CONCEPTUALIZATION AND ASSESSMENT OF THE HOME WORKSPACE: A PERSON-CENTERED APPROACH

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CONCEPTUALIZATION AND ASSESSMENT OF THE HOME WORKSPACE: A PERSON-CENTERED APPROACH

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LIST OF SYMBOLS AND ABBREVIATIONS

WFH	Work from Home
df	Degrees of Freedom.
M	Mean.
SD	Standard Deviation.
CI	Confidence Interval.
LL	Lower Level
UL	Upper Level

SUMMARY

The prevalence of working from home (WFH) as an alternative work arrangement has gradually increased as a result of pivotal technological, societal, and global developments from the 1990s (Felstead & Henseke, 2017). WFH is not a novel phenomenon, but relatively little attention has been given to the impact of how the spatial environment of the home workspace affects an individual's work experience (Stephenson et al., 2020). Given that remote work is unlikely to recede to pre-Covid-19 pandemic levels (Bana et al., 2020), organizational psychologists should consider the impact of home workspace environments on worker-related outcomes. This study builds upon boundary theory (Ashforth et al., 2000) and architectural perspectives by using person-centered, sensory based (i.e., visual, auditory, olfactory) measures of the home environment. 199 administrative staff participants were administered a survey that measured connections between objective aspects of the home environment (e.g., workspace size), sensory inputs from the home domain, psychological outcomes, and respondent intentions to WFH in the future. Ultimately, objective and self-situated aspects of the home environment positively related to the sensory inputs. Auditory and visual inputs positively related to general stress and home-work boundary violations. Specifically, auditory inputs from the home environment predicted general stress, while visual inputs predicted a more general assessment of home-work boundary violations. Finally, home-work boundary violations were positively related to a worker's intention to work from home in the future. Implications for theory, remote workers, organizational leaders, and designers, are discussed.

CHAPTER 1. INTRODUCTION

Forty-two percent of workers in the US transitioned from office work to working from home (WFH) during the COVID-19 pandemic (Bloom, 2020). The tumultuous and rapid transition from office work to at-home work for many of these workers raised many new challenges (Wanberg et al., 2020). For example, Couch et al. (2020) argued that many current WFH workers experienced stress due to the restructuring of their work and home and physical environments. In addition, many workers have been sharing their home workspaces with household members (Cheema et al., 2020), resulting in difficulties in partitioning a space for work that is distinct from the rest of the home (Fazlurrahman et al., 2020).

Organizational policies supporting flexibility between work and nonwork boundaries has been linked to positive short-term worker outcomes (Allen et al., 2020; Sonnentag et al., 2010). However, research from the teleworking literature suggests that physical co-location of work and home may not always end in positive outcomes (Allen et al., 2013; Schieman & Young, 2010). While some studies have shown initial interest in how working from home may blur work/home boundaries (e.g., Allen et al., 2021; French & Shockley, 2020), there has not been empirical research which investigates how the design of home workspaces may influence the work-home boundary for workers. In particular, even though architects argue that humans come to understand environments through the senses (Spence, 2020), the relationship between workers' sensory inputs from the home and their psychological reactions has not been empirically examined.

Understanding the impacts of an individual's home workspace environment is crucial because the home has become, in effect, the new office for many workers. There are two goals of the current research project: The first goal is to use a multisensory measurement approach to understand how the setup of an individual's home workspace may influence the aspects of the home domain they see, hear, and smell. The second goal is to examine the relationships between the home-sourced sensory inputs and psychological reactions, as well as the relationship between these outcomes and a worker's future intentions to work from home. Using the Ashforth et al. (2000) boundary theory, I proposes and tests several individual linkages in a relationship model to explain the influence of the home workspace environment on the work from home experience (**Figure 1**).

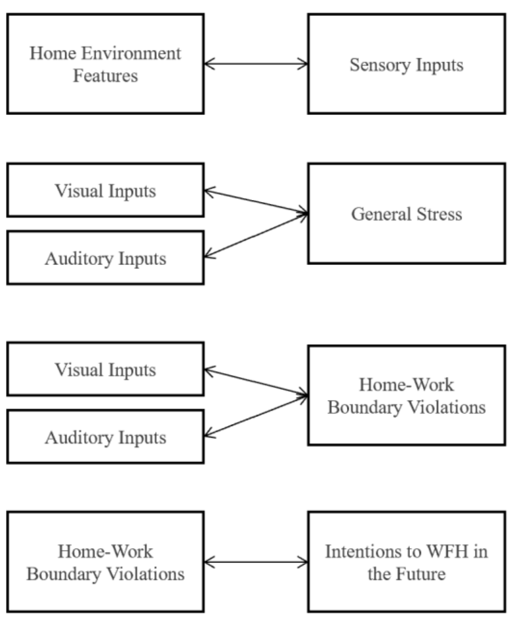


Figure 1 - The proposed relationships

This proposal proceeds as follows. To provide a background for the study, I present a brief review of the past and present work from home research findings and discuss the relative absence of research that address the impact of home workspace environments on WFH outcomes. I introduce boundary theory (Ashforth et al., 2000) and the idea of roles, as they pertain to the WFH arrangement. Next, I provide an overview of past sensory-related examinations of work and nonwork environments. I integrate findings from the psychological and architectural literatures to discuss how design elements may constrain inputs, which may have boundary-related outcomes. This will lead to my hypotheses development.

I make several contributions to the existing work from home, boundary theory, and architecture literatures. Broadly, there has been little investigation of how spatial aspects of the home workspace influence worker-related outcomes (e.g., effects of design of workspace configuration on attitudes and wellbeing outcomes). In this project, I measured objective aspects of the home environment such as workspace size. Additionally, I employed a multisensory perspective to understand the home environment. Previous examinations have focused mainly on measuring reactions to one sense at a time - typically vision. I measured three key sensory inputs from the home environment: visual, auditory, and olfactory. This was done in a novel context – the home environment, where performing work is inherently different from that of in the office due to the co-location of home and work domains. Because of this, I expand upon boundary theorizing to demonstrate a different, but critical, influence on a worker's WFH experience.

1.1 Work from Home Developments and Progression

At the broadest level, WFH is just one facet of remote work, which may be defined as any employment that is accomplished outside a company's main workspace, but is still linked to it (Bailey & Kurland, 2002; Golden & Veiga, 2005). Prior to the emergence of the novel Coronavirus (COVID-19) in November of 2019, there had already been substantial empirical interest in WFH (Felstead & Henseke, 2017), but the practice was not as widespread in major organizations as it is in 2023 (Brewster et al., 1994; Cowans, 1994; Huws, 1994; Solomon & Templar, 1993; Standen, 1997).

Several study findings prior to COVID-19 demonstrated a positive relationship between remote work and employee wellbeing and organizational commitment (Charalampous et al., 2019; Donnelly, 2006; Felstead & Henseke, 2017; Van Horn et al., 2004). The flexibility of this work arrangement contributed to much of the job satisfaction reported by remote employees (Kelliher & Anderson, 2010). Notably, researchers have found that those who benefitted from pre-COVID-19 remote working had a diverse set of resources available to them for WFH, such as information resources, technologies, and physical spaces (Dal Fiore et al., 2014; Kietzmann, 2008). Due to the volitional and self-selecting nature of pre-pandemic remote work, employees who chose to WFH were typically those who were best suited for it. Altogether, these past trends suggest that employee resources contribute to the preference for working from home.

The nature of WFH changed dramatically after the introduction of COVID-19. While WFH was volitional for many employees prior to the pandemic, it was largely the only option available to non-essential employees during the pandemic (Bana et al., 2020). COVID-19 led to a phenomenon never seen before in the modern era; workers scrambled to build viable workstations at home due to necessity rather than choice. They were compelled to make changes in their home workspace to facilitate full-time WFH (Arslan & Allen, 2020). Some workers did not have the resources or time to make their homes suitable for working from home, while others were able to craft effective workspaces at home with little difficulty (Couch et al., 2020). Notably, many workers found WFH to be a viable work arrangement during the pandemic (Barrero et al., 2021; Forbes et al., 2020). Recent findings from Stress and Health indicate that workers might prefer WFH post-pandemic for the flexibility it affords to their work and home lives (Darouei & Pluut, 2021). Findings such as these suggest that employees who may not have considered WFH before the pandemic are now adopting more positive attitudes towards the arrangement. Even popular articles from Forbes, Time, and others suggest that WFH will continue as a widely accepted arrangement after the pandemic ends (Banjo et al., 2020; Hilton, 2020; Kerman et al., 2021; Koetsier, 2020).

Though many employees report that they enjoy the WFH arrangement, research findings from the past two decades have indicated that there may be a ‘pattern of distinguishable spatial needs’ that remote workers must satisfy to effectively promote their over-all work-life quality (Bardram & Bossen, 2005; Kakihara & Sørensen, 2002; Richards, 2015). However, not only have these spatial needs not been uncovered, but there is not an understanding of how the home environment may shape worker experiences.

1.2 Boundaries and the Co-Location of Home and Work

The environment of the home workspace differs in several important ways from that of an office building. Most notably, during WFH, work activities are situated within a physical space typically associated with an individual’s home life. This intersection of work and home is a focal area of interest related to boundary theorizing in organizational research. In 2000, Ashforth and his colleagues introduced boundary theory, which centered on how individuals define and interact with their home and work ‘roles.’ A boundary, in this context, can be thought of as a psychological barrier between these roles that varies in flexibility and permeability. A boundary is more flexible when it allows for the shifting of a person’s work and home roles, and more permeable when it allows ‘in’ aspects of another role (Olson-Buchanan & Boswell, 2006; Kreiner, 2006). The roles of workers are often specified by space (e.g., the office) and time (e.g., 8am-5pm), but can be segmented or integrated together in varying degrees along the flexibility and permeability parameters (Ashforth et al., 2000). During WFH, workers are physically closer to features of their home (e.g., household members, pets, chores, hobbies) than they would be in a separated office location. Because of this, an investigation of environmental influences on a WFH worker should take into consideration this co-location of roles.

