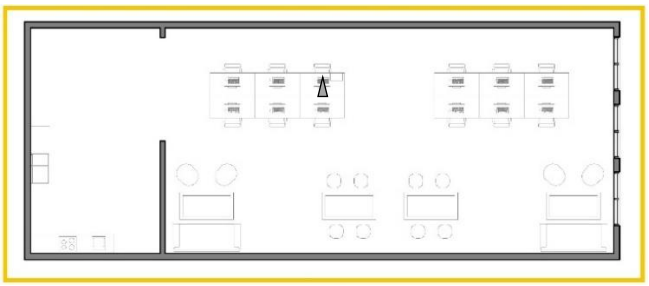
Panoramic View



Participant View

Figure 3.4 Added Breakout Rooms Intervention Environment

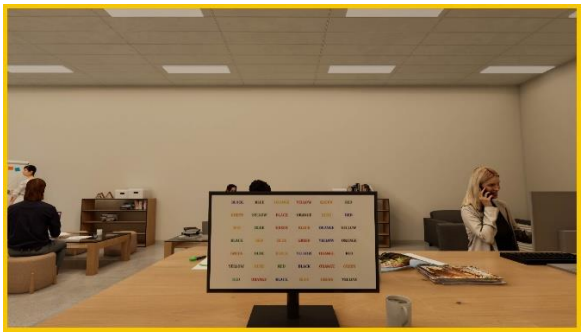
The third intervention simulation replaced the second row of workstations with a flexible seating arrangement. This intervention incorporated lower-height tables surrounded by cushioned couches and chairs to provide a variety of seating options. The flexible layout was intended to support individual preferences and accommodate different work activities by increasing occupant choice within the workplace environment. This configuration supports a more informal and collaborative setting while maintaining adaptability for varied task requirements. The architectural layout and participant views of the scene are depicted in Figure 3.5.



Floor Plan



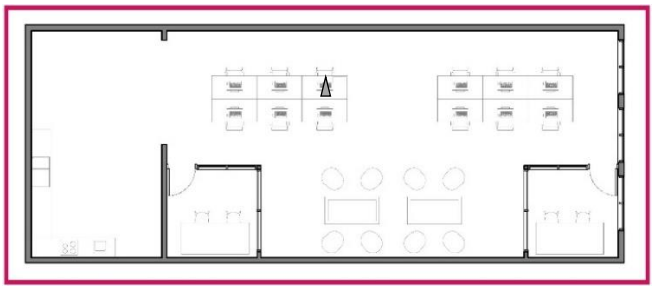
Panoramic View



Participant View

Figure 3.5 Added Flexible Seating Intervention Environment

The final intervention simulation combined the previously described interventions into a single integrated workplace environment. In this configuration, the second row of workstations were replaced with two enclosed breakout rooms positioned at either end of the space, with two flexible seating arrangements located between them. The remaining individual workstations incorporated the privacy screen intervention. This combined layout introduced multiple levels of environmental choice, providing privacy options for individual and small group activities while supporting flexibility in workplace preferences and task needs. The architectural layout and participant views of the scene are depicted in Figure 3.6.



Floor Plan



Panoramic View



Participant View

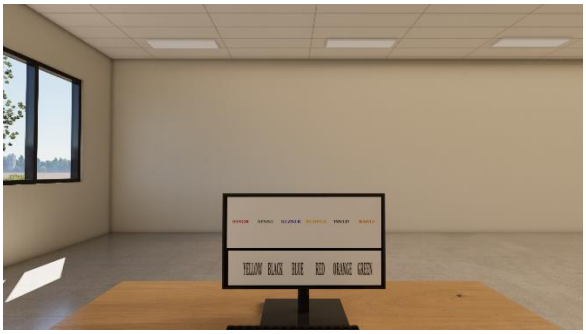
Figure 3.6 Added Combination Intervention Environment

3.3.2 Digital Simulation of Test Models

Within each simulation in the Virtual Reality setup, the participant is situated in the first row of workstations, facing the second row of workstations. The scenes were presented in a random order to the participants of the study to limit order bias. The participants first entered Virtual Reality in a demonstration simulation, shown in Figure 3.7, which was used to calibrate the equipment and get baseline readings as well as to test for ability to read English and identify colors. This helped to calibrate the cognitive performance tests administered later in the study.



Panoramic View



Participant View

Figure 3.7 Demonstration Environment

3.4 Data Collection and Research Protocol

The research protocol for this thesis consisted of a human factors experiment designed to collect quantitative data through survey questionnaires, a Stroop Test task, and physiological measurements. The study was conducted within the University of Oregon's Allan Price Science Commons and Research Library RAVE (Reality Augmentation and Virtual Experiences) lab, an enclosed research space equipped with advanced immersive technology. For the duration of the experiment, the space was dedicated exclusively to this study to maintain consistency across participant sessions.

Verbal and physiological responses were collected through self-reported survey measures, cognitive task performance, and physiological sensors. All collected data were coded and prepared for statistical analysis to examine relationships between architectural interventions, environmental stimuli, and participant responses. Physiological data collected during this study will also support future research exploring emotional responses to environmental stimuli within workplace environments. The research protocol in Figure 3.8 details the steps of the experimental session timeline.

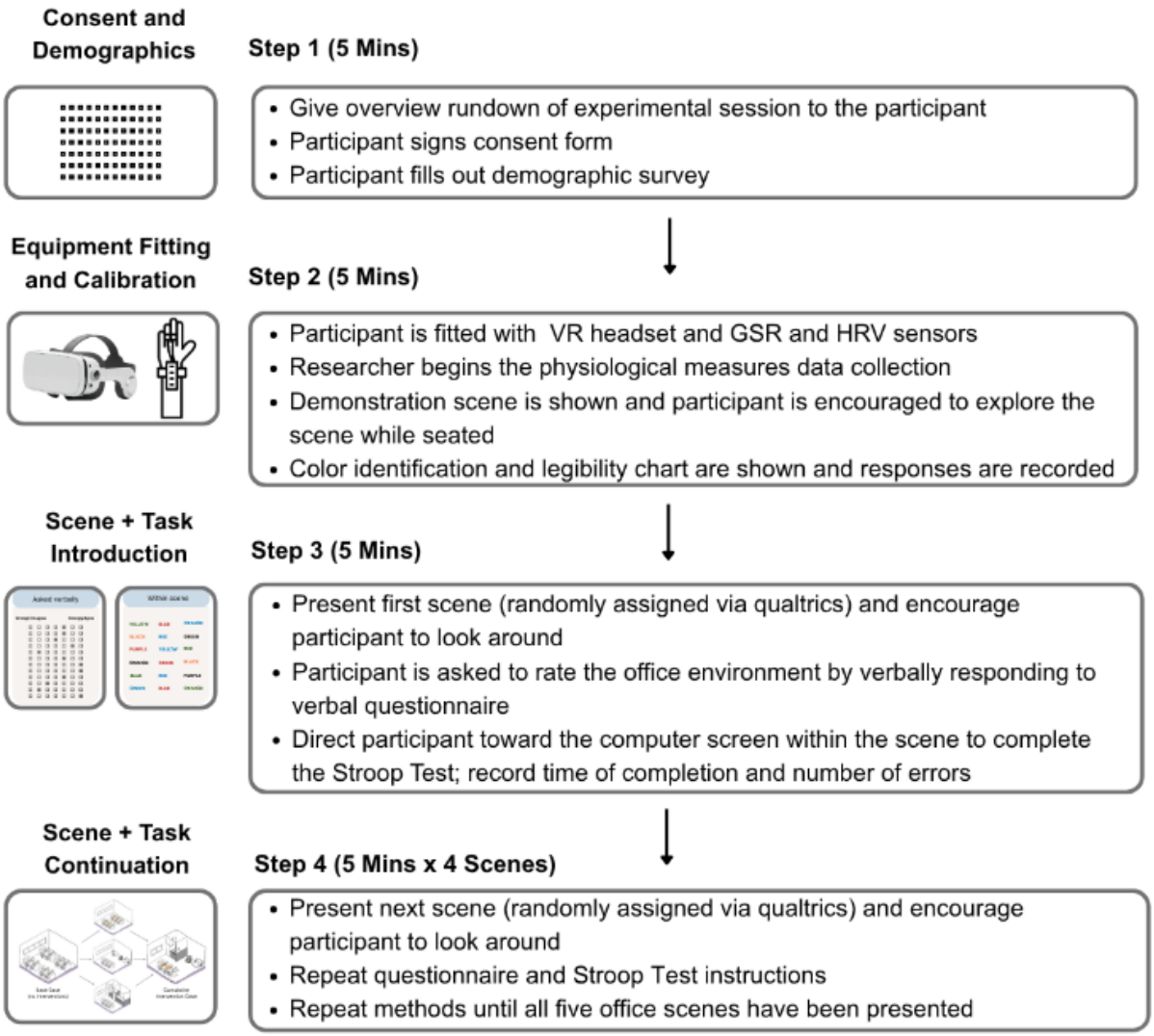


Figure 3.8 Experimental Session Timing and Protocol

3.4.1 Recruitment of Participants and Ethical Approval

Participants were randomly recruited for this study through posters and flyers posted around the University of Oregon campus, targeted email through the department of architecture to students and faculty, and word-of-mouth. Eligibility was limited to students and faculty associated with the University of Oregon. This was a singular recruitment pool with two participant pools recruited in tandem, including neurodivergent individuals and neurotypical individuals. Participants were walked through the informed consent process, noting that all

pariticpation is voluntary and anonymous. On the demographic form during the experimental session, participants were asked to identify sensory sensitivities that they experience. Experimental sessions lasted for approximately 35 minutes each and participants were compensated with a $25 gift card.

In total, 46 participants partook in the experiment. Of those 46 pariticipants, 27 identified as female, 16 identified as male, and 3 identified as non-binary or a third gender. 33 of the participants fell into the age range of 18-24, 10 participants were in the age range of 25-34, two were in the age range of 35-44, and one participant was in the 45+ age category. 34 of the participants identified as neurotypical and 12 identified as neurodivergent, with 26 participants reporting no sensory sensitivities and 20 reporting that they experience sensory sensitivities. Of the sensory sensitivities noted, auditory sensitivity was predominant, with 13 people noting auditory sensitivity. 11 noted tactile sensitivity, 11 noted visual sensitivity, 10 noted olfactory sensitivity, and 5 noted movement sensitivity (vestibular/proprioceptive). Participants were able to select multiple sensory categories to account for multisensory sensitivities. Although this study focused on auditory and visual-spatial sensitivities, acknowledging additional sensory experiences was important for identifying possible confounding variables.

3.4.2 Experimental Setup and Equipment

This study was conducted in-person, shown in Figure 3.9. Participants were asked to answer some basic demographic questions on a tablet before being fitted within the Virtual Reality headset, the Valve Index using Steam VR. Participants were then fitted with the physiological sensors measuring galvanic skin response and heart rate variability. Both these measurements were taken using the Shimmer GSR+ device, which attached to the wrist and had electrode sensors and an optical pulse sensor placed on the pads of the fingers.



Equipment Participant Setup Researcher Setup

Figure 3.9 Experimental setup within the RAVE lab

3.4.3 Human Factors Testing

This thesis incorporates an experiment with human subjects to reveal connections between design interventions and behavioral responses to environmental stimuli. Physiological data collected will be compared against the subjective verbal questionnaire data and environmental simulations to pinpoint instances of increased and decreased stress.

