Rethinking the home office: Teleworking mothers' material housing adaptations during COVID-19

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ABSTRACT: This follow-up qualitative study delves into the contribution of housing on the material adaptations of teleworking mothers during the COVID-19 pandemic. The investigation concentrates on the interplay between housing conditions, the multifaceted challenge of daily routines faced by mothers, and telework setups during stay-at-home orders. Insights from the adaptation process will inform flexible design criteria for home offices in the context of a global telework upsurge and enhance preparedness for future emergencies. Narrative accounts were gathered through 33 semi-structured Zoom interviews of teleworking mothers, supplemented by annotated architectural plans. AI-assisted discourse analysis using ChatGPT-4.0 was conducted on four groupings defined by comparable residential situations (defined along housing attributes, family structure, and work modality profiles). Floor plans, dwelling pictures from home offices or multifunctional spaces, participant profiles, and interview extracts were used for a thorough architectural assessment and for uncovering each group's material adaptations. The findings were subsequently verified through qualitative analysis. Key design strategies for future housing projects and renovations to improve work modality transitions and telework productivity, especially when living in apartments or with small children, are the inclusion of flexible multifunctional rooms, quiet areas with foldable desks, portable home office setups for the self-employed on the move, small home offices for occasional meetings in sub-utilized storage rooms, modular and soundproof partitions temporarily separating open plans or shared home office spaces, visual partitions to demarcate private and work environments, designing office spaces in intermediate and exterior areas like verandas and balconies through the inclusion of glassed perimeters for winter use, and planning adaptable building systems.

KEYWORDS: COVID-19, residential situation, adaptation, design guidelines, mental health.

1.0 INTRODUCTION

1.1 Pandemic and telework: residential architecture in transition

While telecommuting is not a new phenomenon, residential projects have begun to incorporate flexibility criteria to facilitate working from home (Bettaieb and Alsabban 2020; Yaneva 2022), with popular magazines and architects' firms advising on the best ways to create a home-office (DK Studio 2021; Rajendrakumar 2023). The U.S. Government Accountability Office reports that, in 2021, exclusive telecommuting, i.e., when the worker completes all work tasks from home, increased from 5.7% in 2019 to 17.9% in 2021, and partial or hybrid telecommuting, when some tasks are performed from home, increased from 23.7% to 38.1%. However, this increase was mainly concentrated in certain industries, especially those linked to information, and among people with higher salaries (Government Accountability Office 2023), conducive to hybrid telework modalities (Carrasco-Garrido, De-Pablos-Heredero, and Rodríguez-Sánchez 2023). One of the direct consequences of telework's growth is that the real estate market must incorporate home offices in residential projects, especially for those targeting middle-to-high earners. Public policy will also need to find ways to incentivize the transformation of the existing housing stock to incorporate multifunctional office space.

Women carry a significant part of the household burden (Hilbrecht et al. 2008; Morin, Fortier, and Deschenaux 2018), and during the pandemic, there were no exceptions (Craig 2020; Kofman and Garfin 2020; Pasqualini et al. 2022). Even in progressive societies such as Canada, women were at the center of household adaptation efforts (Cockayne 2021; Fuller and Qian 2021; Tremblay and Mathieu 2020). Moreover, the adaptive difficulties of the mothers in the study are a critical pillar for residential design improvements because of the impact their mental and physical health has on families (Freisthler et al. 2021; Heilman and Calarco 2022; Statistics Canada 2022). The research presented in this paper focuses on the difficulties of teleworking mothers during the pandemic as well as on identifying how residential architecture can make their everyday lives easier and more comfortable, especially in times of lockdown, equally contributing to an existing pool of COVID-19 research applicable to future crises with stay-at-home orders (Alhusban, Alhusban, and Alhusban 2022; Aramayona and Nofre 2021; El-Husseiny 2021; Yaneva 2022).

1.2 Research question and objectives

Considering these developments, how can the adaptations of teleworking mothers during the COVID-19 pandemic inform future residential design to safeguard mental health and improve work-life balance? From this question, the two main objectives follow. First, to investigate teleworking mothers' adaptations in varied residential situations and

with different mental health profiles. Second, to identify design strategies enabling telework during crises (Alhusban, Alhusban, and Alhusban 2022; Downing 2016; Hagar 2012) and improving telework conditions in the context of a burgeoning information society (Castells 1996; 2001).

2.0 THEORETICAL AND CONCEPTUAL FRAMEWORK

Similar to Sweet & Scott (2022), here the term telework is used as a synonym for home-based work. The use of the term does not include other out-of-home locations for work, like cafes or coworking environments. It does not include third or fourth places, despite the potential benefits of developing teleworking spaces within them (Aelbrecht 2022; Williams and Hipp 2019). The term adaptation is used from the point of view of the material, behavioral and cognitive modifications necessary to meet the objective of routine continuity and coping with stressors, specifically in the case of working from home (Alves, Amorim, and Bezerra 2021; Ayuso et al. 2020; Barahona 1983; Guilloux et al. 2021; Hizra, Dewi, and Izziah 2021; Lloyd 2021; Platt 1970; Simonet 2009; Viriot Durandal et al. 2018). Finally, the term vulnerability is used from the perspective of potential coping difficulties, not immediately implying a scarcity of economic resources. It means a complex situation where a lack of resources may be one of the elements combining to generate crucial adaptation difficulties (Doucet, Turman, and Diwan 2021; Raynor and Panza 2021; Robinson et al. 2021; Vergara-Perucich, Correa-Parra, and Aguirre-Nuñez 2020). In turn, adaptation difficulties are potentially linked to a lack of personalization opportunities, hindering its well-being-enhancing properties (Al-Tarazi et al. 2024).