1.3 The Environment and a Multisensory Perspective

Modern theorizing in both architecture and environmental psychology domains takes into consideration the social and physical aspects of the environment (Bulger et al., 2007; Desrochers et al., 2005; Glavin & Schieman, 2012; Matthews & Barnes-Farrell, 2010; Myrie & Daly, 2009; Standen et al., 1999; Vieira et al., 2018). Broadly, a physical environment consists of its milieu (or items; e.g., furnishings), activities (e.g., work or home tasks), and occupants (e.g., coworkers or household members; Hattrup & Jackson, 1996; Johns, 2006). These aspects may be changed and understood by occupants with greater clarity over time, as occupant goals are communicated (Barker, 1968; Wicker, 2002).

Architects recognize that individuals come to understand these components in their environment through their senses (Spence, 2020). To date, most research in architectural literature has focused on the effects of design achieved through vision (Bille & Sorensen, 2018; Levin, 1993). However, the union of vision along with auditory and olfactory cues gives additional information relevant to design, including information about where one is and what is happening in one's surrounding space (Forster & Spence, 2018; Spence & Keller, 2019; Spence, 2020).

Findings in the architectural domain indicate that aspects which alter visual capability within environments, such as ceiling height significantly influence spatial satisfaction (Baird et al., 1978, $R^2 = 0.98$) and number of doors (Bernstein & Turban, 2018, $r = 0.31$), and cubicle size (Danielsson & Bodin, 2008) influence worker wellbeing. A study by Stamps (2012), for example, examined how the visible features of space influence perceptions of the environment. They found that atmospheric permeability, or the distance that one can see, influences the perception of safety in participants such that perceived enclosure was positively related to safety ($r = -0.90$).

Likewise, researchers have found that the number of people an individual can see in a workspace also affects behavior and attitudes. For instance, Bernstein and colleagues (2018) captured employee reactions to the transformation of worker office space from a traditional office design into an "open" office plan, where a lack of spatial boundaries encouraged transparency and greater visibility of other workers. Bernstein and colleagues (2018) found that the open design of workspace led to social withdrawal and an increase in electronic interaction ($r = 0.31$). Additionally, the researchers found that this design change indirectly and negatively impacted worker productivity through qualitative examinations.

Lim et al. (2020) investigated the impact of visual exposure of primary care clinic staff members to patients, and related it to the staff member preferences for 'backstage' communication areas. Across four teams, the researchers found that clinics designed with less visual exposure between clinic staff member teams and patients were related to fewer concerns about needing private communication spaces (r = 0.642). Similarly, staff members were found to dislike talking in visually exposed areas of the clinics (e.g., corridors and exposed team meeting spaces, (β = -0.294).

Considering auditory inputs, design research has focused largely on the impact of "noisy," distracting workplace sounds which have the potential to inhibit completion of work tasks. Several empirical examinations of sound in the workplace have found that noisy environments relate to decreased productivity (e.g., see Vischer, 2005). Schlittmeier and colleagues (2008) found that irrelevant background speech from workers increased the mental workload of individuals working in an office (d = 0.97). However, Vassie and Richardson (2017) found that "crucial", nearby conversations in the work environment are facilitative for work.

Corbett (2003) explored the role of sounds in organizations and argued that across time, the different sounds present in organizations, whether they be from a mechanical clock, a chiming town bell, or from the voices of coworkers, have influenced the structure of work and several work outcomes such as productivity. He also distinguished between background sounds, such as people talking, and sounds that provide information, such as bells or whistles that signify time (e.g., the beginning and end of the workday). In sum, the research involving sounds in the workplace has been limited, but indicates that they matter not only for workers, but can allow for increased understanding of the workspace (e.g., time, presence of others).

The literature surrounding olfactory cues as it relates to reactions and behavior, has been limited. However, some researchers have noted qualitatively that olfactory cues differ from that of visual and auditory as they can be more easily sensed in a closed-in space (Classen et al., 1994; Rasmussen, 1999). The smells that manifest in our living and working spaces may, however, permeate into other areas throughout the building.

In 2006, Corbett examined the meanings that people attribute to olfactory cues while at work and argued that smell has “a significant bearing upon human interaction and social identity.” He proposed that smell informs people of their location and of changes occurring in that location. Taken together, while empirical examinations from this domain have been few, and narrative investigations likewise scarce, olfactory cues during WFH remain important as they may serve as indicators for home-sourced activities. The sense may impact work outcomes by communicating time of day, urgency to complete tasks, or needs to complete household tasks.

1.4 Space Constrains Inputs

The placement of workspaces within the home might determine the way in which the work and home domain activities of an individual’s life may overlap and conflict. (Allen et al., 2021; Allen et al., 2015; Delanoeije et al., 2019; Gurstein, 1991; Kreiner, 2006; Standen et al., 1999; Voydanoff, 2005). In this way, if a WFH worker does not have a dedicated office space in his/her home, there is an inherent incongruence between the task (working) and the setting (the home & home-related tasks). For example, an employee working in their home workspace might see, hear, and/or smell more or less home-related activities (e.g., laundry) while working, depending on where and how their workspace is situated. One might expect that within the home, areas typically designated for social activities may allow for greater exposure to more sensory inputs from the home domain. Whereas closed-in areas within the home may afford physical boundary management resources such as walls and partitions, open areas are designed in a way that allow for greater boundary permeability (Allen et al., 2022).

Hypothesis 1: Workspace size will significantly and positively relate to auditory and visual home-sourced sensory inputs.

Hypothesis 2: Working in the kitchen, living room, and "open areas of the home" workspace locations will significantly and positively relate to all sensory inputs.

Chambers and colleagues (2018) found an interesting pattern of results related to objective workspace measures and psychological outcomes. The researchers examined the impact of apartments that varied in visual exposure of common social areas on occupant depressive symptomology. In "living-centered" apartments, walls, and other physical boundaries were designed to promote social encounters in communal spaces. These layouts had greater visual exposure, while "circulation-centered" apartment layouts were characterized by having less visual exposure. Chambers and colleagues found that women living in "living-centered" apartments demonstrated less depressive symptomology, suggesting that the ability to see household members at home may influence psychological outcomes ($\chi^2 = 4.14$; df = 1, $p = 0.04$). This isolation was purported to be due to their measurement of the apartment *mean depth*. Within the architecture literature, depth is a measure commonly used in space syntax research and theorizing (Bafna, 2003). Many studies utilize mean depth as a space descriptor by averaging a room's depth from all other spaces in the home. This parameter has been used to investigate social effects of spaces. In these instances, a high depth value is typically associated with greater privacy and isolation from social activity (Bafna, 2003; Choudhary et al., 2010; Evans et al., 2003; Hanson, 1998).

However, boundary violations should occur most commonly in the most social, or communal, areas of the home. For the purposes of this study, a proxy measure was used which is concerned with the depth between the respondent's workspace area and their main living room. For this reason, if workspaces are situated in areas in the home that have a greater number of spaces between that workspace area and a social area, they may be distanced from household members and activities within the home.

Hypothesis 3: Workspace depth will significantly and negatively predict all sensory inputs.

1.5 Household Members

The home environment includes not only walls, furnishings, and items, but also individuals within it. Household members may cook food, engage in noisy video meetings, and walk throughout the home. From a boundary theory perspective, those who live with more household members should find boundary management more difficult. Additionally, those who WFH and take care of household members should be more exposed to auditory and visual sensory inputs. Dependent household members such as children, elderly family members, or those with disabilities may not necessarily cook during the day, but it is likely that they are kept in the line of sight and/or within ear range during the day.

Hypothesis 4: The number of household members will significantly and positively relate to all sensory inputs.

Hypothesis 5: Living with dependent household members will be significantly and positively related to auditory and visual inputs.

1.6 Outcomes of Home-Sourced Sensory Inputs

Characteristics of the home environment may constrain or allow for increased sensing of inputs from the home environment. But what is the impact of these sensory inputs on the worker? One cannot expect the home environment influences to operate in the same way as those from a traditional office. Home-related milieu, activities, and inhabitants are of personal importance to a worker's life. Therefore, inputs from the home domain may not be as easily shut out as inputs from co-workers, or unrelated conversations or activities at a traditional office (Vassie & Richardson, 2017). Having to refocus on work tasks after sensing inputs from the home domain may, then, lead to a general increase in stress. This may be especially true for visual and auditory inputs, which have been known to be disruptive to workers in office environments (Bernstein & Turban, 2018; Schlittmeier and colleagues, 2008; Stamps, 2012).

Hypothesis 6: Visual and auditory sensory inputs will significantly and positively relate to general stress.

Worker perceptions of their home and work boundaries may be influenced by the number of home-sourced inputs they experience. These perceptions can be measured by asking about worker boundary violations experienced during the typical work week. Boundary violations include instances where a worker's preferred home and work boundaries are breached in a way that is disruptive to them (Hunter et al., 2019, Maertz & Boyar, 2011). This is different from a measure of general stress as it takes into account a worker's personal preferences for their home and work domains overlapping. It is well-established that boundary violations from home to the work domain (home-work) are commonly reported by teleworkers (Delanoeije et al., 2019; Golden et al., 2006, Kerman et al., 2021). Teleworkers complete work outside of a traditional office space but may work in locations other than their home (Delanoeije et al., 2019; Golden & Viega, 2005). Visual and auditory inputs should be positively related to these boundary violation assessments.

Hypothesis 7: Visual and auditory sensory inputs will significantly and positively relate to reported home-to-work boundary violations.

1.7 Intentions to Work from Home in the Future

As workers consider their future work arrangements, organizations and researchers have a critical need to understand the antecedents of WFH adoption (Anderson et al., 2015; Luse et al., 2013). Person determinants for WFH preferences have been well documented, and include aspects such as family life, commute time and cost, health, and independence (Beasley et al., 2001; Shafizadeh et al., 1997). However, recent findings show that employee perceptions of their workspace, as well as psychological reactions to that workspace, are related to attitudes about working from home in general (Berti et al., 2018;

Gifford, 2014; Oldham & Brass, 1979, O'Neill, 1994; Wells, 2000; Wollman et al., 1994). As boundary violations assess disruption of home and work domains within this arrangement, I expect that these assessments will be negatively related to a worker's intentions to WFH in the future.