3.4.3.1 Verbal Questionnaire

Within each simulated environment, participants were asked to verbally respond to a series of 13 statements on a semantic differential scale from one to seven. The scale corresponds to 1: strongly disagree, 2: disagree, 3: somewhat disagree, 4: neutral, 5: somewhat agree, 6: agree, 7: strongly agree. The statements remained consistent throughout each scene and were used to evaluate the subjective quality of the virtual environment. The chosen statements are listed in Table 3.1 based on research by Ingrid Vogels (2008) and Flynn et al. (1973).

Table 3.1 Study questions and the relevant semantic differential scale

Questions	Scale (1 to 7)
This space makes me feel comfortable	Strongly disagree -- strongly agree
This space makes me feel alert	Strongly disagree -- strongly agree
This space makes me feel anxious	Strongly disagree -- strongly agree
This space makes me feel relaxed	Strongly disagree -- strongly agree

This space makes me feel excited	Strongly disagree -- strongly agree
This space makes me feel calm	Strongly disagree -- strongly agree
This space makes me feel included	Strongly disagree -- strongly agree
This space makes me feel distracted	Strongly disagree -- strongly agree
This space makes me feel productive	Strongly disagree -- strongly agree
This space makes me feel tense	Strongly disagree -- strongly agree
This space makes me feel content	Strongly disagree -- strongly agree
This space makes me feel overwhelmed	Strongly disagree -- strongly agree
I would choose this space as somewhere to do individual work	Strongly disagree -- strongly agree

3.4.3.2 Cognitive Performance Test

Within each scene, participants were asked to complete a cognitive performance test, in the form of a Stroop Color Word Test. This test has been used in many studies as a tool for assessing cognitive performance (Poguntke et al., 2019; Osimani et al., 1997; Gwizdka, 2010). The Stroop Test was situated on the computer screen in front of the participant in each scene, each comprised of six columns of seven rows of words, amounting to 42 words. Participants were asked to state aloud the color of the text that each word was written in, which differed from the word of the color that was typed. The test began at the top-left corner of the chart and continued horiontally from left to right and then continued in such a manner down the rows until all words were observed. This test was analyzed for accuracy and time of completion, recorded on a stopwatch, and was intended to emulate a task requiring focus within a workplace environment. This measured cognitive processing speed and participant attentional capacity. Examples are provided in Figure 3.10 and Figure 3.11.



Baseline Stroop + Screens Stroop + Breakout Stroop + Flex Stroop + Combo Stroop

Figure 3.10 Stroop Test iterations by simulated environment



Figure 3.11 Example of Stroop Test on computer screen within simulated environment

3.4.3.3 Physiological Response

To interpret emotional response to the interventions introduced within the virtual environments, physiological measures were collected. This consisted of galvanic skin response and heart rate variability, conducted through wearable technology. GSR entails electrode placement on the hands of participants and HRV is collected through an optical pulse sensor on the finger. The technology used for this physiological measurement is the Shimmer GSR+ sensor (Shimmer3R GSR+ unit, Shimmer Research), shown in Figure 3.12. The physiological data collected will be analyzed in future work using biofeedback technology, where the amplitude of GSR response correlates to stress, and HRV will be analyzed via metrics of parasympathetic activity. The measurements were recorded in the Shimmer Consensys software.

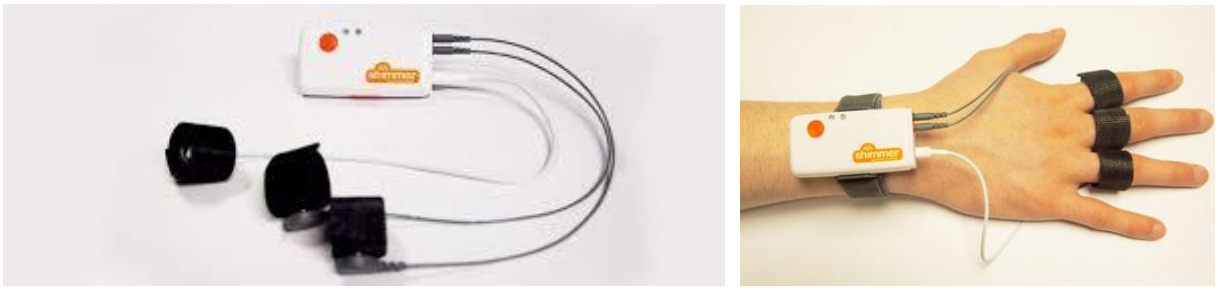


Figure 3.12 Shimmer GSR+ Device with GSR electrodes and HRV Sensor

3.5 Data Analysis Overview

The analysis of the collected data was performed in both the IBM SPSS Statistics software and GraphPad Prism. Power analysis was conducted via Cohen's *d* in GraphPad Prism to determine the effect sizes between the comparison groups. Despite imbalanced population groups, the effect size between the population groups remains informative for the purposes of this study.

3.5.1 Repeated Measures One-Way ANOVA

Participants in this study responded to the same survey questions and a Stroop Test task across each of the five office simulations. Due to this, we are able to compare responses across each scene at the individual level. This can then be applied to the larger studied population group.

3.5.2 Two-Way ANOVA

The population pool was divided according to response in the demographic survey conducted at the beginning of the experimental session. This allows for comparison across intervention simulations at an additional level of analysis. Using a two-way ANOVA, we are able to detect any differences in reponse across the interventions as they specifically relate to neurotype or sensory sensitivity experience.

3.5.3 Paired Comparisons

Post hoc tests were run between the different office simulated environments for each survey question and Stroop Test response. This compares the responses between each scene individually, allowing for statistically significant differences to be determined. The prioritized comparison in this study is the individual intervention responses in comparision to the baseline case. Comparisons between the interventions were also run to supplement potential impact of intervention on response as it relates to specific sensory sensitivities. The Bonferonni correction was used.

CHAPTER 4 – DATA ANALYSIS AND FINDINGS

4.1 Background

This section presents the results of the survey questionnaire and Stroop cognitive performance test across the five simulated office environments. The data analysis methods applied in this study support interpretation of how individual architectural interventions relate to perceived environmental quality and cognititve performance.

4.2 Impact of Architectural Intervention on Perception

The perception of environmental experience within each of the virtual environment simulations was evaluated through verbal response to a questionnaire. This was repeated across each of the simulated environments and provided a subjective measure of perception.

4.2.1 Frequencey Response Results By Intervention

All 46 participants answered the same 13 questions in each of the five simulation office environments. Figure 4.1 presents the frequency of responses on the likert rating scale for each of the ratings, with each row culminating in a total of 46 reponses. The provided scale went from “strongly disagree” as rating 1, represented in deep blue, to “strongly agree” as rating 7, represented in deep pink. The gray is a neutral response, which signifies a rating of 4. Within Figure 4.1, the dotted line signifies the 50% response mark, where 23 participant responses are shown on either side. This provides a benchmark for majority participant perception.

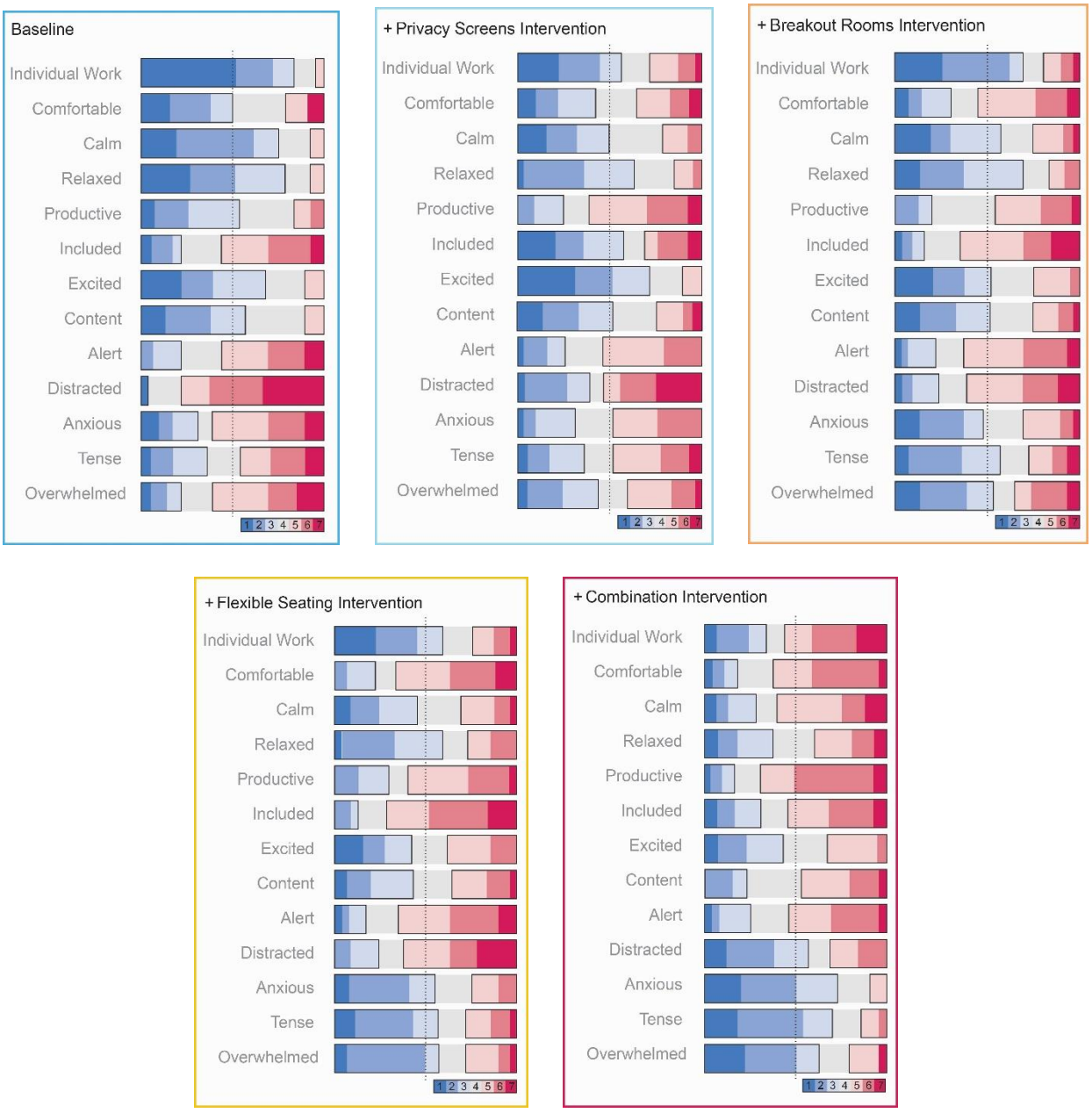


Figure 4.1 Frequency of Likert responses showing perceived quality by simulated environment

In the baseline open-plan office condition, a strong majority of participants indicated that the environment was distracting and reported that they would not choose it for individual work. Responses to the emotional perception measures showed that at least 50% of participants disagreed with feeling comfortable, calm, relaxed, productive, excited, or content in this environment. Conversely, at least half of participants agreed that they felt included, alert,

anxious, and overwhelmed. Responses regarding feelings of tension were more evenly distributed among participants.

In the privacy screen intervention condition, participant responses were more evenly distributed across several perception measures than in the baseline environment. More than half of participants reported feeling productive and alert in this environment. Conversely, over 50% indicated that they would not choose to work in this space and disagreed with feeling relaxed or excited.