Hypothesis 8: Home-to-work boundary violations will significantly and negatively predict a worker's intentions to WFH in the future.

CHAPTER 2. METHODS

1.8 Sample and Procedure

Participants were 199 university administrative employees who met the following criteria: Worked from home at least eight hours per week and were at least 18 years of age. Participants were recruited via email solicitations from several university college communication staff workers, including the Colleges of Architecture, Computing, and Liberal Arts. The average age was 45.0 years (range: 22 – 70 years), with a majority female population (75.4%). Participants work from home an average of 21.9 hours per week (range: 8 – 48 hrs). The job areas that made up the majority of the sample included advising (21.0%), program coordination (20.0%), and finance (13.5%). **Appendix A** provides more information on the demographic characteristics of the sample. A power analysis (using the open-source software package G*Power) indicated that a total of 85 participants would be needed to achieve at least .80 power to detect medium effects for all hypotheses, assuming a perfect response rate.

Interested potential participants were first directed to an online informed consent page, followed by a 13-minute online survey designed to assess the relevant demographic, home workspace, behavioral, and attitudinal information. Data were collected between August 31 and September 29, 2022. A copy of a participant recruitment e-mail that was distributed is provided in **Appendix B**.

1.9 Measures

All responses were recorded on a five-point agreement Likert-type scale ranging from “Strongly Disagree” to “Strongly Agree”, unless indicated otherwise. See **Appendix B** for a list of survey variables and a general layout of the survey.

1.9.1 Objective Home Characteristics

Objective home characteristics measured included workspace size, workspace location within the home, and workspace depth. Size was assessed with one item: “What is the approximate size of your main work area, or the area of your home you typically work in? Participants selected one of five response options: 5'8' (Very small; bathroom-sized), 11'x12' (Small; room-sized); 14'x16' (Medium; larger bedroom-sized); 20'x20' (Large, living room or larger-sized).

Workspace location was assessed with one item: “Currently, where are you working from home? If you work in more than one place, which is the one you use most often?” Participants chose one of seven response options: “In a dedicated home office”, “In a closed-off bedroom”, “In a spare room”, “In the living or family room”, “In the kitchen”, “Outdoors or on a patio”, “In an open area of the home”. Participants were also asked to choose a secondary workspace location, if they sometimes worked elsewhere in their home. Depth was assessed using one items in which participants reported the number of rooms or spaces that they must pass through in order to reach their work area from their living room.

1.9.2 Self-Referenced Home Characteristics

Self-referenced home characteristics included number of household members and household member type. The number of household members was assessed with one fill-in-the-blank survey item ("Enter below the number of people who live with you at home, not including yourself"). Household member type was assessed with an item ("Indicate the household members who currently live with you at home") with five options ("Partner, Children (dependent), Roommate, Elderly (dependent), Other"). Participants were able to select more than one household member type option.

1.9.3 Home-Sourced Sensory Input Scales

Given that existing literature does not yet provide measures of visual, auditory, and olfactory inputs from the home within the WFH space, original measures were designed for the purposes of the study. Both WFH and design literatures informed item development. Original items were examined by a professor and three graduate students in a university's School of Architecture. Two pilot studies were conducted in order to determine the item and overall measure quality for each input. During the piloting phases, items were altered and dropped if inter-item correlations were below 0.15 or above 0.60 (for a discussion of this approach, see Clark & Watson, 1995). First, twenty-five members of the Georgia Tech Staff Council Board took the survey in May and April of 2022. In the summer of 2022, 30 individuals took the revised measure. After small edits were made to the revised measure, it was added to the full project survey. A summary of the pilot tests can be found in **Appendix D**.

Items assessed sensory inputs along three dimensions: home-sourced tasks, items (e.g., personal items, clothing), and household members (including pets). Ultimately, each scale included five items, each with one reverse-scored item. Higher combined sensory input scores for each type (visual, auditory, olfactory) indicate that the participant was able to sense home-sourced stimuli from where they work at home. The scales were presented together, with alternating items for each sense. The complete measure with three scales is presented in **Appendix E**.

1.9.3.1 Visual Inputs

The measure for visual inputs from home included items which assessed if the worker is able to sense home-sourced items (laundry, videogames), home-sourced tasks (dinner cooking, a spill needing to be cleaned), and household members. Participants were also asked to indicate their ability to see other household members from their workspace. An example item is "I have a clear view of other household members, including pets, as they move around the home."

1.9.3.2 Auditory Inputs

Auditory inputs were assessed in the same manner as vision (i.e., items, tasks, household members). An example hearing item is "I can hear other household members, pets, or visitors in my home."

1.9.3.3 Olfactory Inputs

Olfactory inputs were assessed with five Likert-type items that asked about the participant's capacity to smell the three dimensions of home-sourced activity. However, the olfactory input measure focused on tasks and activities, not household members. An example smell item is "I cannot smell food being cooked or eaten in my home."

1.9.4 Home-Work Boundary Violations

Home-Work Boundary Violations was assessed with one item taken from Hunter and colleagues' (2019) Boundary Violation Scale (including "Work-into-Home Boundary Violations", $\alpha = 0.95$): "This week at work, my home life has interrupted my work more than I desire". The Hunter and colleagues (2019) scale was originally based two previously developed measures (Ashford et al., 2000; Kreiner et al. 2009). Notably, "Home-Work" is an abbreviation of "Home-into-Work".

1.9.5 General Stress

General stress throughout the workday was assessed with the short-form version of the State-Trait Anxiety Inventory (STAI; Marteau & Bekker, 1992; Spielberger, 1983, α = 0.82). Participants were instructed to indicate how they feel on a typical workday with five, six-point Likert-type items (1 "Never" to 6 "Almost Always"). Example items include "I feel calm", "I am tense", "I feel upset". Two of the five items were reverse scored.

1.9.6 Intention to WFH in the Future

Participant's intention to work from home in the future was assessed with one item: "If you could choose, how many days out of the work week would you like to work from home after the threat of COVID-19 is greatly diminished?" Response options ranged from zero to five at half-point intervals to allow indication of half-days.

CHAPTER 3. RESULTS

1.10 Survey Respondents

Two-hundred and forty participants (31% response rate) initially responded to the survey, but 41 participants were removed to ensure data quality. Thirty-eight participants were removed because they exited the survey before completing it. Additionally, data from three participants were removed as their results included conflicting responses. Each of these excluded respondents completed the survey in under seven minutes, even though survey piloting in the spring of 2022 showed that the average time to take the survey was 11 minutes. This possibly indicates that the three removed respondents may not have carefully read each item and response choices. After dropping these 41 participants, the overall participation rate was 25%.

1.11 Preliminary Analyses

Normality and the presence of outliers was checked by reviewing descriptive and frequency statistics as well as inspection of histograms for each variable. The linearity and normality assumptions were also checked via visual inspection of Q-Q plots. Upon checking the demographic descriptive and frequency statistics, tenure was substantially and positively skewed. It appeared that most respondents have worked for the university between <1 year and 10 years. However, five participants reported working for 10-20 years, and another six reported working for the university more than 20 years. Those who reported working more than 20 years were each in senior-level positions and were above the age of 46. Therefore, there was no reason to suspect that the tenure outlier values were reported in error. Additionally, 75.4% of participants are female, which is notably higher than the 54% of females that comprise the institution's staff population (Institutional Research & Planning, 2022). However, administrative staff are a subset of the overall staff and national census data from 2019 indicates that more than 80% of all administrative staff are female (Beckhusen, 2022). Thus, the gender distribution generally reflects industry norms.

After eliminating participants that did not complete the entire survey or finished quickly, a potential outlier for the household member number variable was identified. According to Aguinis and colleagues (2013), a data point might be considered an outlier if it sits 2.24 standard deviations above the mean. One respondent reported having six household members other than themselves. Their data was otherwise complete and normal; therefore, it was determined that there was not sufficient evidence to remove the participant from analyses. Additional participant data may be found in **Appendix A**. Workspace and home related information may be found in **Appendix C.** Correlational and descriptive data for main study variables may be found in **Table 3**.

1.11.1 Variable Independence Testing

Next, I examined the relationships between depth, workspace size, and workspace location. The measurement of depth is typically calculated using drawings of floorplans. The number of links and thresholds between rooms are either calculated by hand, or by software. However, for the purposes of this study, participants indicated the relative depth of their workspace from a social, living room in their home by manually entering in the number of thresholds between the spaces. Variable independence was examined to test the validity of the depth measure in this context. Correlational analyses revealed that workspace size and depth are significantly related $r(197) = -.15$, $p < .05$. Contrast codes were generated for workspace location and entered into regression analyses to compare with depth. Results are displayed in **Table 1**. Workspace location and depth are related, $R^2 = 0.20$, $F(5, 193) = 9.70$, $p < 0.05$. There was not a significant difference in depth between open spaces and the kitchen ($\beta = 0.11$, $p > .05$) or open spaces and bedrooms ($\beta = 0.16$, $p > 0.05$). However, there was significant differences found between open spaces and dedicated offices ($\beta = 0.23$, $p < 0.05$), open spaces and spare rooms ($\beta = 0.17$, $p < 0.05$), and open spaces and living and family rooms ($\beta = -0.26$, $p < 0.05$). Levene's Test of Equality of Error Variances was not significant ($p > .05$), meaning that the error variance of the sensory input variables is equal across groups.