In the breakout room intervention condition, 67% of participants indicated that they would not choose the environment for individual work. More than half of participants reported feeling comfrotable, included, alert, and distracted, expressing some contradictory emotions. Conversely, at least 50% disagreed with feeling calm, relaxed, excited, content, tense, or overwhelmed in the environment. Responses regarding productivity and anxiousness were more evenly distributed, with approximately half of participants reporting each perception.

In the flexible seating intervention condition, a majority of participants reported feeling comfortable, productive, included, alert, and distracted. More than half also disagreed with feeling overwhelmed, tense, or anxious. Responses regarding relaxation and preference for individual work were similarly distributed, with over 50% of participants indicating disagreement. Participant perceptions of excitement and contentment were more evenly divided, suggesting that these questions in particular may not show experimental effect.

Among the five simulated environments, the combination intervention received the highest level of participant preference for individual work. More than half of participants reported feeling comfortable, calm, productive, included, and alert. Conversely, a majority of

participants disagreed with feeling distracted, anxious, tense, or overwhelmed in this environment.

4.2.2 Architectural Intervention Results

The mean values and distributions of questionnaire responses were used to compare results across the simulated office environments. There was a significant effect of environment on participant response across all 13 questions from the questionnaire. The coresponding p-values are found in Table 4.1.

One-Way ANOVA Results for Perception

Question	p-value
Comfortable	**<0.001**
Alert	**0.014**
Anxious	**<0.001**
Relaxed	**<0.001**
Excited	**<0.001**
Calm	**<0.001**
Included	**<0.001**
Distracted	**<0.001**
Productive	**<0.001**
Tense	**<0.001**
Content	**<0.001**
Overwhelmed	**<0.001**
Individual Work	**<0.001**

Table 4.1 Effect of participant perception response across the simulated environments

Box and Whisker plots for each question from the questionnaire exemplify the participants' response to the intervention according to the likert rating scale. A rating of 1 signifies "strongly disagree," a rating of 2 signifies "disagree," a rating of 3 signifies "somewhat disagree," a rating of 4 signifies "neutral," a rating of 5 signifies "somewhat agree," a rating of 6

signifies “agree,” and a rating of 7 signifies “strongly agree.” Therefore, a “higher” rating corresponds to a sentiment with which the participant relates, whereas a “lower” ranking signifies a statement with which the participant does not relate. The corresponding pairwise comparison tables note whether or not there is a statistically significant difference in the means of participant responses according to the intervention, after the Bonferroni correction was applied. A p-value of <0.05 is signaled by a check mark and a p-value of >0.05 is signaled by an ×. The corresponding numerical p-values are provided in the supplemental materials section of this thesis. Each questionnaire statement is individually examined in Figures 4.2 – 4.14.

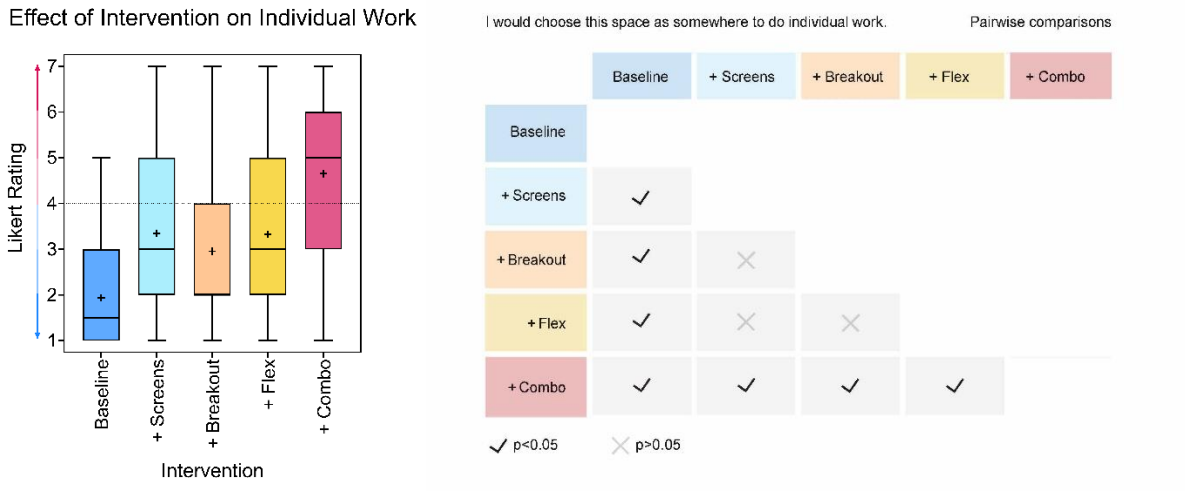


Figure 4.2 Box and Whisker Plot with corresponding pairwise comparison table showing effect of intervention on participant response of preference of the environment in which to do Individual Work

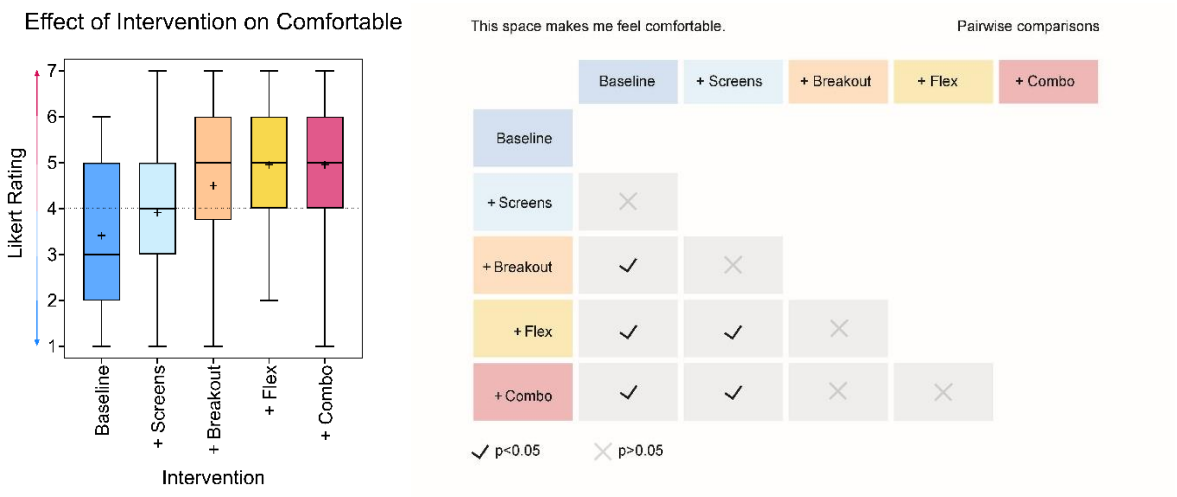


Figure 4.3 Box and Whisker Plot with corresponding pairwise comparison table showing effect of intervention on participant response of Comfortable

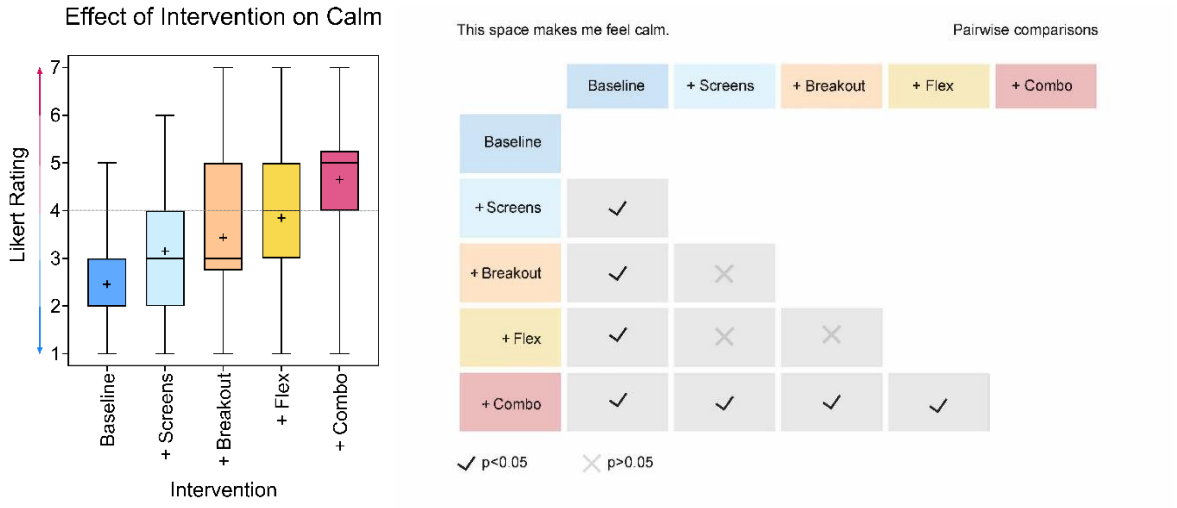


Figure 4.4 Box and Whisker Plot with corresponding pairwise comparison table showing effect of intervention on participant response of Calm

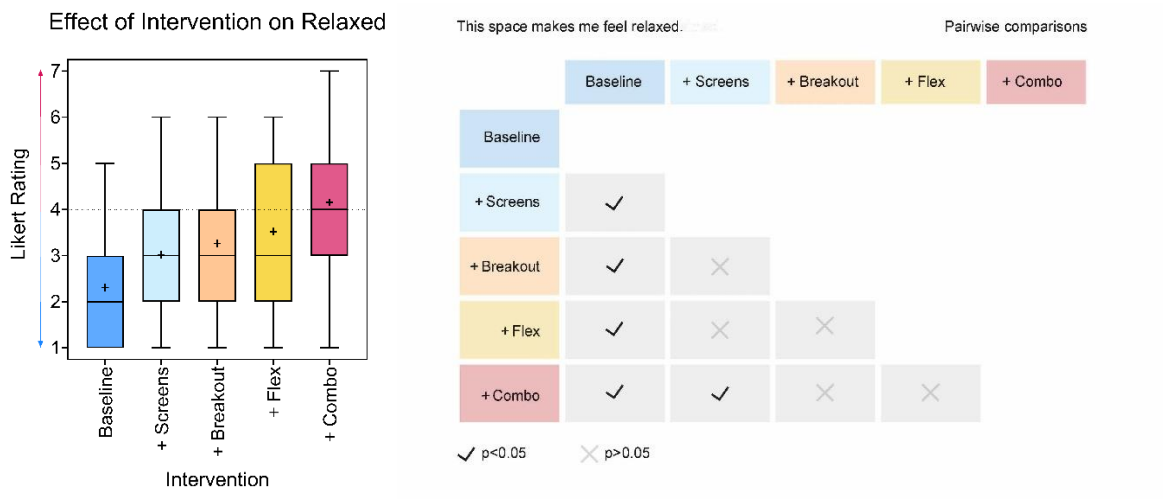


Figure 4.5 Box and Whisker Plot with corresponding pairwise comparison table showing effect of intervention on participant response of Relaxed

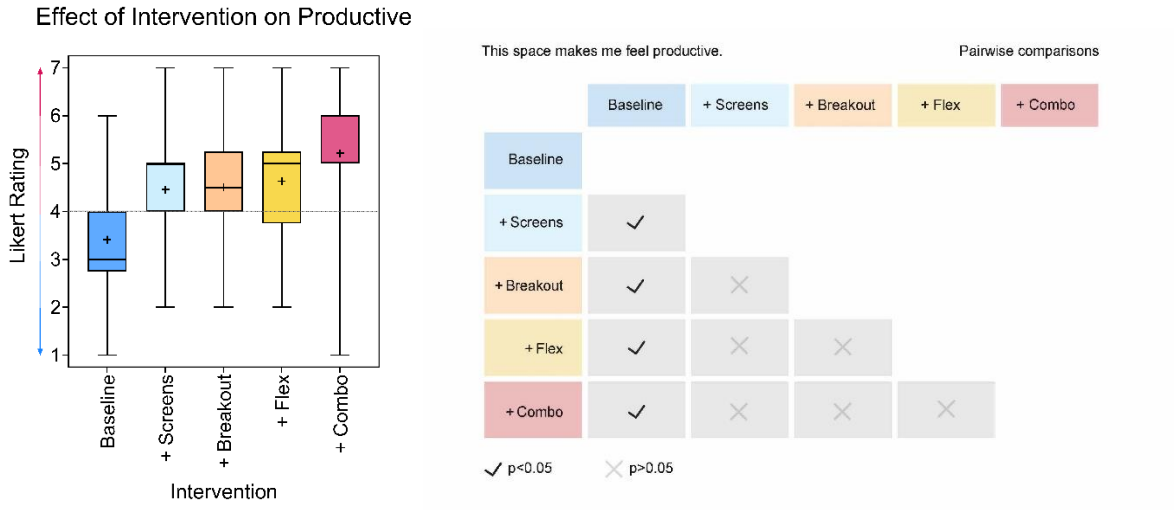


Figure 4.6 Box and Whisker Plot with corresponding pairwise comparison table showing effect of intervention on participant response of Productive

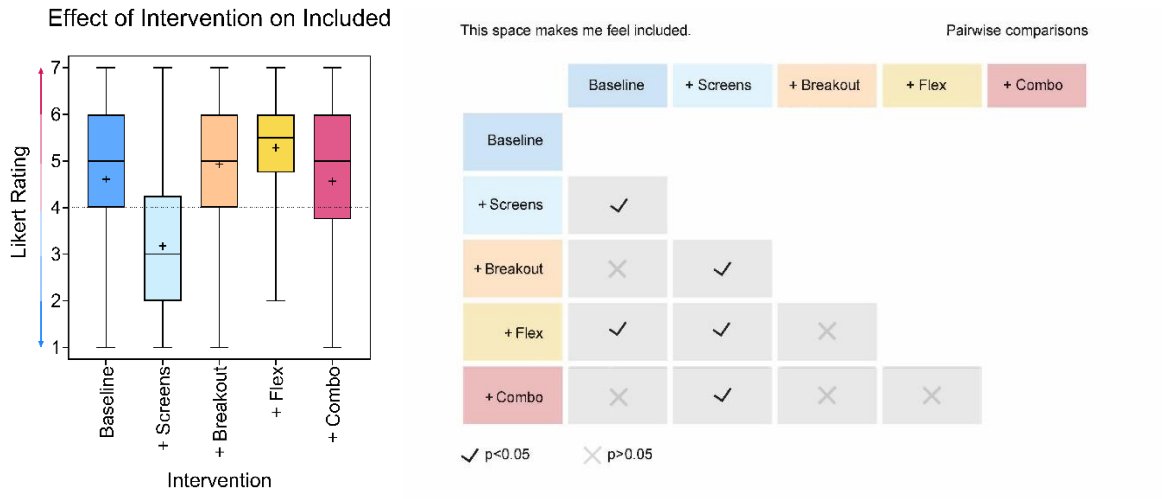


Figure 4.7 Box and Whisker Plot with corresponding pairwise comparison table showing effect of intervention on participant response of Included

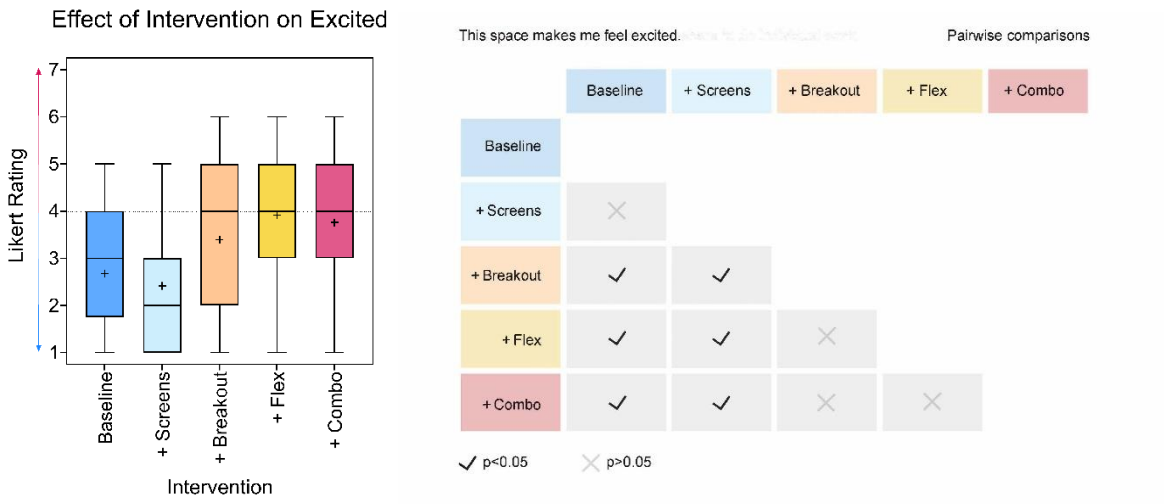


Figure 4.8 Box and Whisker Plot with corresponding pairwise comparison table showing effect of intervention on participant response of Excited

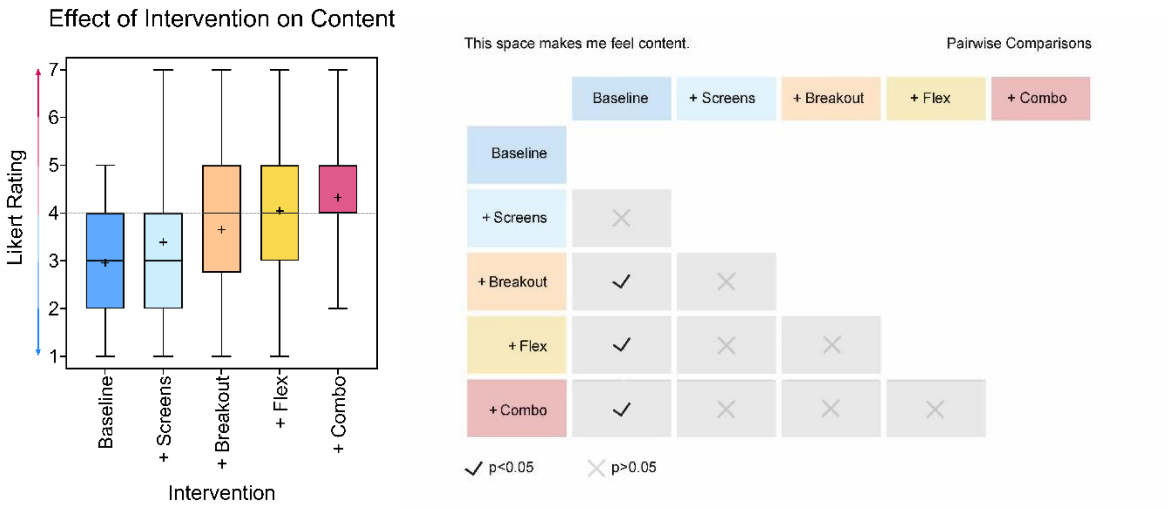


Figure 4.9 Box and Whisker Plot with corresponding pairwise comparison table showing effect of intervention on participant response of Content

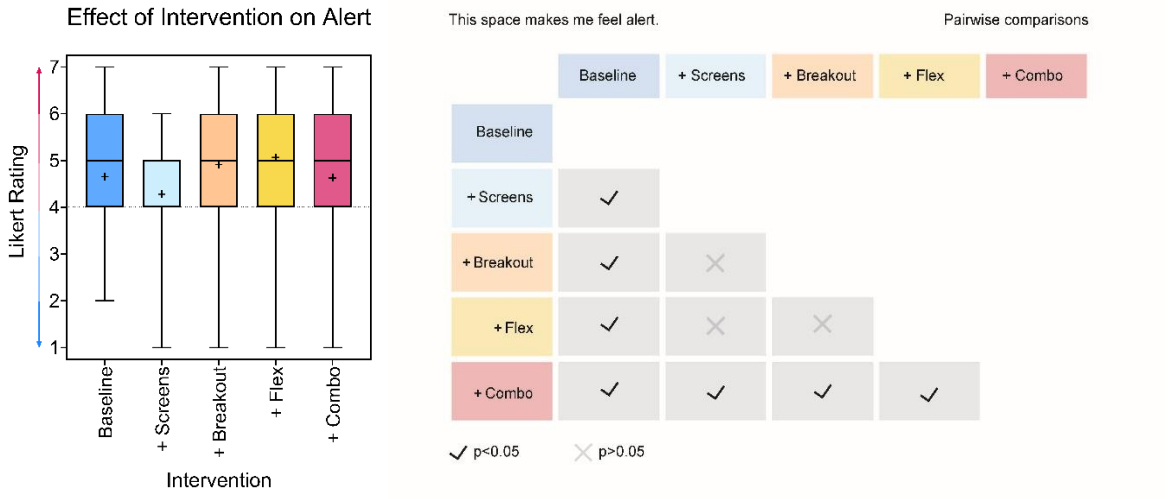


Figure 4.10 Box and Whisker Plot with corresponding pairwise comparison table showing effect of intervention on participant response of Alert

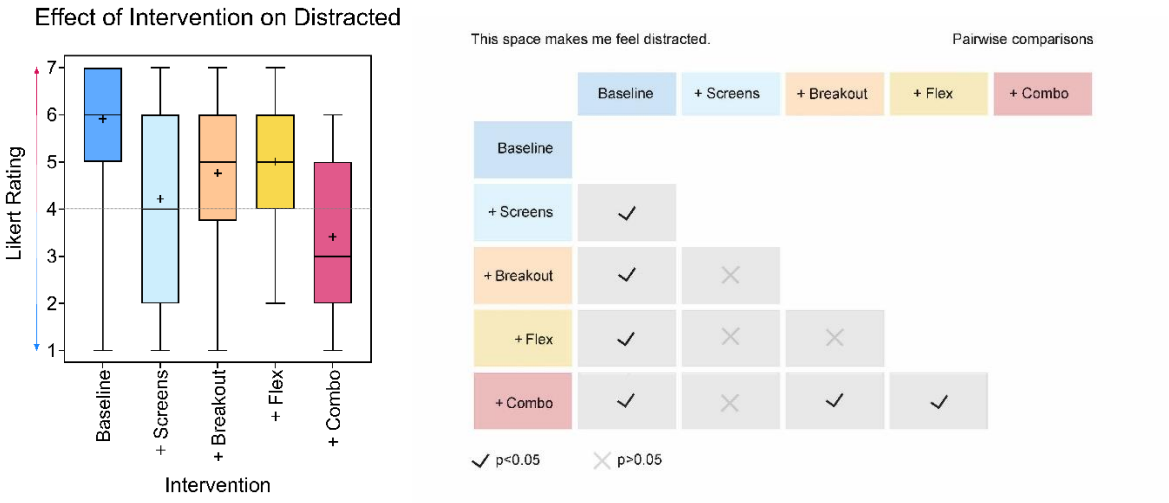


Figure 4.11 Box and Whisker Plot with corresponding pairwise comparison table showing effect of intervention on participant response of Distracted