Table 1 - Regression output for workspace location on depth

Effect	*B*	*SE*	95% CI		*p*
			LL	*UL*	
Constant (open[a])	1.08	0.16	0.76	1.39	<.001
Dedicated office	0.36	0.18	0.01	0.71	0.04
Bedroom	0.37	0.21	-0.06	0.79	0.08
Spare room	0.45	0.23	0.01	0.89	0.04
Kitchen	0.43	0.3	-0.17	1.02	0.15
Living/Family	-0.52	0.2	-0.91	-0.13	0.01

Note. $R^2 = 0.20$

[a] open = open area of the household

Likewise, as the workspace size and location variables were measured with survey item choices and not with specific measurements or labels, providing a validity check is needed. For this, a one-way ANOVA was conducted to compare workspace size means along the location categories. **Table 2** displays the ANOVA results. The ANOVA revealed that there was no significant differences in workspace sizes along the different workspace locations, $F(5,193) = 2.15$, $p > 0.05$. The Levene's Test statistic was significant here ($p < 0.05$), indicating that the population variances are uneven. Therefore, I cannot rely on the p-value for the F-test. Instead, the eta-squared value can be interpreted. This effect size statistic does not rely on homogeneity or normality assumptions and ranges from 0 to 1, where values closer to 1 indicate a higher proportion of variance in the categorical variables explained by the continuous variable. According to Cohen and colleagues (2001), eta-squared values of 0.01 – 0.06 reflect small effects, 0.06 - 0.14 reflect medium effects, and > 0.14 reflect large effects. In this analysis, the eta squared is 0.05. This is a small effect according to the thresholds. The Welch statistic may also be used as a statistic that does not assume homogeneity. For this analysis, the statistic was not significant. Therefore, the size means do not significantly differ across workspace locations, $F_{Welch}(5,43.17) = 1.61$, $p < 0.05$.

In multiple regression analyses, independent variables should not be highly correlated. If this happens, then the assumption of multicollinearity is not met. The correlations between visual and auditory inputs were taken into consideration as the inputs serve as dependent variables in a regression model predicting stress and home-work boundary violations. The overall correlational analysis revealed significant relationships between all three of the sensory inputs ($r_{vxa} = 0.58$, $r_{vxo} = 0.51$ $r_{axo} = 0.66$, $p < 0.05$).

However, Tabachnick & Fidell (2012) suggest that no correlation should be above $r = 0.90$. As the correlations range from 0.51 to 0.66, there is no reason to be concerned about multicollinearity violations.

Table 2 - ANOVA Comparing Workspace Size and Location

Measure	Office[a]		Bed[b]		Spare		Kitchen		Living		Open[c]		$F(5,193)$	η^2
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*		
Size	2.47	0.71	2.42	0.58	2.24	0.54	2.38	1.19	2.89	1.22	2.35	0.88	2.15	0.05

Note. [a] Office = "dedicated home office". [b] Bed = "bedroom". [c] open = open area within the home (generic); The Levene's statistic for the test was significant, $p < .05$. I reject its null hypothesis of equal population variances.

Table 3 - Main Variable Correlations

Variables	Possible Range	Range	*M*	*SD*	*Skew*	*Kurtosis*	α	1	2	3	4	5	6	7	8
Workspace															
1. Depth	0-20	0-4.5	1.24	0.79	1.01	2.50	0.72								
2. Size	1-4	1-4				0.01		-0.15*							
3. HHM #[b]	0-20	0-6	1.76	1.31	0.68	0.01		0.26**	-0.11						
Inputs															
4. Visual	1-5	1-5	2.85	0.92	0.35	-0.45	0.82	-0.17*	-0.04	-0.43					
5. Auditory	1-5	1-5	3.24	1.01	-0.19	-0.97	0.89	0.05	-0.21**	0.20**	0.58**				
6. Olfactory	1-5	1-5	3.65	0.80	-0.66	0.39	0.81	-0.16*	-0.09	0.13	0.51**	0.66**			
Outcomes															
7. Stress	1-6	1-5.6	2.63	0.83	0.52	0.60	0.86	0.10	-0.22**	0.00	0.28**	0.35**	0.16*		
8. HW BVs[a]	1-5	1-5	1.76	0.85	1.41	2.55		0.08	-0.55	0.06	0.29**	0.27**	0.11	0.36**	
Appraisals															
9. Intentions [c]	1-5	1-5	3.50	1.10	-0.07	-0.92		-0.03	0.03	0.04	-0.08	-0.18**	-0.47	-0.07	-0.25**

[a] "HW BVs" ="Home-into-work boundary violations"
[b] "HHM #" = "Number of household members"
[c] "Intentions" = "Intentions to WFH in the future"
* *p* < .05. ** *p* < .01, two-tailed.

1.12 Workplace Characteristics and Sensory Inputs

1.12.1 Objective Home Characteristics

Hypothesis 1 stated that workspace size will be positively related to visual and auditory home-sourced sensory inputs such that workspace size will increase as visual and auditory inputs increase. These relationships were tested with correlations (**Table 3**). Workspace size did not significantly relate to visual inputs, $r(197) = -0.04$, $p > 0.05$. Interestingly, workspace size did predict auditory inputs, but instead of increased size predicting and increase in auditory inputs, the opposite was found, $r(197) = -0.21$, $p < 0.05$.

Hypothesis 2 stated that working in the kitchen, living room, and "open areas of the home" will significantly and positively relate to all sensory inputs. To test these, MANOVA analyses were computed as this analysis type allows for comparison between categorical independent variables and multiple continuous dependent variables. Since the dependent variables are each intercorrelated and measure sensory inputs from the home environment, Roy's Largest Root (RLR) was selected as the statistic of choice. A MANOVA allowed for comparison of means of sensory input scores along chosen primary workspace locations: dedicated home offices, bedrooms, spare rooms, kitchens, living room, and open areas within the home.

Workspace location significantly and positively related to visual inputs, RLR = 0.22, $F(5,199) = 7.07$, $p < 0.05$ (**Table 4**). The effect for location on visual inputs is also considered to be large, $\eta 2 = 0.15$. Performing a Tukey's HSD test on workspace location revealed that there is a significant difference in visual inputs between those working in dedicated home offices ($M = 2.58$, $SD = 0.81$) and the kitchen ($M = 3.80$, $SD = 0.70$), dedicated home offices and the living/family room (*M* = 3.20, *SD* = 0.90), and dedicated home offices and open areas in the home (*M* = 3.29, *SD* = 0.92). For each of these, workers in dedicated home offices reported significantly fewer visual inputs. There were also significant differences in visual inputs between those working in spare rooms (*M* = 2.40, *SD* = 0.84) and in the kitchen, and those working in spare rooms and those working in the living/family room. For both results, the workers in the spare rooms reported significantly fewer visual inputs. All other room combinations did not differ significantly.

Workspace location significantly predicted olfactory inputs, RLR= 0.22, $F(5,199)=3.85$, $p < 0.05$. Likewise, there is a medium-sized effect of location on olfactory inputs, $\eta^2 = 0.09$. There was a significant difference in olfactory inputs reported by those in dedicated home offices (*M* = 3.48, *SD* = 0.79) versus the kitchen (*M* = 4.35, *SD* = 0.47), as well as those working in a spare room (*M* = 3.32, *SD* = 0.90) versus those working in the kitchen. For both of these results, the workers in the kitchen reported significantly more olfactory inputs. Additionally, Box's Text of Equality of Covariance Matrices was not significant ($p = 0.78$), indicating that the sample size is an adequate size for the MANOVA analysis. Likewise, for visual inputs ($p = 0.62$), auditory inputs ($p = 0.64$), and olfactory inputs ($p = 0.42$), Levene's Test of Equality of Error Variances was not significant ($p > 0.05$) meaning that the error variance of the sensory input variables is equal across groups.

Table 4 - MANOVA and Univariate ANOVA Results for Workspace Location Predicting Sensory Inputs

Measure	Office[a]		Bed[b]		Spare		Kitchen		Living		Open[c]		η^2	$F(5,193)$	p
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*			
Visual	2.58	0.81	3.00	0.96	2.40	0.84	3.80	0.90	3.20	0.90	3.29	0.92	0.15	7.07	<.001
Auditory	3.08	0.93	3.52	1.04	3.15	1.02	4.12	0.65	3.23	1.04	3.32	1.20	0.05	2.21	0.05
Olfactory	3.48	1.20	3.92	0.78	3.32	0.90	4.35	0.47	3.83	0.72	3.72	0.76	0.09	3.85	0.00
MANOVA	*Roy's Largest Root =0.22, F(1,193)= 8.61 ,p = <.001*														

Note. [a] Office = "dedicated home office". [b] Bed = "bedroom". [c] open = open area within the home (generic)

Hypothesis 3 stated that workspace depth will significantly and negatively predict all sensory inputs. Depth could not be added to any ANCOVA models as the covariate as the variable significantly relates to both workspace size and location. Adding it would violate the assumption of independence of treatment effects. Instead, the relationship between depth and the sensory inputs was tested with simple correlations (**Table 3**). This hypothesis was partially supported. An increase in depth was associated with a decrease in visual inputs $r(197) = -0.16$, $p < 0.05$. Depth likewise negatively correlated with olfactory inputs $r(197) = -0.16$, $p < 0.05$. It did not, however, significantly relate to auditory inputs, $r(197) = 0.05$, $p > 0.05$.

1.12.2 Self-Referenced Home Characteristics

Hypothesis 4 is concerned with whether the number of household members is significantly and positively related to all sensory inputs. Results from correlational analyses demonstrated that household members did significantly and positively relate to auditory inputs $r(197) = 0.20$, $p < 0.05$. Household member number did not predict visual inputs, $r(197) = -0.04$, $p > 0.05$, or olfactory inputs, $r(197) = 0.13$, $p > 0.05$. For household member number, Levene's test of Equality of Error Variances was not significant, (vision: $p = 0.95$; auditory: $p = 0.98$; olfactory: $p = 0.44$), indicating that the error variance is approximately equal across groups.

To explore the influence of the quantitative workspace variables on sensory inputs, I also tested a model of workspace characteristics. Depth, workspace size, and household member number were added into a regression equation. With this, I could test if the significant relationships hold while controlling for the other workspace characteristic variables. **Table 5** provides a summary of the results. Even while controlling for the other workspace characteristics, workspace size (β = -0.19, p < 0.05) and number of household members (β = 0.18, p < 0.05) still predicted auditory inputs. In fact, the effects of these two predictors accounted for 28% of the variance in auditory inputs (R^2 = 0.28). Visual inputs are significantly and negatively predicted by workspace depth, β = -0.18, p < 0.05. Interestingly, while depth still significantly and negatively predicted olfactory inputs (β = -0.23, p < 0.05), household member number also significantly and positively predicted olfactory inputs in the regression analysis, β = 0.18, p < 0.05.