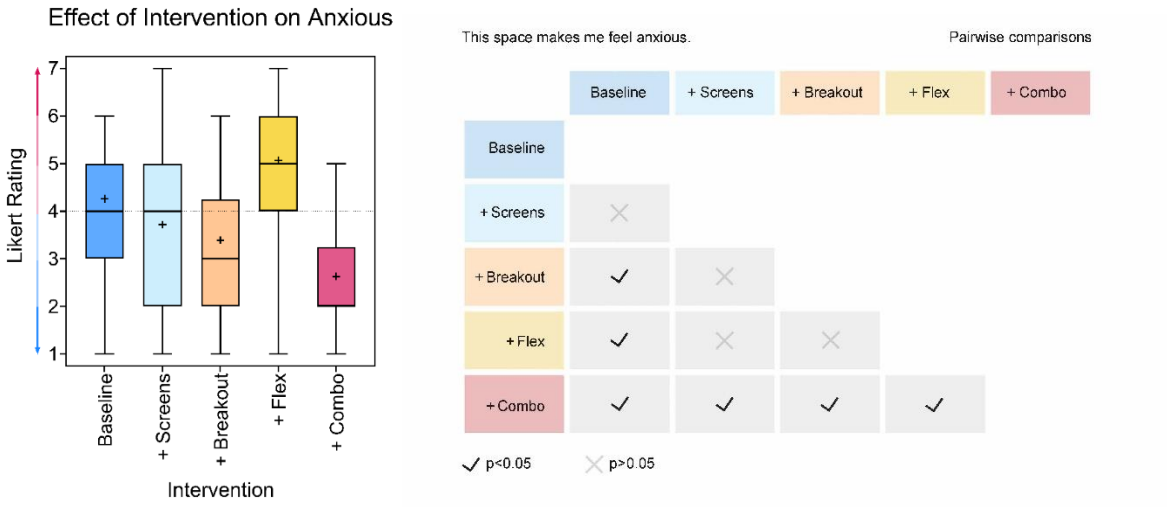


Figure 4.12 Box and Whisker Plot with corresponding pairwise comparison table showing effect of intervention on participant response of Anxious

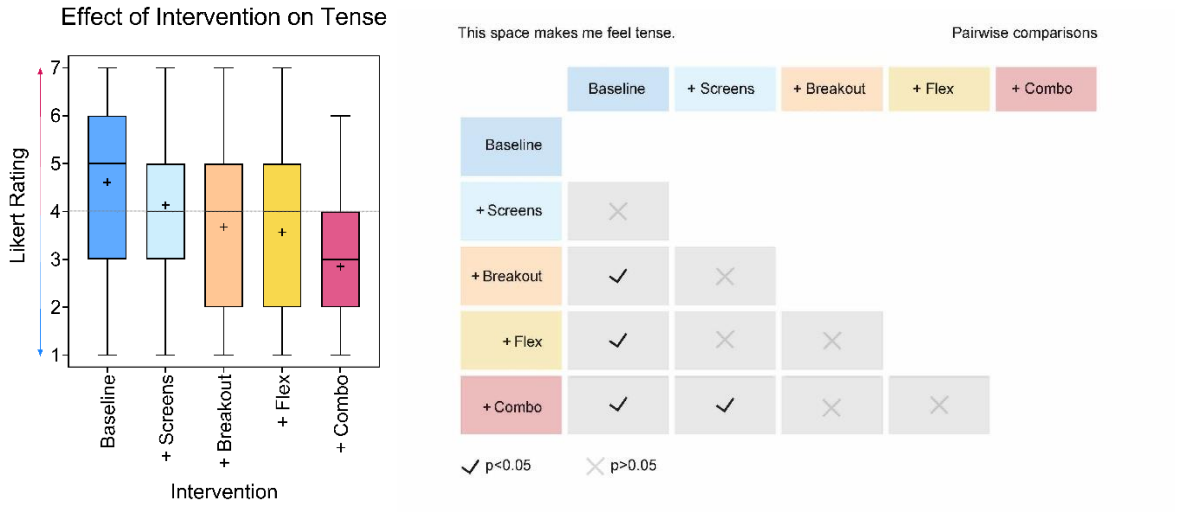


Figure 4.13 Box and Whisker Plot with corresponding pairwise comparison table showing effect of intervention on participant response of Tense

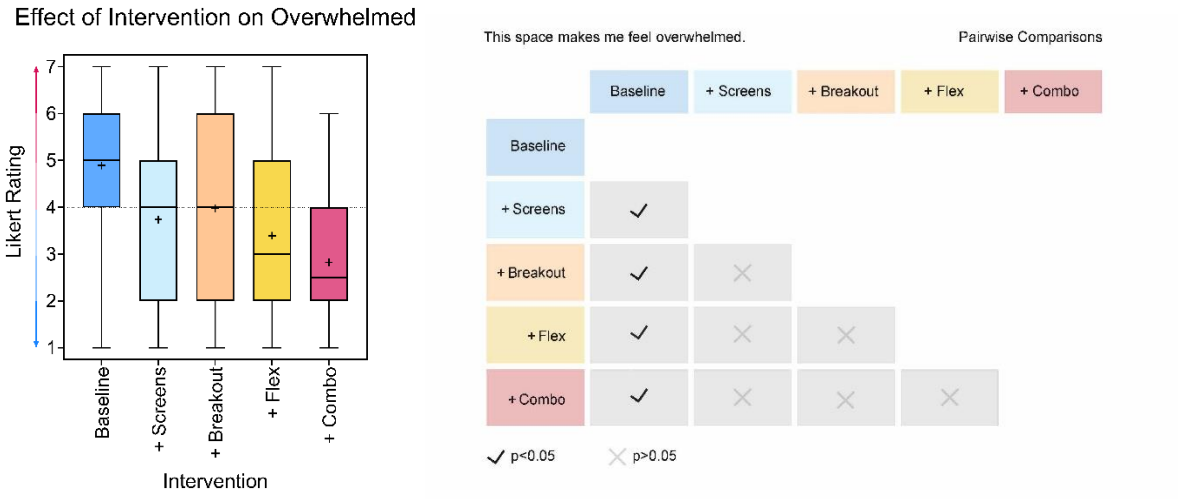


Figure 4.14 Box and Whisker Plot with corresponding pairwise comparison table showing effect of intervention on participant response of Overwhelmed

4.3 Results by Neurotype Comparison

This section examines whether neurodivergent-identifying and neurotypical-identifying pariticpants responded differently within the simulated environments. Of the 46 participants, 34 identified as neurotypical and 12 identified as neurodivergent. The same comparison method was performed as was done with the overall responses, with the additional level of neurotype

consideration as a response factor. Table 4.2 shows the groupings by questionnaire response. In 2 of 13 questions, there was a significant effect of the interaction between the scene and neurotype. In 12 of 13 questions there was a significant effect of scene on participant response. In 3 of 13 questions there was a significant effect of neurotype on participant response.

Two-Way ANOVA Results for Data by Group and Perception: Split by Neurotype

Question	p-value Interaction (Scene x Group)	p-value Scene	p-value Group
Comfortable	0.151	**<0.001**	0.127
Alert	0.198	0.140	0.312
Anxious	0.253	**<0.001**	0.275
Relaxed	0.610	**<0.001**	0.129
Excited	0.312	**<0.001**	0.733
Calm	**0.042**	**<0.001**	**0.041**
Included	**0.003**	**<0.001**	0.222
Distracted	0.719	**<0.001**	0.218
Productive	0.299	**<0.001**	0.05
Tense	0.390	**<0.001**	**0.014**
Content	0.327	**<0.001**	0.199
Overwhelmed	0.103	**<0.001**	**0.022**
Individual Work	0.151	**<0.001**	0.127

Table 4.2 Effect of neurotype on participant perception response across the simulated environments

The Box and Whisker plots shown in Figure 4.15 compare response distributions and mean values between neurodivergent-identifying and neurotypical-identifying participants across the simulated environments for each questionnaire statement. Overall, those self-identifying as neurodivergent responed with lower-rated responses and wider ranges in responses compared to their neurotypical counterparts.

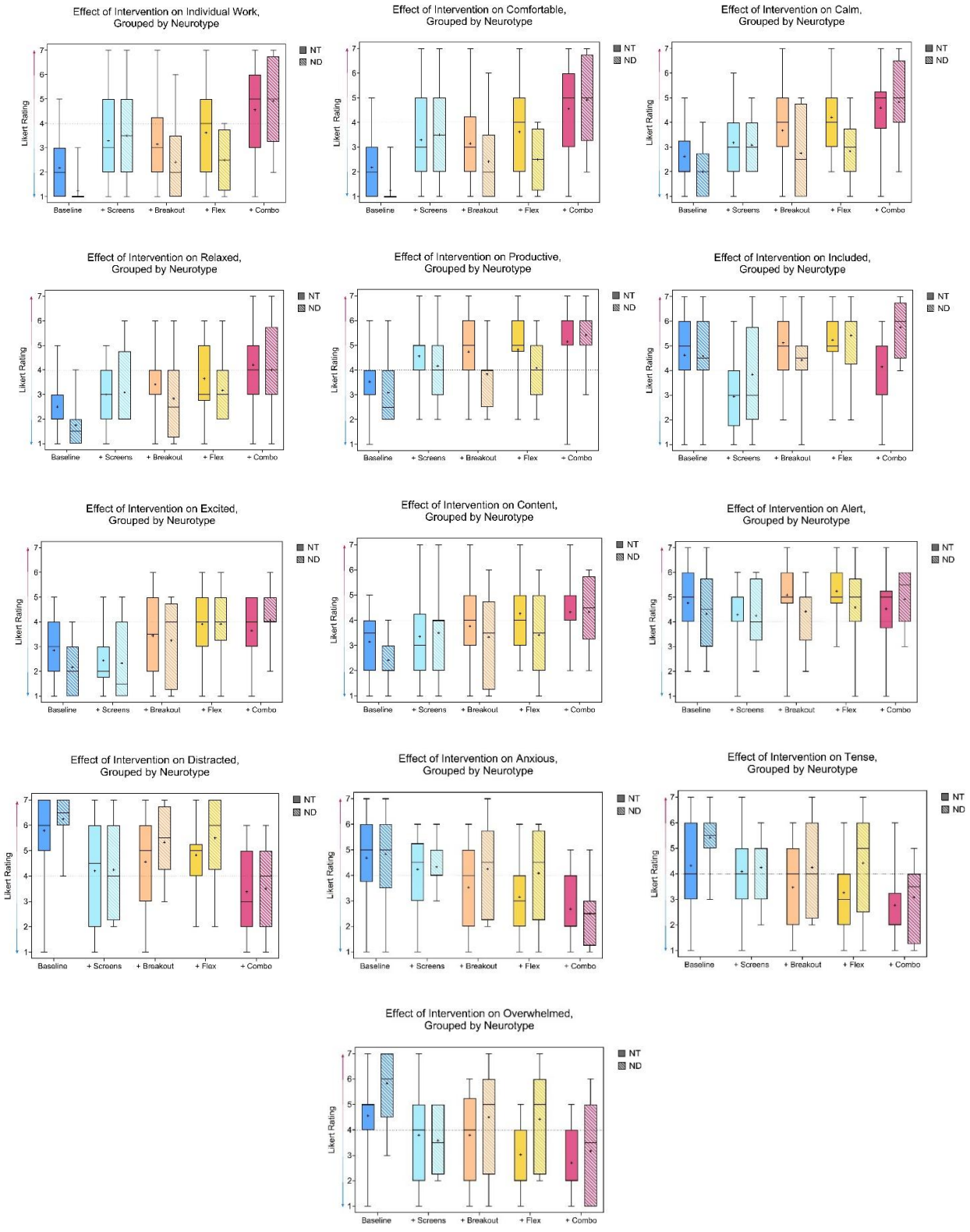


Figure 4.15 Box and Whisker plots showing effect of intervention on each of the questionnaire statements, with neurotype comparisons

4.4 Results by Sensory Experience Comparison

Because neurodivergence encompasses diverse sensory experiences, additional analysis was conducted based on self-reported sensory sensitivities. Of the 46 participants, 26 reported that they experience sensory sensitivities and 20 reported that they do not. In 1 of 13 questions there was a significant effect of the interaction of scene and sensory experience group on participant response. In all 13 questions there was a significant effect of scene on participant response, while there was no significant effect of sensory experience group on participant response. Table 4.3 shows the groupings by questionnaire response.

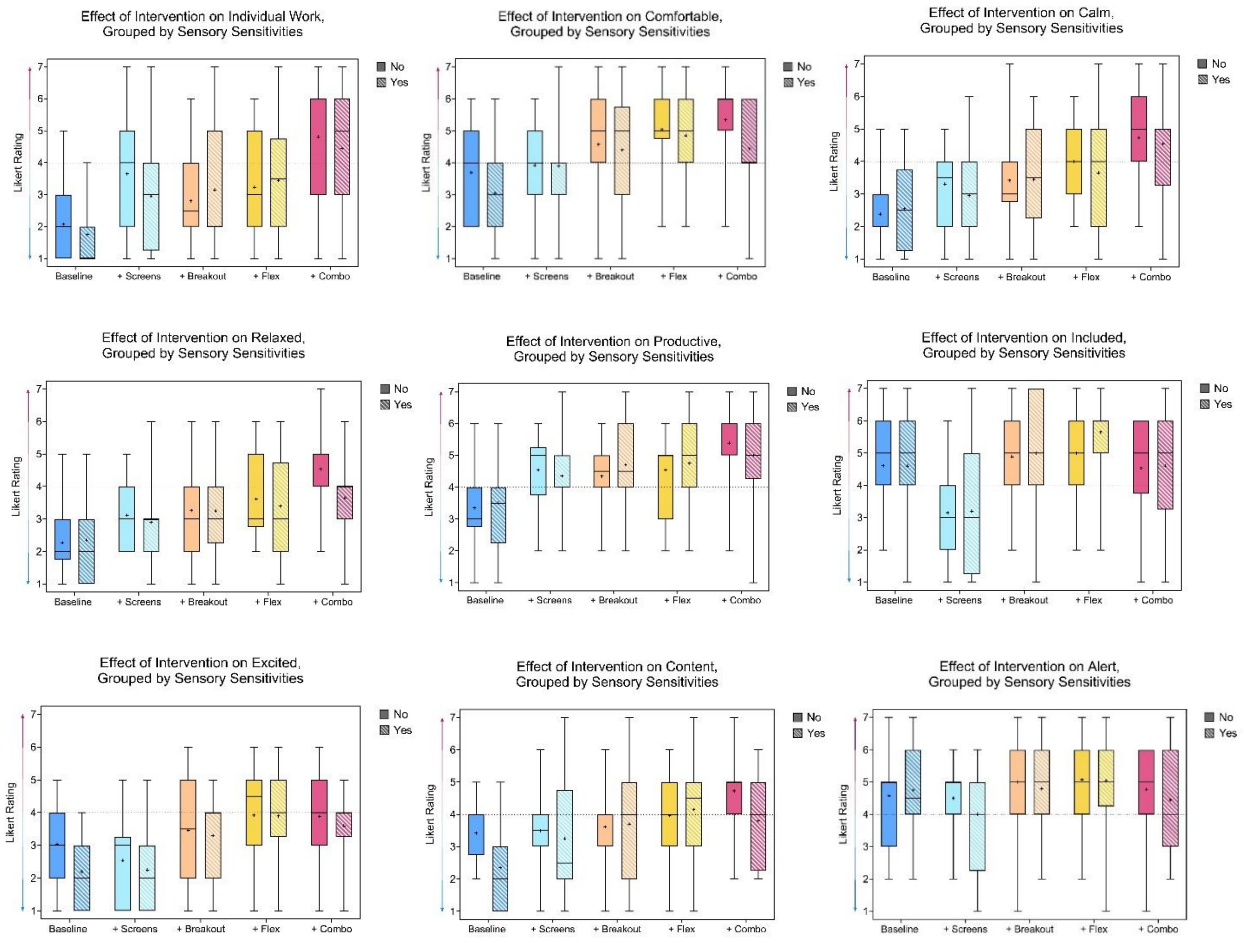
Two-Way ANOVA Results for Data by Group and Perception: Split by Sensory

Question	p-value Interaction (Scene x Group)	p-value Scene	p-value Group
Comfortable	0.339	**<0.001**	0.150
Alert	0.642	**0.008**	0.482
Anxious	0.283	**<0.001**	0.646
Relaxed	0.331	**<0.001**	0.268
Excited	0.466	**<0.001**	0.256
Calm	0.811	**<0.001**	0.569
Included	0.759	**<0.001**	0.545
Distracted	0.211	**<0.001**	0.720
Productive	0.583	**<0.001**	0.886
Tense	0.307	**<0.001**	0.566
Content	**0.034**	**<0.001**	0.120
Overwhelmed	0.220	**<0.001**	0.478
Individual Work	0.475	**<0.001**	0.523

Table 4.3 Effect of sensory experience on participant perception response across the simulated environments

The Box and Whisker plots shown in Figure 4.16 compare response distributions and mean values between participants who expressed that they experience sensory sensitivities and participants who expressed that they do not experience sensory sensitivities, across the simulated environments for each questionnaire statement. Once again, there is an observed overall wider

range of response ratings across the questions and scenes for those reporting sensory sensitivities compared to those reporting no sensory sensitivities. Further Post-Hoc analysis can be performed to delve into this deeper.



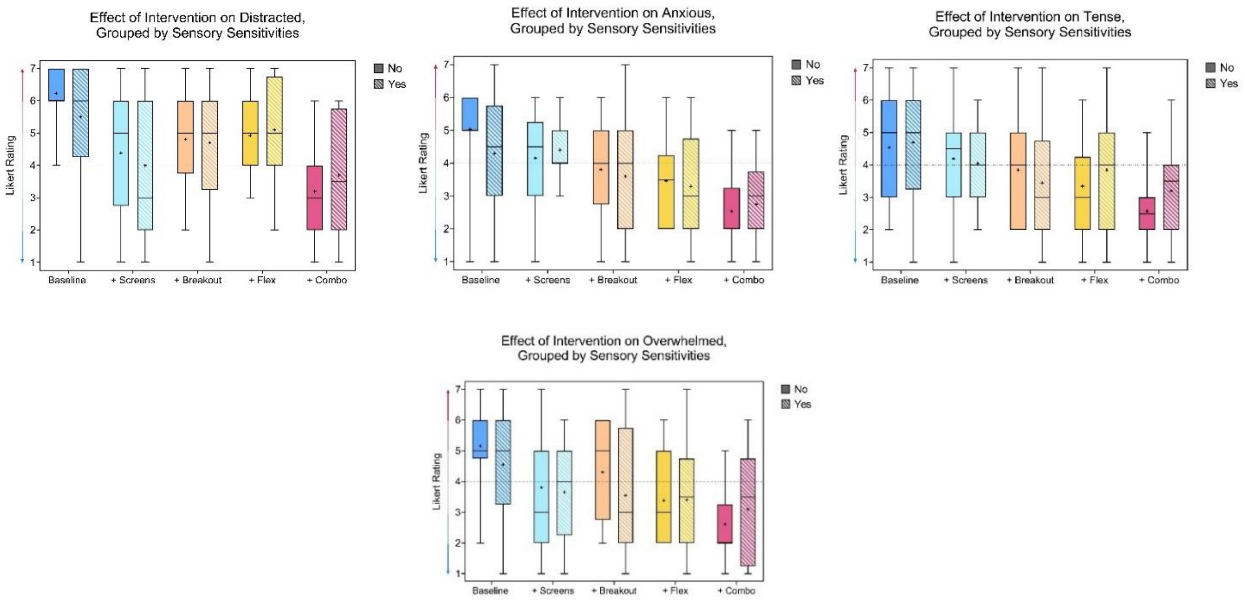


Figure 4.16 Box and Whisker plots showing effect of intervention on each of the questionnaire statements, with sensory experience comparisons

4.5 Impact of Architectural Intervention on Cognitive Performance

Cognitive performance was analyzed across the simulated environments by Stroop Test completion time and number of errors. The Box and Whisker plots in Figure 4.17 show the effect of intervention on these cognitive performance measures overall. Table 4.4 then compares the Stroop Test completion time significance effects broken up by analysis group. While the range of response ratings varies by simulated environment, there is no overall significant difference between Stroop Test completion time or number of errors across the environments overall.

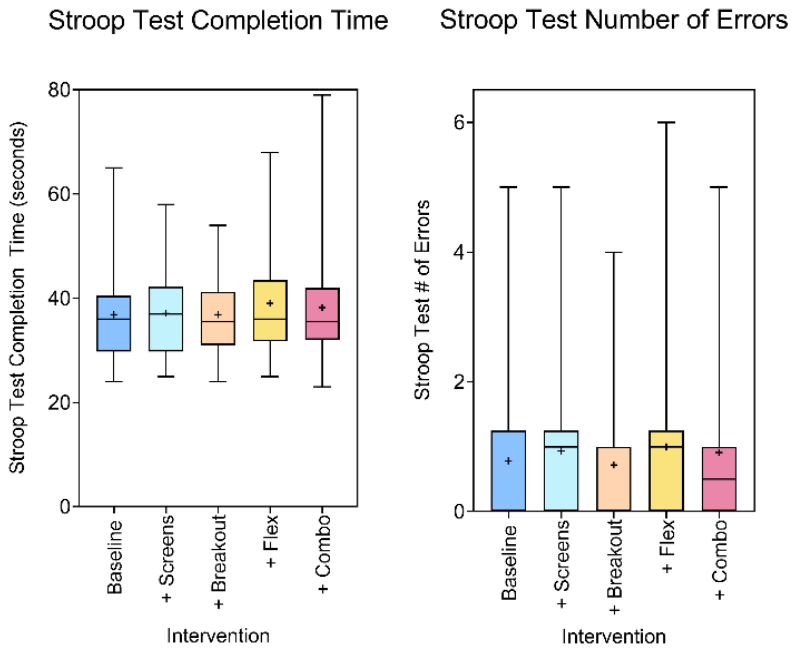


Figure 4.17 Effect of intervention on Stroop Test completion time and errors, overall

Two-Way ANOVA Results for Data by Group and Stroop Completion Time

Group	p-value Interaction (Scene x Group)	p-value Scene	p-value Group
Split by Neurotype	0.356	0.132	0.893
Split by Sensory	0.433	0.063	**<0.001**
Split by Specific Sensory	0.073	**0.033**	**0.021**

Table 4.4 Effect of Stroop Test completion across the simulated environments, by group

Additional analyses were conducted to examine whether participant responses differed across environmental conditions based on neurotype and sensory experience. Figures 4.18 and 4.19 present Box and Whisker plots of Stroop Test performance grouped by neurotype and self-reported sensory experience, respectively. Because the simulated design interventions specifically targeted auditory and visual-spatial characteristics, an supplementary analysis was performed to examine participant responses within these sensory groups. The results of this

analysis is presented in Figure 4.20. There is observed difference in range of Stroop Test completion time and number of errors across the simulated environments when broken down into comparison groups. The Stroop Test completion time is significantly higher for those noting that they experience sensory sensitivities compared to those noting that they do not experience sensory sensitivities. In observing differences in range of response between the comparison groups, further Post-Hoc analysis could be performed to determine the relationship between the individual simulated environments and noted sensory experience. This could be especially useful in understanding the individual sensory experiences within each of the environments.