Table 5 - Summary of Three Regression Results for Workspace Characteristics on Sensory Inputs

	β	*SE*	*95% CI*		*p*	R^2
			LL	*UL*		
Visual						
Intercept		0.25	2.77	3.73	<.001	
Depth	-0.18	0.07	-0.32	-0.03	0.02	0.03
Size	-0.06	0.07	-0.21	0.08	0.39	
HHM #[a]	-0.01	0.05	-0.11	0.09	0.86	
Auditory						
Intercept		0.26	3.08	4.10	<.001	
Depth	-0.03	0.07	-0.19	0.12	0.64	0.06
Size	-0.19	0.08	-0.38	-0.07	0.01	
HHM #	0.18	0.06	0.04	0.26	0.01	
Olfactory						
Intercept		0.21	3.53	4.34	<.001	
Depth	-0.23	0.06	-0.32	-0.07	0.00	0.06
Size	-0.11	0.06	-0.23	0.03	0.13	
HHM #	0.18	0.04	0.02	0.20	0.01	

Note. [a] HHM # = "Household member number"

Hypothesis 5 stated that living and working alongside dependent household members will be significantly and positively related to auditory and visual inputs.

Participants could choose dependent household members by selecting “children (dependent)”, “elderly (dependent)”, or by writing in and explaining another situation by which they took care of a household member. A MANOVA was conducted to test this relationship (**Table 6**). This hypothesis was partially supported. There was a significant difference between auditory inputs depending on household member types, RLR = 0.193, $F(4,195) = 5.78$, $p < 0.05$. Additionally, this relationship demonstrated a large effect, $\eta^2 = 0.11$. Household member type did not relate to visual inputs, RLR = 0.193, $F(4,195) = 9.16$, $p < 0.05$.

The differences found were comparisons between some household member types and those who did not have any household members. Results from a Tukey’s HSD Test revealed that there was a significant difference found in reported auditory inputs between those who live with a partner ($M = 3.00$, $SD = 0.92$), and those who live alone ($M = 2.83$, $SD = 0.88$). Respondents who live with a partner report significantly more auditory inputs from home. There was also a significant difference found in reported auditory inputs between those who live with a partner and children ($M = 2.81$, $SD = 0.88$) and those who live alone. Finally, there was a significant difference found in reported auditory inputs between those who had household members in an ‘other’ category ($M = 2.88$, $SD = 0.97$) versus those who live alone. This “other” household member category included family, friends, and roommates who were not dependents. The Levene’s Test statistic was not significant ($p > 0.05$), indicating that the variances across samples are equal.

Table 6 - MANOVA and Univariate ANOVA Results for Household Member Type Predicting Sensory Inputs

Measure	Children		Partner		C&P [a]		Other		Alone		η^2	*F(4, 190)*	*p*
	M	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*			
Visual	2.68	0.92	3.00	0.97	2.81	0.88	2.88	0.97	2.83	0.88	0.01	0.53	0.71
Auditory	3.16	1.08	3.33	0.96	3.48	0.91	3.54	0.97	2.56	0.95	0.11	5.78	<.001
MANOVA	*Roy's Largest Root =0.19, F(4,195)= 9.16 ,p <.001*												

Note. [a] C&P = "At least one child and Partner".

1.13 Sensory Inputs and Worker Outcomes

Hypotheses 6-7 predicted that visual and auditory inputs would significantly and positively relate to a worker's general stress throughout the week (Hypothesis 6) and their home-work boundary violations (Hypothesis 7). These hypotheses were supported. A correlational analysis found that visual inputs significantly and positively predicted general stress (r = 0.28, p <.05) and home-work boundary violations (r = 0.29, p <.05). Likewise, auditory inputs significantly and positively related to general stress (r = 0.35, p <.05) and home-work boundary violations (r = 0.27, p <.05).

To investigate the predictive quality of visual and auditory inputs on these outcomes, multiple regression with simultaneous input analyses were conducted. Results from these analyses may be found in **Table 7**. Visual and auditory inputs accounted for 13% of the variance in reported general stress (R^2 = 0.13). Yet, auditory inputs are the only type which significantly and positively predict stress, β = 0.28, p < 0.05. Visual inputs did not predict stress, β = 0.11, p > 0.05. Visual inputs significantly and positively related to home-work boundary violations, β = 0.20, p < 0.05. However, contrary to expectations, auditory inputs did not significantly predict home-work boundary violations, β = 0.15, p > 0.05. Together, the two inputs accounted for 10% of the variance in home-work boundary violations reported ($R^2 = 0.10$).

Table 7 - Summary of Two Regression Results for Visual and Auditory Inputs on General Stress and Boundary Violations

	β	*SE*	*95% CI*		p	R^2
			LL	*UL*		
General Stress						
Intercept		0.20	1.16	1.97	<.001	0.13
Visual	0.11	0.07	-0.04	0.24	0.17	
Auditory	0.28	0.06	0.10	0.37	<.001	
Boundary Violations						
Intercept		0.21	0.38	1.21	<.001	0.10
Visual	0.20	0.07	0.03	0.34	0.01	
Auditory	0.15	0.07	-0.01	0.26	0.06	

1.14 Intentions to WFH in the Future

The final hypothesis stated that home-work boundary violations will significantly and negatively relate to the participant's intention to work from home in the future. A correlational analysis supports this, $r(197) = -0.25$, $p < 0.05$. In a regression equation which includes home-work boundary violations as well as general stress (**Table 8**), only home-work boundary violations significantly predicted intentions $\beta = -0.26$, $p < 0.05$. General stress did not significantly relate to future intentions to WFH, $\beta = 0.02$, $p < 0.05$. Overall significant relationships with effect sizes and standardized estimates are displayed in **Figures 2-4**.

Table 8 - Multiple Regression Results for Home-Work Boundary Violations and General Stress on Intentions to WFH in the Future

	β	*SE*	%CI		p	R^2
			LL	*UL*		

Intercept		0.26	3.50	4.56	<.001	
Stress	0.02	0.09	-0.16	0.22	0.78	0.05
HW BVs	-0.26	0.09	-0.53	-0.15	<.001	

Note. [a] "HW BVs" ="Home-into-work boundary violations"

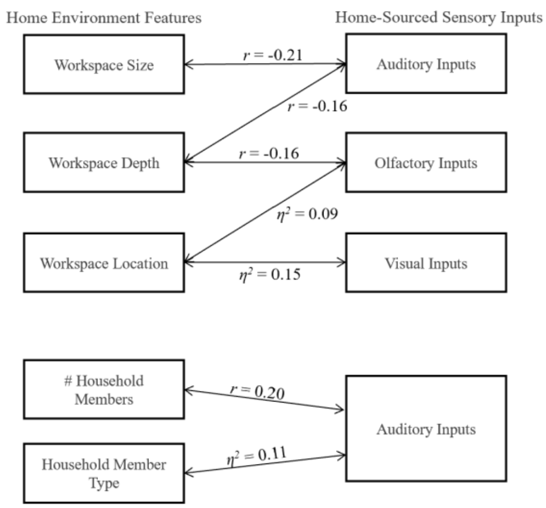


Figure 2 - The Significant Relationships Between Environment Features and Sensory Inputs

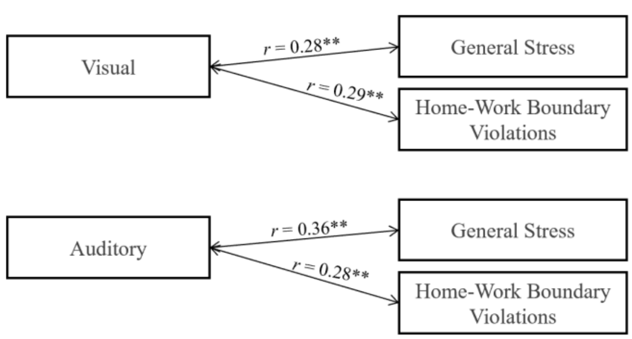


Figure 3 - The Significant Relationships Between Sensory Inputs and Worker Outcomes

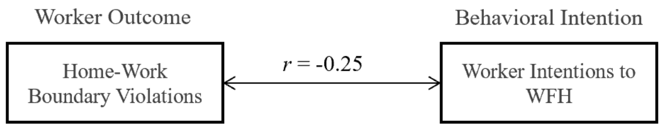


Figure 4 - The Significant Relationship Between Home-Work Boundary Violations and WFH Intentions

CHAPTER 4. DISCUSSION

This study drew upon boundary theory to explain relationships between home workspace features and home-sourced sensory inputs as well as the relationships between the sensory inputs and home-work boundary violations and stress. Additionally, I investigated the relationship between home-work boundary violations and workers' future intentions to work from home. This study is a first step into exploring the effect of the home workspace environment on worker home and work domain boundaries.

Out of the eight hypotheses tested, two were fully supported, five were only partially supported, and one (hypothesis 1), was not supported. When considering the influence of the home workspace environment on home-sourced sensory inputs (Hypotheses 1-3), individuals with larger workspaces reported hearing less, not more, from their home domain than those in small and very small workspaces. No significant differences related to workspace size were found for visual inputs, contrary to the original hypothesis. Workspace location within the home and workspace depth did relate to visual and olfactory inputs from the home domain. Specifically, those who work in more "public" areas of the home such as the kitchen, living room, and open areas, reported seeing more from their home domain than those who work in dedicated home offices or spare rooms. Additionally, as expected, those who work in the kitchen smelled more stimuli from their home domain than those working in a dedicated office or a spare room.

These findings suggest that home design elements (size and location) may not constrain sensory inputs in the same way. It is possible that as one moves "deeper" into the home, they may have greater opportunities to avoid visual and olfactory disruptions. Likewise, a space that is larger or without partitions, may offer greater opportunities to hear home-sourced inputs. The findings support theorizing by Spence (2020) and imply that along these characteristics, the permeability of WFH workspaces may differ along varying sensory inputs. Interestingly, olfactory inputs only differed between the kitchen and the office and space rooms. This may imply that food-related smells are the most salient to WFH workers. Not every worker will experience a variety of other types of smells (such as a lit candle). Therefore, the olfactory input finding makes sense and suggests that future research is needed to fully understand the home design's impact on olfactory inputs. Considering Hypotheses 3, those who indicated higher levels of workspace depth were more likely to indicate experiencing less visual and olfactory inputs from their home domain. Is possible that the measures of depth and location are intercorrelated and not significantly different. The response pattern makes sense as it seems that more social rooms within the home, such as living rooms, are typically those close to the entryway of the home. Even so, this result suggests that permeability of home workspaces may decrease as the workstations are moved "deeper" into the home (e.g., away from busy, social areas).