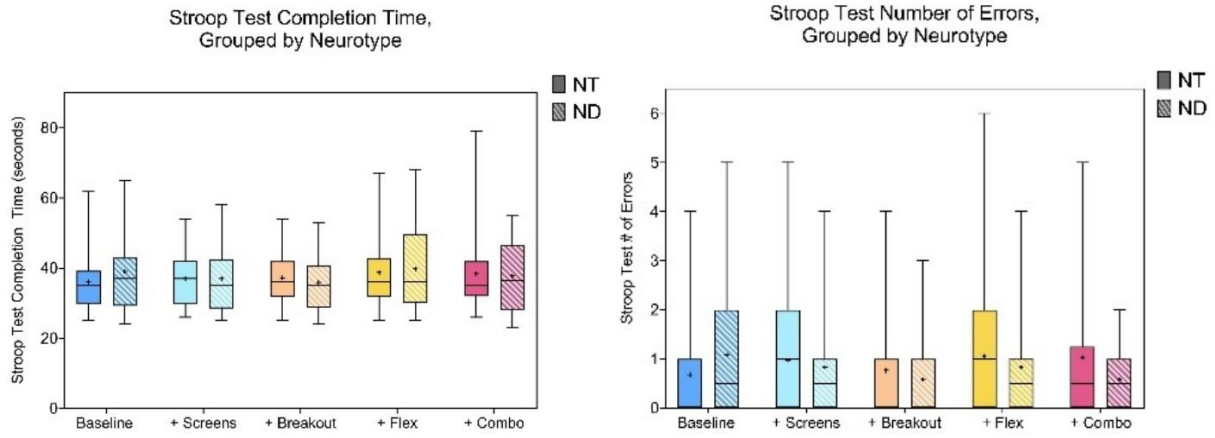


Figure 4.18 Effect of intervention on Stroop Test completion time and errors, by neurotype

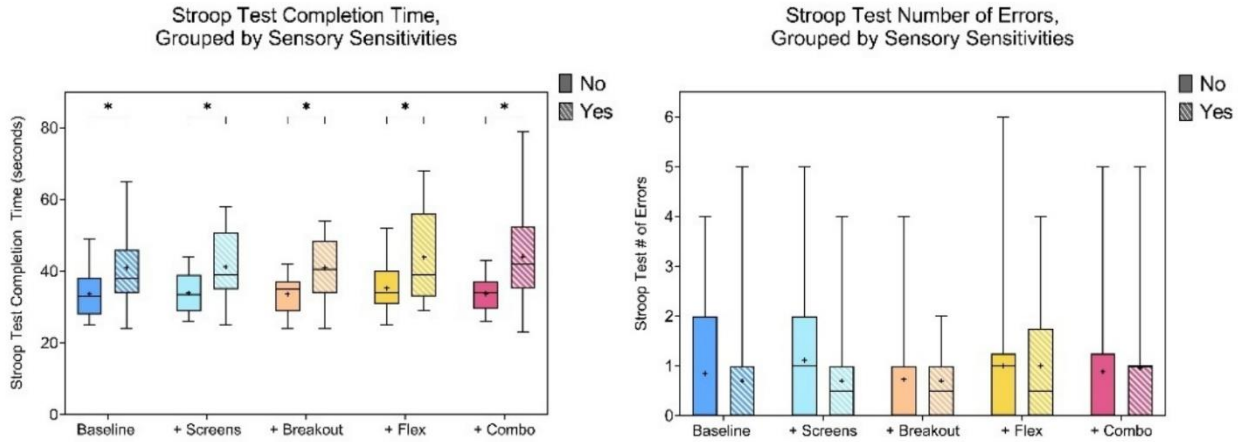


Figure 4.19 Effect of intervention on Stroop Test completion time and errors, by sensory experience

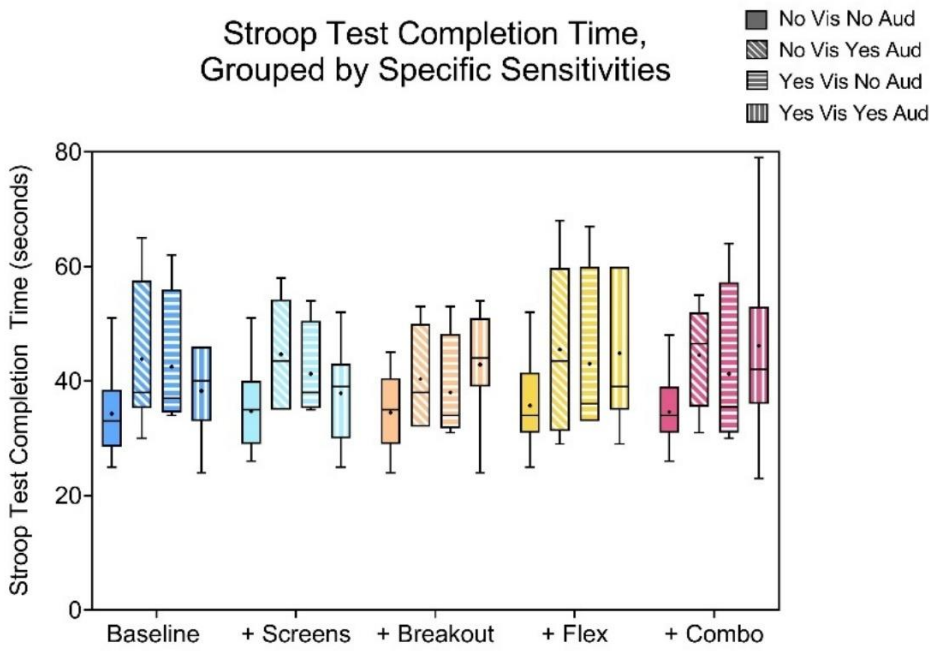


Figure 4.20 Effect of intervention on Stroop Test completion time and errors, by specific sensory experience

CHAPTER 5 – DISCUSSION

5.1 Findings by Simulated Environment

Comparison of participant responses across the five simulated office environments revealed distinct patterns in perceptions of environmental quality. While no single intervention received the greatest level of agreement across every perception measure, several trends emerged. The combination intervention had the greatest proportion of participants indicating that they would choose the environment for individual work and received the greatest agreement with statements related to comfort, calmness, and productivity. The flexible seating intervention received the greatest frequency of agreement with statements related to comfort and inclusion, whereas responses to the privacy screen intervention were more evenly distributed across several perception measures. Although the breakout room intervention received agreement with statements related to comfort and inclusion, participant responses also indicated continued perceptions of distraction. Collectively, these findings suggest that interventions providing a range of environmental choices may better accommodate diverse occupant preferences than individual design strategies implemented independently.

Specifically referring to the individual experiences addressed within the environments of this experiment, the data aligned with the hypothesis that occupant perceptions will differ significantly between open-plan and intervention-based environments. Spatial configurations with incorporated privacy elements resulted in more varied occupant perception compared to the open-plan environment. Occupant perception via the subjective questionnaire provided more significant findings overall, whereas the cognitive performance measures presented less range of response overall.

Baseline Open-Plan

The baseline open-plan environment contained no architectural interventions. The responses observed in this condition suggest that participants generally perceived the environment as less supportive of focused individual work. Reports of distraction, anxiety, and overwhelm, coupled with lower ratings of comfort and calmness, are consistent with previous research identifying open-plan offices as environments that may contribute to cognitive distraction and reduced environmental satisfaction (Haapakangas et al., 2014; James et al., 2021). While participants also reported feeling included and alert, these findings may reflect on the collaborative characteristics typically associated with open-plan workplaces. The mixed responses regarding tension suggest greater variability in individual experiences, highlighting that perceptions of open-plan environments are not uniform across occupants.

+ Privacy Screens Intervention

Compared to the baseline condition, the addition of privacy screens produced a more varied distribution of participant responses, suggesting greater individual variability in how the intervention was perceived. Increased reports of productivity alongside continued reluctance to work in the environment indicate that reducing visual exposure alone may not be sufficient to improve overall perceptions of workplace quality.

+ Breakout Rooms Intervention

The breakout room intervention produced a distinct pattern of participant respones. Although the environment was generally not preferred for individual work, participants more frequently reported feeling comfortable and included than in the baseline condition. The simultaneous reporting of comfort and distraction suggests that introducing enclosed breakout spaces alone may not substantially reduce perceived environmental distractions within the

surrounding open-plan office. The relatively balanced responses for productivity and anxiousness further indicate variability in how occupants experienced this intervention.

+ Flexible Seating Intervention

The flexible seating intervention was associated with increased reports of comfort and productivity while also maintaining relatively high levels of perceived distraction. This pattern suggests that providing greater choice in seating arrangements may enhance perceptions of the workplace without fully addressing environmental distractions associated with the open-plan layout. Lower reports of anxiety, tension, and overwhelm may indicate that flexibility contributes to a more supportive work environment for some occupants.

+ Combination Intervention

The combination intervention produced the most consistently positive pattern of participant responses across the evaluated environments. By integrating multiple design strategies, including privacy screens, breakout rooms, and flexible seating, the intervention addressed several aspects of the workplace simultaneously.

5.2 Findings by Individual Question

Individual Work

In terms of preference for an environment in which to perform individual work, the baseline open-plan simulation was ranked significantly lower than each of the intervention environments. Conversely, the combination intervention environment was ranked significantly higher than both the separate intervention environments and the baseline condition. These findings suggest that incorporating multiple architectural interventions within a single workplace environment better support individual work preferences than implementing a single intervention alone.

Comfortable

With respect to participant perceptions of comfort, the baseline open-office environment was ranked significantly lower than the breakout room, flexible seating, and combination intervention environments. In additon, the flexible seating and combination intervention environments both were ranked significantly higher than both the privacy screens intervention and the baseline condition. These findings suggest interventions incorporating breakout rooms, flexible seating, or a combination of multiple design strategies were associated with greater agreement with statements related to comfort. By comparison, the privacy screen intervention alone did not demonstrate the same pattern of participant responses.

Calm

In participant ratings of perceived calm across the simulated environments, the basline open-office condition was rated significantly lower than each of the intervention environments. Conversely, the combination intervention environment was rated significantly higher than all the other simulated conditions. These findings suggest that the tested auditory and visual-spatial interventions were associated with greater agreements with statements related to calmness compared to the baseline open-office condition. The combination interventon, which incorporated multiple design strategies, demonstrated the strongest relationship with participant perceptions of calm.

Relaxed

Participants rated each intervention environment significantly higher on average than the baseline open-office environment in relation to feelings of relaxation. Additionally, the combination intervention environment was rated significantly higher than both the baseline condition and the privacy screen intervention environment. Among the simulated environments,

the combination intervention wass the only condition in which the average participant response indicated agreement with the statement related to feeling relaxed.

Productive

Participants reported significantly greater agreement with statements related to productivity in each of the intervention environments compared to the baseline open-office condition. This provides evidence that the incorporation of any of the tested interventions increases feelings of productivity. The responses for the combination intervention condition are concentrated towards the highest rating of the space compared to each of the other envionrments. These findings are particularly relevant to workplace design, where perceptions of productivity are an important component of occupant experience and environmental evaluation.