Hypotheses 4 and 5, which had to do with household member's effects on sensory inputs, were only partially supported. As opposed to an increase in all sensory inputs accompanying an increase in household members, an increase in household members only positively related to auditory inputs. Because the household member number only related to auditory inputs, it is possible that the workers enacted other physical or normative boundaries which reduced reported visual and olfactory inputs. For example, respondents could have a desk oriented away from household member activity or chosen a workspace that is further from kitchen smells. This finding may imply that for the WFH worker, it may be more difficult to enact auditory-related boundaries than visual or olfactory. Pragmatically, respondents may work in a dedicated office room that offers visual privacy but may still hear commotion from household members in the hallway nearby. Counter to Hypothesis 5, differences in sensory inputs were only found between those who had no household members at all, versus those with dependent and non-dependent household members. Specifically, only those who live with a partner, a partner and children, or “other” (a category created which encompassed family or friends who are not dependents), indicated that they heard more stimuli from their home domain when compared to those who live alone. This finding suggests that having dependent household members in the home may not matter as much as having household members that may also work from home. Now that day care and child education facilities are offering more in-person care as opposed to during the peak of the COVID-19 pandemic lockdown (Meghani et al., 2022), there are potentially fewer opportunities for inputs to be related to dependent members. It is difficult to draw conclusions related to these caretakers as only six participants indicated that they live with elderly dependents.

The three sensory inputs were investigated along with two worker psychological outcomes: general stress and home-to-work (home-work) boundary violations. Hypothesis 6 stated that visual and auditory home inputs would positively relate to general stress felt throughout the workday. However, only auditory inputs from the home environment are positively related to general stress. As expected, this result suggests that auditory inputs may be disruptive to the WFH worker. Findings related to the traditional office space have supported this notion (Appel-Meulenbroek et al., 2020; Vassie & Richardson, 2021). The lack of a visual input relationship may be due to the aforementioned ease at which a worker could enact boundaries to limit visual inputs from the home environment. However, these findings could also imply that visual inputs may not be as disruptive to one's general stress throughout the workday than auditory inputs. It is important to note that auditory inputs only predict approximately ten percent of the variance in the respondent's general stress. There is still a considerable amount variance that is not captured by the sensory inputs. A lower *r squared* value is to be expected with such a general measure, however, this leaves room for further examinations regarding the multiple influences of general stress throughout the week.

Hypotheses 7 and 8 were supported. Visual and Auditory inputs significantly and positively related to both general stress and home-work boundary violations. From the regression results, visual inputs positively related to reported home-work boundary violations. Finally, as scores on home-work boundary violations increase, intentions to continue working from home in the future decrease. Home-work boundary violations are a source of stress specifically related to the home domain infringing upon the work domain (Kreiner et al., 2009). This is unlike the stress measure, where participants indicated their agreement on a daily level with general statements such as "I feel calm". Though the relationship between the two variables can be considered small, these findings are interesting as they imply that sensory events from the home domain (i.e., the sensory inputs), are relevant to a key psychological outcome that predicts a worker's intentions to work from home in the future, home-work boundary violations. This finding helps to fill in gaps suggested by several researchers (Allen et al., 2021; French & Shockley, 2020) related to how the aspects of the home environment may influence boundary overlap, and, in turn, possibly influence intentions to WFH.

Out of the correlations tested, all were small in magnitude, though statistically significant. The strength of these relationships may be shaped by the context of the survey items asked. The items pertain to the experience of WFH, and broad, psychological and behavioral reactions. Therefore, the relevant situational characteristics examined, such as the sensing of home-sourced inputs and psychological reactions, may be broad and be influenced by multiple aspects (e.g., home design, job influences, interpersonal relationships). Interestingly, the relationships between workspace locations and household member types on visual and auditory inputs respectively, demonstrated medium to large effects. This further supports the broad assertion of this study that the characteristics of the home physical environment may constrain or allow for the sensing of home-related inputs.

These results imply that a multisensory approach is, in fact, useful for this research as the senses seem to work independently from one another. The effects are different between auditory and visual inputs, as only auditory inputs relate to stress between the two input types. Interestingly, olfactory inputs did not relate to either home-work boundary violations or stress. It is possible that olfactory inputs are neutral or enriching to the WFH worker, rather than disruptive. Further research is needed to fully understand the role of home-sourced olfactory inputs in the work-home boundary scope. The overall pattern of results suggests a potential downstream effect whereby contextual and subjective features of the home workspace environment (e.g., household members and size, location, and depth) constrain or allow for the sensing of the home environment (through visual, auditory, and/or olfactory cues), which in turn lead to psychological outcomes (e.g., stress and home-work boundary violations), that may negatively influence intention to WFH in the future.

However, though these individual relationships were identified, future research is needed to test such a path model.

1.15 Implications for Theory

Ashforth and colleague's (2000) boundary theory put forward the idea of boundaries between our work and non-work roles. Work and home domains are physically co-located during WFH, making the arrangement a unique yet unexplored venue to better understand boundary conflicts. Boundaries were initially described as having the capability to take up physical, psychological, temporal, and spatial qualities (Ashforth, 2000; Nippert-Eng, 1996). Regarding the physical environment, the similarity of items and objects in an environment to one's occupied role were stated to influence the blurring of boundaries (Nippert-Eng, 1996). For instance, in a home environment that includes an easily-accessible work office, the boundary between the home and work domains are said to be weaker than if the home environment did not include items from work (Eddleston & Mulki, 2017; Kreiner et al., 2009).

To my knowledge, the influence of the physical environment on boundary conceptualization has not been clarified further as of yet. However, the nature of this study's results warrant a closer examination of how boundaries present themselves in the WFH environment. More specifically, the finding that the auditory and visual sensory inputs from the home environment are disruptive to workers but are related to different home environment aspects suggests that physical boundaries within the home may not be as local as current conceptualizations describe them. Meaning, the flexibility and permeability of a particular physical space one works in within the home should be considered alongside the *wider home environment*. Given my results, it is not sufficient to say that simply having aspects of the home environment (objects, activities, smells, etc.) in one's WFH area leads to greater sensing of the home environment and boundary violations. Although speculative, perhaps investigating home-work boundary blurring and boundary violations may be better informed by considering the behavior settings that exist within the home. Behavior settings are self-referenced and socially-defined spaces where certain activities may take place (Barker, 1968; Wicker, 2002). The activities within behavior settings are created by a shared understanding of the environment. For instance, if household members decide that from 8 a.m. until 5 p.m. on workdays, the kitchen is for work, then work activities may be better facilitated in that space. The boundaries of behavior settings become clarified over time as individuals communicate their goals and expectations to others.

The negative relationship found between workspace size and auditory inputs also supports the behavior settings inference. This relationship may have been found because the respondents' work-related behavior setting within their home allowed for successful WFH in a large room during their work hours. Additionally, even though olfactory inputs signify the presence of home activities occurring to a WFH worker, these inputs did not relate to negative outcomes. This finding, again, runs counter to current boundary theorizing. It is possible that the WFH workers are not attuned to distinct smells in their homes. Another possibility is that workers may feel enriched when smelling home-related inputs, as opposed to feeling stressed over their psychological boundaries blurring.

Finally, as progress is made further into the "Fourth Industrial Revolution" (Mayer & Oosthuizen, 2020), crafting sustainable careers to combat shorter tenure, greater reskilling requirements, and more prominent role blurring, is becoming paramount (McDonald & Hite, 2018). Sustainable careers are those which adapt to fit worker's needs, match with worker values, provide renewal opportunities and equip workers with financial security (McDonald & Hite, 2018). This research broadens the understanding of work arrangements as an important element of sustainable careers. It also may highlight potential economic inequality issues that influence what spatial affordances are available for WFH workers to use. For instance, from the results, those who have dedicated office spaces sense less visual inputs from their home environment while working. This may allow these workers to escape boundary violations, as results indicated that visual inputs lead to violations. For those who do not have such resources in their home, working from home sustainably may be a more difficult task. Going along with this, the measure for workspace size may serve as a proxy for a worker's *overall* home size. Recall the negative workspace size and auditory inputs relationship. If a worker has smaller overall living areas (potentially without sufficient space for a work area or potentially leading to crowded social activities), they may be led to work in a bedroom or another space within the home. On the other hand, those who have larger homes may work in larger rooms because they 1) have sufficient space for an enlarged home office, or 2) have enough space in their home to be separated from disruptions while working in a large common space. Again, while speculative, this suggests that inequality between home environment resources may have an influence on worker outcomes such as boundary violations.

1.16 Implications for Practice

As noted, despite being an indispensable aspect of work, the home workspace environment has attracted little attention in the industrial-organizational psychology research (Stephenson et al., 2020). Yet, it is valuable for designers and those in decision making roles to have a better understanding of home office environments versus traditional office building environments (Sundstrom et al., 1980). From a practical standpoint, workspaces have an influential impact upon an individual's entire working experience (Wineman & Barnes, 2018). The results from this study suggest that working within a home environment comes with additional opportunities for the home and work domains to intersect. The findings showcase that not all inputs from the home lead to negative outcomes. Likewise, the results highlight that environmental aspects do not relate to the sensory inputs in the same way. Workers may use these results to think about what would disrupt them the most at home, and to plan their workspace accordingly.

The results from this study may inform individual workers of potential beneficial alterations they could make to their home workspace environment to support WFH. Though some elements of design are less adjustable, such as wall placement and height, other actions may be taken to make productive alterations to the design of the home. Auditory inputs may have particular disruptive qualities, as shown by the study results. Enacting soundproof partitions or opting to wear soundproof headphones may be reasonable actions a worker can make. Arranging one's workstation in front of a window may offer helpful boosts in creativity while also managing visual input disruptions. Notably, the changes made should coincide with a worker's individual boundary preferences.

Understanding the results at hand may also help managers or those in decision-making roles when it comes to hybrid work. With the increase in WFH across the U.S., organizations face unique strains related to investing in sizable at-home workspace equipment stipends. For organizations with large numbers of WFH workers, it would be beneficial to offer flexible tools, furnishings, and/or technologies that workers can utilize to manage boundary violations within their homes.

Finally, as workers return to "normal" business functioning, it is important to understand what will influence a worker's decision to work from home, adopt a hybrid schedule, or return to the office. The study identified aspects of an employee's WFH experience related to sensory inputs and boundary management that contribute to their work arrangement preferences going forward. Having a more complete understanding will allow managers and applied researchers to improve employee workplace satisfaction and plan for arrangement-based changes in the workplace. Ultimately, this research has potential design implications that are useful and based in psychological research. The study of the sensory experience of the home workspace may provide important insights regarding the future of work such as in understanding how to properly design WFH spaces to promote worker wellbeing.

1.17 Study Limitations

The current study provided an initial investigation into the work and home domain boundary effects of the home workspace environment. However, it is not without meaningful limitations. First, the survey results represent simultaneous self-reports, meaning that there is no way to test for causality within these relationships. The potential trickle-down model of relationships starting from the home workspace design and ending with intentions to WFH is supported only through a combination of independently tested cross sectional relationships. Going along with this, though the study results successfully found relationships between environmental, psychological, and behavioral outcomes, past alterations to the work environment that participants may have made in reaction to the home domain aspects were collected with only cross-sectional data. Additionally, these items asked if participants changed their workspaces, not when and why. Understanding more deeply the catalysts for altering the home workspace environment may provide additional rich information about how participants may react to home environment stimuli during WFH.

Moreover, to encourage participation, the length of the survey was kept short. Shortened version of measures were included instead of full versions to keep in line with this goal. For example, the measure for boundary violations included only two items: one for home-work, and one for work-home, boundary violations. Though this measure was previously validated and included in research featured in top-tier psychological journals, having only one item to assess such an important study variable was potentially limiting. Additionally, the study materials do not include a completely objective design-based measure. Utilizing precise, objective measures of the worker's home workspace, such as floorplans, would be useful in understanding how workers react to their environment. Future research in this area should consider collecting participant floorplan information to analyze quantifiable aspects of their home such as the workspace's depth and centrality compared to the rest of the home (Bafna, 2003; Chambers et al., 2018). In spite of this, the study collected "ballpark" measures of the physical environment via survey items.

Finally, the question of the relative importance of each sensory input to understanding the environment has long been debated (Spence, 2020). Literature coming from neuroscientific domains emphasizes visual dominance as the amount of space in our brains dedicated to visual processing is larger than other senses (Hutmacher, 2019; Meijer et al., 2009). Designers and architects have likewise given the visual sense majority consideration in their products for many decades (Mau, 2018; Spence, 2020). Yet, when thinking about what might matter the most to WFH workers in their home environments, it is not outwardly apparent that visual inputs reign king. The present study results indicate that auditory inputs from the home environment may substantially disturb or change the WFH experience. In the case that there are any substantial differences in the relative importance of visual, auditory, and olfactory inputs on our understanding of the environment, then the equal weighting and treatment of the variables may have been not well enough informed.

1.18 Future Directions

Several of the discussed limitations may be corrected in future research. First, the understanding of the role of sensory inputs within the home environment opens up opportunities for clarification about how boundaries could function under different behavior settings. Crafting clear and sustainable norms (Kreiner, 2009) or behavior settings (Barker, 1968), regarding how household members may interact with the WFH worker(s) or home environment during the workday may help provide the worker with sufficient autonomy to comfortably work from home. Future research is needed to unpack how boundary setting behaviors such as norm-crafting or behavior setting construction may soften potential negative effects of workspace design choices on psychological consequences.

Also, the inclusion of Matthews and colleagues' 2010 home-and-work transition scale would enable better capturing of facets of boundary violations. Instead of having participants make an overall assessment of their work or home lives invading the other domain, this eight-item measure presents respondents with scenarios they can respond to which reflect domain boundary violations. For instance, and example item is "Today, I changed plans at home to meet work-related responsibilities." The shorter Hunter, Clark, and Carlson (2019) boundary violations scale could be used if the daily level is inappropriate for the study conditions. Likewise, instead of prompting participants to make an educated guess about their home and workspace dimensions, future research could include the aforementioned objective home environment measures. Though this would certainly increase participant burden and require substantive reassurances about participant privacy, collecting purely objective measures of the home environment would decrease error, and strengthen connections between psychological and architectural theorizing.

Further information may be gathered regarding the relative importance of the three sensory inputs in different ways. One option would be to gather a panel of subject-matter experts from architectural and neuroscientific fields to read the sensory input measure items and weigh in on the best option for determining the relative weights. Another, person-centric option, could have survey respondents weigh the sensory inputs on affectivity (how disruptive or enriching it was) and intensity. This could be done via experience sampling methodologies so that also, discrete, interruptive events could also be immediately reported during WFH.

1.19 Conclusion

Changes in the nature of work resulting from advances in technology as well as the social and economic consequences of the COVID-19 pandemic have led to a sharp increase in WFH. As there has been no indication of this trend slowing, there is a critical need to understand how a worker's home environment may shape their WFH experience. This study demonstrates that understanding how the home environment constrains or encourages overlap between a worker's home and work domains is useful and provides additional insight into the WFH experience. Though prior research has taken into account sensory inputs constrained by traditional office environments, this study serves as the first to examine these aspects within the home environment while also considering the home domain. Additionally, whereas past research has largely focused on one sense at a time, this research provides a useful, multisensory look into the home environment. Ultimately, this approach in measuring the home domain impact has demonstrated practical utility in uncovering individual, psychological outcomes. The differences in sensory inputs effects found are particularly impactful when considering how boundaries in WFH are conceptualized in general. As more workers consider adopting a virtual or hybrid work arrangement, many will begin to think about how to set up an effective at-home workstation. The results from this investigation provide initial stepping stones for future research in this area to better understand how effective and comfortable work can be done at home.

APPENDIX A. SUPPLEMENTARY PARTICIPANT DATA

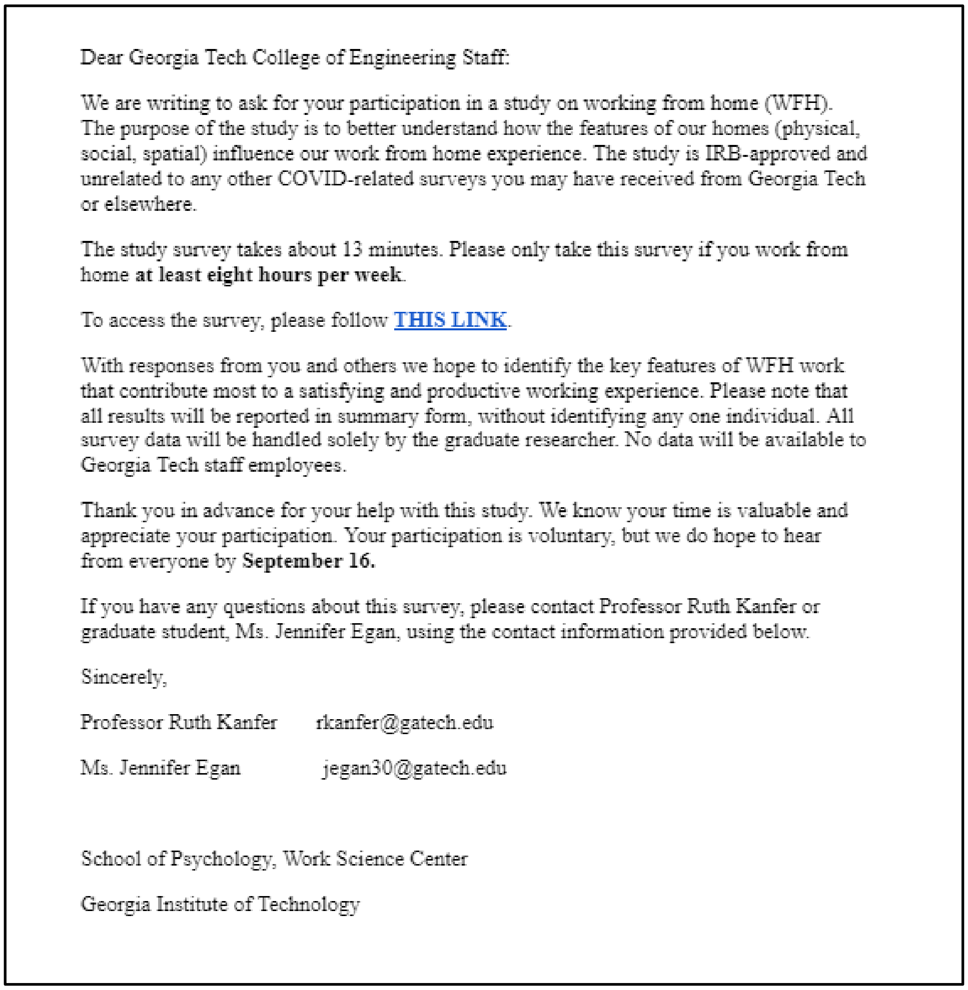
Table 9 - Sample Demographic Information

Variables	*M or %*	*SD*
Gender		
Male	22.1%	
Female	75.4%	
Gender nonconforming	1.00%	
Prefer not to say	1.50%	
Job Area		
Advising	21.0%	
General administration	8.50%	
Faculty support	7.00%	
Communications officer	3.00%	
Program coordination	20.00%	
Finance	13.50%	
IT	5.50%	
HR	3.50%	
Research	3.00%	
Web Design	2.50%	
Other	12.50%	
Age	45.01	10.59
Job tenure (years)	6.54	6.31
WFH hours per week	21.94	9.51
Office work hours per week	19.57	9.60
Household members	1.76	1.31
Household member type		
None	16.10%	
Partner	26.1%	
Children	5.50%	
Partner & children	32.20%	
Partner, children, & other non-nuclear family member	3.50%	
Children & other non-nuclear family member	3.00%	
Elderly (dependent)	4.5%	
Other	9.10%	
WFH before COVID-19		
Did not WFH	48.20%	
Full-time	4.50%	
Part-time	38.70%	

Both full- and part-time	8.50%

APPENDIX B. SURVEY INFORMATION AND MATERIALS

Below is an example recruitment letter sent to a communications representative for a college at Georgia Tech. A layout of the survey with variables within corresponding sections may be found in the following table.