Included

The privacy screen intervention environment was rated significantly lower in relation to perceived inclusion compared to each of the other intervention environments, and the baseline open-office condition. Additionally, the flexible seating intervention environment was rated significantly higher than the baseline open-office environment. These findings suggest that the flexible seating arrangement was associated with greater agreement with statements related to inclusion, whereas the privacy screen intervention alone did not demonstrate the same pattern of participant responses. The difference between these conditions may indicate that visual separation and increased privacy do not necessarily correspond with greater perceptions of inclusion within a workplace environment.

Excited

In ratings related to feelings of excitement within the simulated office environments, participants reported significantly lower agreement with statements related to excitement in both

the baseline open-office condition and the privacy screen intervention compared to the other intervention environments. It is important to note that the average participant response for all simulated environments remained below the neutral midpoint of the scale.

Content

Participants reported a significantly higher level of agreement with statements related to contentment in the breakout room, flexible seating, and combination intervention environments compared to the baseline open-office condition. The privacy screen intervention environment showed a slight increase in average contentment ratings compared to the baseline condition, however the difference was not statistically significant.

Alert

Participants reported similar levels of agreement with statements related to alterness across all simulated environments. Average responses for each office condition indicated agreement with the perception of being alert within the environment, with no significant differences observed between conditions.

Distracted

Participants reported significantly greater agreement with statements related to distraction in the baseline open-office condition compared to each of the intervention environments. The combination intervention environment received significantly lower distraction ratings than the other simulated environments, with the exception of the privacy screen intervention condition. These findings suggest that environments incorporating privacy screens were associated with lower agreement with distraction-related statements, indicating a potential relationship between visual-spatial separation strategies and perceived distraction within the workplace environment.

Anxious

In relation to feelings of anxiety across the simulated office environments, participants reported significantly lower agreement with statements related to anxiousness in the combination intervention environment compared to each of the other conditions. Additionally, participants reported significantly greater agreement with anxiousness-related statements in the baseline open-office condition compared to the privacy screen, breakout room, and combination intervention environments. Conversely, the flexible seating intervention environment received significantly higher anxiety ratings compared to the baseline condition. The variation observed across individual interventions indicates that different workplace interventions may influence perceptions of anxiety in distinct ways.

Tense

Participants reported significantly lower agreement with statements related to feeling tense in the breakout room, flexible seating, and combination intervention environments compared to the baseline open-office condition. Additionally the combination intervention environment received significantly lower tension ratings than the privacy screen intervention condition. The difference between the combination intervention and privacy screen condition may indicate that a broader range of spatial options contributed to more favorable perceptions related to tension.

Overwhelmed

Participants reported significantly greater agreement with statements related to feeling overwhelmed in the baseline open-office environment compared to each of the intervention environments. These findings suggest that each tested intervention condition was associated with lower reported perceptions of overwhelm compared to the baseline. The consistency of this

response across intervention conditions indicates that multiple approaches to modifying the workplace environment may support perceptions of reduced sensory and spatial stressors.

5.3 Findings by Neurotype

Neurodivergent-identifying paricipants demonstrated greater variation in responses across environmental conditions compared to neurotypical-identifying participants. The mean value responses were generally lower for neurodivergent-identifying participants compared to the mean value responses for neurotypical-identifying participants. The largest differences between groups occurred within measures related to calmness, tension, overwhelm, and inclusion, which collectively reflect aspects of perceived environmental comfort. Notably, neurodivergent-identifying participants reported lower agreement with statements related to feeling overwhelmed in the privacy screen intervention environment and lower agreement with statements related to feeling anxious in the combination intervention compared to neurotypical-identifying participants. These findings suggest that specific architectural interventions may influence perceptions of environmental comfort differently across participant groups.

5.4 Findings by Sensory Experience

While comparisons between neurotype groups provide insight into differences in environmental perception, analysis of sensory experience offers a more individualized understanding of how architectural conditions may influence occupant responses. Generally, participants reporting sensory sensitivities demonstrated differences in perception across simulated environments, indicating that environmental modifications may not produce uniform outcomes across all users. There were no statistically significant differences found in responses overall between the sensory experience groups.

5.5 Findings by Cognitive Performance

Analysis of Stroop Test performance revealed no statistically significant differences in either task completion time or number of errors across the five simulated office environments. Similarly, no significant differences were observed between neurodivergent-identifying and neurotypical-identifying participants. Collectively, these findings suggest that the architectural interventions evaluated in this study did not measurably influence cognitive task performance under the conditions tested

In contrast, comparisons based on self-reported sensory experience identified a significant difference in Stroop Test completion time within each simulated environment. On average, participants who did not report sensory sensitivities completed the Stroop Test more quickly than participants who reported sensitivities. This pattern was also observed when participants were grouped by self-reported auditory and visual-spatial sensitivities. The consistency of these findings across all simulated office conditions suggests that individual sensory experience may have a greater influence on cognitive task performance than the architectural interventions themselves.

Although the interventions did not produce significant differences in objective task performances across environments, cognitive performance remains an important consideration in workplace design.

CHAPTER 6 – LIMITATIONS AND FUTURE WORK

This study represents an exploration of how architectural design can respond to sensory variation and influence occupant experience. As sensory experiences are highly individual and multifaceted, the findings also identify opportunities for future research to further examine the relationship between environmental conditions, perception, and physiological response. This thesis did not focus on a single diagnostic category, but rather examines sensory sensitivities that may across neurodivergent populations. Future research could investigate specific neurotypes or sensory profiles to develop more targeted understandings of how individuals respond to architectural interventions.

The experimental conditions examined auditory and visual-spatial environmental stimuli, while other sensory domains were not explicitly incorporated into the analysis. Because individuals may experience multisensory interactions between environmental inputs, future studies could expand upon this work by investigating the combined influence of multiple sensory conditions within architectural environments or untangle the influence of the individual sensory interactions.

Due to recruitment methods that maintained anonymity regarding neurotype and sensory identities, participant groups were not evenly distributed across demographic categories. This imbalance introduces additional uncertainty when interpreting between-group comparisons. Future replications with larger and more participant samples would strengthen the reliability of staistical comparisons and provide greater confidence in the observed relationships. However, the effect sizes identified within this study remain informative in evaluating patterns of response across participant groups.

The research protocol developed for this study provides a stepping stone towards future application within physical architectural environments. Translating the experimental methodology into built-space case studies could further examine how sensory-focused design interventions perform within real-world workplace settings.

Although physiological data were collected as part of the experimental protocol, analysis of these measures was outside the scope of this thesis. Future analysis of galvanic skin resopnse (GSR) and heart rate variability (HRV) data may provide additional insight into emotional responses associated with each simulated intervention and further contribute to understanding the relationship between architectural design and the human experience. Future work combining physiological measures with subjective perception data may provide a more comprehensive understanding of how architectural interventions influence occupant experience.

In observing trends in the data for results between comparison groups for sensory experience and neurotype, additional post-hoc analysis and correlation analysis could be performed for another layer of understanding of impact of the intervention simulations inividually. Overall, this study presents the impacts of workplace interventions on emotional and cognitive responses to further the understanding of occupant experience.

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SUPPLEMENTAL INFORMATION

Descriptive Statistics

Descriptive Statistics

Y/N_Sensory	Neurotype		Mean	Std. Deviation	N
Baseline: Tense	No	Neurodivergent	5.25	0.5	4
		Neurotypical	4.41	1.436	22
		Total	4.54	1.363	26
	Yes	Neurodivergent	5.5	1.414	8
		Neurotypical	4.17	1.749	12
		Total	4.7	1.72	20
	Total	Neurodivergent	5.42	1.165	12
		Neurotypical	4.32	1.532	34
		Total	4.61	1.513	46
Privacy Screens: Tense	No	Neurodivergent	4.75	1.258	4
		Neurotypical	4.09	1.306	22
		Total	4.19	1.297	26
	Yes	Neurodivergent	4	1.195	8
		Neurotypical	4.08	1.505	12
		Total	4.05	1.356	20
	Total	Neurodivergent	4.25	1.215	12
		Neurotypical	4.09	1.357	34
		Total	4.13	1.31	46
Breakout Rooms: Tense	No	Neurodivergent	4.25	2.217	4
		Neurotypical	3.77	1.378	22
		Total	3.85	1.488	26
	Yes	Neurodivergent	4.25	1.982	8
		Neurotypical	2.92	1.311	12
		Total	3.45	1.701	20
	Total	Neurodivergent	4.25	1.96	12
		Neurotypical	3.47	1.398	34
		Total	3.67	1.578	46
Flexible Seating: Tense	No	Neurodivergent	4.25	1.708	4
		Neurotypical	3.18	1.296	22
		Total	3.35	1.384	26
	Yes	Neurodivergent	4.5	2.07	8
		Neurotypical	3.42	1.621	12
		Total	3.85	1.843	20
	Total	Neurodivergent	4.42	1.881	12
		Neurotypical	3.26	1.399	34
		Total	3.57	1.601	46
Combination: Tense	No	Neurodivergent	3.25	1.708	4
		Neurotypical	2.45	0.8	22
		Total	2.58	0.987	26
	Yes	Neurodivergent	3	1.512	8
		Neurotypical	3.33	1.497	12
		Total	3.2	1.473	20
	Total	Neurodivergent	3.08	1.505	12
		Neurotypical	2.76	1.156	34

Descriptive Statistics

Y/N_Sensory	Neurotype		Mean	Std. Deviation	N
Baseline: Content	No	Neurodivergent	2.25	0.5	4
		Neurotypical	3.64	0.848	22
		Total	3.42	0.945	26
	Yes	Neurodivergent	2.5	1.195	8
		Neurotypical	2.25	1.288	12
		Total	2.35	1.226	20
	Total	Neurodivergent	2.42	0.996	12
		Neurotypical	3.15	1.209	34
		Total	2.96	1.192	46
Privacy Screens: Content	No	Neurodivergent	3.25	1.5	4
		Neurotypical	3.55	1.184	22
		Total	3.5	1.208	26
	Yes	Neurodivergent	3.63	2.066	8
		Neurotypical	3	1.859	12
		Total	3.25	1.916	20
	Total	Neurodivergent	3.5	1.834	12
		Neurotypical	3.35	1.454	34
		Total	3.39	1.542	46
Breakout Rooms: Content	No	Neurodivergent	4	2.449	4
		Neurotypical	3.55	1.143	22
		Total	3.62	1.359	26
	Yes	Neurodivergent	3	1.512	8
		Neurotypical	4.17	1.642	12
		Total	3.7	1.658	20
	Total	Neurodivergent	3.33	1.826	12
		Neurotypical	3.76	1.35	34
		Total	3.65	1.479	46
Flexible Seating: Content	No	Neurodivergent	3	1.633	4
		Neurotypical	4.14	1.125	22
		Total	3.96	1.248	26
	Yes	Neurodivergent	3.63	1.768	8
		Neurotypical	4.5	1.508	12
		Total	4.15	1.631	20
	Total	Neurodivergent	3.42	1.676	12
		Neurotypical	4.26	1.263	34
		Total	4.04	1.414	46
Combination: Content	No	Neurodivergent	4.75	1.893	4
		Neurotypical	4.73	0.883	22
		Total	4.73	1.041	26
	Yes	Neurodivergent	4.13	1.246	8
		Neurotypical	3.58	1.379	12
		Total	3.8	1.322	20
	Total	Neurodivergent	4.33	1.435	12
		Neurotypical	4.32	1.199	34
		Total	4.33	1.248	46

Pairwise Comparison Significance Values