Dear Georgia Tech College of Engineering Staff:

We are writing to ask for your participation in a study on working from home (WFH). The purpose of the study is to better understand how the features of our homes (physical, social, spatial) influence our work from home experience. The study is IRB-approved and unrelated to any other COVID-related surveys you may have received from Georgia Tech or elsewhere.

The study survey takes about 13 minutes. Please only take this survey if you work from home **at least eight hours per week**.

To access the survey, please follow **THIS LINK**.

With responses from you and others we hope to identify the key features of WFH work that contribute most to a satisfying and productive working experience. Please note that all results will be reported in summary form, without identifying any one individual. All survey data will be handled solely by the graduate researcher. No data will be available to Georgia Tech staff employees.

Thank you in advance for your help with this study. We know your time is valuable and appreciate your participation. Your participation is voluntary, but we do hope to hear from everyone by **September 16.**

If you have any questions about this survey, please contact Professor Ruth Kanfer or graduate student, Ms. Jennifer Egan, using the contact information provided below.

Sincerely,

Professor Ruth Kanfer rkanfer@gatech.edu

Ms. Jennifer Egan jegan30@gatech.edu

School of Psychology, Work Science Center

Georgia Institute of Technology

Figure 5 - Example Recruitment Letter

Table 10 - Representation of the General Layout of the Survey Sections

Background	Your Workspace	Weathering WFH	WFH in the Future
Informed consent	(EXP) Workspace characteristics	General stress	Future intent to WFH
Age, gender, tenure	Depth	(EXP) life efficiency and family scales	(EXP) WFH advantages
Past WFH Experience	(EXP) satisfaction scales, multifunctionality	Boundary violation scales	(EXP) WFH disadvantages
Housing type and size	(EXP) boundary-setting behaviors		
Primary and secondary workspace information	Visual, auditory, and olfactory input scales		
Household member information	(EXP) videoconferencing information		
(EXP) Home role demands			
(EXP) work intensity			

APPENDIX C. HOME AND WORKSPACE INFORMATION

Table 11 - Home and Workspace Information

Variables	*M or %*	*SD*
Housing Type		
House (2/2+ story)	60.30%	
House (1-story)	16.10%	
Apartment / Condo	16.60%	
Townhome	6.00%	
Other	1.00%	
Housing Size		
1-2k sqft		
2-3k sqft	40.20%	
	28.60%	
> 3k sqft	16.60%	
	9.00%	
> 1k sqft		
Workspace Size[a]	2.50	
Very small	10.60%	
Small	43.70%	0.88
Medium	30.20%	
Large	15.60%	
Primary WFH Location		
Dedicated home office	43.20%	
Closed-off bedroom	13.10%	
Living/Family room	19.10%	
Spare room	10.60%	
Kitchen	4.00%	
Open area of the home	10.10%	
Secondary WFH Location		
Do not use	31.70%	
Living/Family room	21.60%	
Closed-off bedroom	12.10%	
Kitchen	10.10%	
Dedicated home office	9.00%	
Outdoors/patio	7.00%	
Open area of home	5.00%	
Spare room	3.50%	
[b]Multifunctionality	2.64	1.43
Privacy	3.62	1.30
Similarity to office space	3.01	1.34
Moved office in home	2.85	1.34

Note. [a] Workspace size was measured using the following scale*: Small = 11'x12', Medium = 14'x16', Large = 20'x20', Very small = 5'x8'*. [b] Quantitative variables were measured using the following scale: *1 = Strongly Disagree; 2 = Disagree; 3 = Unsure; 4 = Agree; 5 = Strongly Agree.*

APPENDIX D. PILOT FOR HOME-SOURCED SENSORY INPUT SCALES

Two pilots were conducted before administration of the whole study survey. Information for these pilots is displayed in the table below. After pilot 1, the scale was altered to scatter input items and a stem "From my home workspace…" was added. The olfactory input items were also edited.

Table 12 - Sensory Input Scales Pilot 1

March 2022 Sample: Georgia Tech Staff Council Board Members (N: 25) Response options: 1 ("Strongly Disagree") to 6 ("Strongly Agree")	
vision_1	I have a clear view of home tasks that need to be completed from where I sit during the workday
vision_2	As I work during the day, I can see my household chores (cleaning, cooking, laundry, pet care)
vision_3	My workstation affords me a clear view of other household members, including pets, as they move around the home.
vision_4*	I cannot see many non-work items or tasks from where I sit during the workday
vision_5	I notice if my house looks like it needs cleaning during the workday
hearing_1	From where I sit during the workday, I can hear the sound of household activities.
hearing_2	While I am working, I can hear other household members in my home
hearing_3	The place I work during the day at home allows me to hear the sounds of household chores being done (e.g., laundry, cooking, etc.)
hearing_4*	When I work from home, I cannot hear any household activities.
hearing_5	I am able to hear others using household appliances, such as a shower or sink, while I work.
smell_1	If someone were to light a candle in a room near my workspace, I would be able to smell it.
smell_2*	From my workspace, I cannot smell food being cooked or eaten in my home.
smell_3	As I work during the day, I can smell meals being cooked.
smell_4	I know when my household members are preparing food during my workday because of the smell
smell_5	If something were to burn in my home, I would be able to smell it from my home workspace

* reverse-scored.

Table 13 - Sensory Input Scales Pilot 2

May - June ‘22
Sample: Georgia Tech Graduate Students (Who WFH; N: 30)
Response options: 1 (“Strongly Disagree”) to 5 (“Strongly Agree”)

Added stem:
From my home workspace:

vision_1	As I work during the day, I can see my household chores (cleaning, cooking, laundry, pet care)
hearing_1*	I cannot hear any household activities.
smell_1	I can smell meals being cooked.
hearing_2	I can hear other household members in my home
vision_2	I have a clear view of household items (packages, clothing, personal projects, etc.)
hearing_3	I can hear the sounds of household chores being done (e.g., laundry, cooking, etc.)
smell_2	I would be able to smell if something is burning in the kitchen
vision_3	I notice if there is a lot to do in my house (tasks, chores, etc.)
hearing_4	I can hear the sound of household activities.
smell_3*	I cannot smell food being cooked or eaten in my home.
smell_4	I can smell when my household member(s) are preparing food.
vision_4	I have a clear view of other household members, including pets, as they move around the home.
hearing_5	I am able to hear others using household appliances, such as a shower or sink.
vision_5*	I cannot see many non-work items or tasks.
smell_5	I would be able to smell a lit candle if someone were to light one in a nearby room.

* reverse-scored.

Table 14 - Sensory Input Pilot 2 Results

Scale	# Items	Alpha	Mean	SD	Skew
Visual	5	0.81	2.89	0.92	0.24
Auditory	5	0.83	3.68	0.82	-0.63
Olfactory	5	0.80	3.63	0.78	-1.37

* All items were measured on a 1-5 Likert scale with greater values representing more of the construct.

1 = Strongly Disagree; 2 = Disagree; 3 = Unsure; 4 = Agree; 5 = Strongly Agree.

APPENDIX E. HOME-SOURCED SENSORY INPUT SCALE

Table 15 - Individual Home Sensory Input Scales

Inputs	#	Item
Visual	1	As I work during the day, I can see my household chores (cleaning, cooking, laundry, pet care).
	2	I have a clear view of household items (packages, clothing, personal projects, etc.)
	3	I notice if there is a lot to do in my house (tasks, chores, etc.)
	4	I have a clear view of other household members, including pets, as they move around the home.
	5	I cannot see many non-work items or tasks.
Auditory	1	I cannot hear any household activities.
	2	I can hear other household members, pets, or visitors in my home
	3	I can hear the sounds of household chores being done (e.g., laundry, cooking, etc.)
	4	I can hear the sound of household activities.
	5	I am able to hear others using household appliances, such as a shower or sink.
Olfactory	1	I can smell meals being cooked.
	2	I would be able to smell if something is burning in the kitchen
	3	I cannot smell food being cooked or eaten in my home.
	4	I can smell when my household members or visitors are preparing food.
	5	I would be able to smell a lit candle if someone were to light one in a nearby room.

Note. All items were measured on a 1-5 Likert scale with greater values representing more of the construct.

1 = Strongly Disagree; 2 = Disagree; 3 = Unsure; 4 = Agree; 5 = Strongly Agree. Item topics/dimensions for sensory input: Home-related tasks, items, and occupants

Table 16 - Sensory Input Scale As Displayed in Study Survey

Section Instructions:	
Each person's home workspace is unique to them. We want to know what you can hear, see, and smell from your main workspace area. Please indicate your agreement with the following statements. *From my home workspace…*	
Input	Item
vision_1	As I work during the day, I can see my household chores (cleaning, cooking, laundry, pet care)
hearing_1*	I cannot hear any household activities.
smell_1	I can smell meals being cooked.
hearing_2	I can hear other household members, pets, or visitors in my home
vision_2	I have a clear view of household items (packages, clothing, personal projects, etc.)
hearing_3	I can hear the sounds of household chores being done (e.g., laundry, cooking, etc.)
smell_2	I would be able to smell if something is burning in the kitchen
vision_3	I notice if there is a lot to do in my house (tasks, chores, etc.)
hearing_4	I can hear the sound of household activities.
smell_3*	I cannot smell food being cooked or eaten in my home.
smell_4	I can smell when my household members or visitors are preparing food.
vision_4	I have a clear view of other household members, including pets, as they move around the home.
hearing_5	I am able to hear others using household appliances, such as a shower or sink.
vision_5*	I cannot see many non-work items or tasks.
smell_5	I would be able to smell a lit candle if someone were to light one in a nearby room.

* reverse-scored. All items were measured on a 1-5 Likert scale with greater values representing more of the construct. *1 = Strongly Disagree; 2 = Disagree; 3 = Unsure; 4 = Agree; 5 = Strongly Agree*.

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