3.0 METHODOLOGY

3.1 Qualitative data collection

The research took place in the province of Quebec, Canada, and interviews were conducted by ZOOM using a subsample of teleworking mothers (n=33) selected from a previous mixed method study employing Multiple Factor Analysis (MFA) on a sample of 538 women with children at their dwelling. This previous study identified four key subgroups representing common residential situations in the sample (showcasing common residential situations defined by housing attributes, family structure, and work modality profiles), which served as a starting point for this paper's qualitative analysis section. All participants in both projects are part of the comprehensive MAVIPAN database (CIUSSS de la Capitale-Nationale 2023; LeBlanc 2021). The study utilized data from 33 interviews with teleworking mothers collected through semi-structured ZOOM interviews (Archibald et al. 2019; Oliffe et al. 2021). Participants discussed their telework or distance learning arrangements (in the case of student mothers) during the pandemic, with a focus on lockdowns. The four groups identified were the following.

1. Young single-parent or recomposed family mothers living in apartments, which encapsulates participants navigating complex family structures.
2. Self-employed mothers with young children, including lower-than-average dwelling occupation density for most participants.
3. Studying and working on-site mothers with children are indicative of participants with a medium gross household annual revenue (50,000-79,999 CAD) and higher-than-average dwelling occupation densities.
4. Self-employed middle-income mothers in small dwellings comprise individuals of average ages and average dwelling occupation densities.

These four groups became the focus of the qualitative analysis section, as telework material adaptations regarding their home-office setups were researched. All except one participant submitted a drawing of the architectural layout of the dwelling. Photographs of living spaces complemented these plans by 27 participants, which allowed for material changes and home modifications to be drawn on top of each plan live during the interviews. The interview -based on a 38-point questionnaire - delved into participants' daily routines, focusing on how they organized telecommuting and distance learning.

3.2 AI-assisted thematic analysis

Additionally, this work combines the use of artificial intelligence through ChatGPT-4 for qualitative analysis -without losing sight of its limitations (Ayub et al. 2023; Khlaif et al. 2023; Kocoń et al. 2023)- and traditional qualitative analysis based on grounded theory (Glaser and Strauss 2017; Uri 2015) emphasizing user perspectives (Clarke 2005), demonstrating the compatibility of new AI-assisted tools with qualitative methodologies, enriching the field of architectural research (Groat and Wang 2013). The methodology was developed with an equally design-oriented vision, which constitutes an interdisciplinary contribution linking social science research with design science (See Appendix C).

Using both text and images, the AI was asked for adaptation patterns showing how each group of working mothers progressively created home offices within their dwellings. In the first step, the model was provided with the floor plan, along with dwelling and home-office photographs, of each participant individually, complemented by interview text detailing the teleworking setup and tele-studying setup when relevant. The model was then tasked with providing an architectural assessment for each participant separately, analyzing their dwelling's architecture during material telework adaptation. The resulting output had three parts. First, an evaluation of the positive and negative aspects of the participant's dwelling architecture, a flexibility assessment, and a description of the participants' adaptation accounts. The two last elements were used to construct separate scores for flexibility and adaptation effort: 1 for low flexibility and low adaptation effort, 2 for moderate flexibility and moderate adaptation effort, and 3 for high flexibility and high adaptation effort. A Microsoft Excel document was constructed using the architectural assessment for in-depth verification and comparison.

All 33 architectural assessments were then re-submitted together in a single document, except pictures and plans, for the model to find participant adaptation patterns according to the MFA groups. The four sub-groups from the MFA were described in the instructions, requesting that the model use them for theme finding, concentrating on material adaptations to telework.

4.0 RESULTS AND DISCUSSION

The present section is articulated in three steps. First, presenting and discussing the architectural assessment and its verification, then proceeding with telework adaptation patterns obtained using ChatGPT-4 for each of the four sub-groups previously identified. The discussion closes with a final section on general housing design guidelines springing from the complete analysis.

4.1 Architectural assessment

The architectural assessment results were accurate, with deep spatial analysis. The model captured themes from participants' needs, showing precise reflection after checks. It detailed the positives and negatives of each residence's architectural layout, considering specific household types, i.e., apartments, multi-generational dwellings and loft studios, and multi-floor homes. For example, the output explained the case of a single mother who faced challenges with her office on the ground floor, away from her children's desks upstairs, affecting supervision. However, errors occurred with 5 participants with complex, non-standard information, like those who moved during the pandemic. These errors underscore the model's need for consistent data, often lacking in semi-structured interviews. Table 13 shows that Group 2 had higher flexibility scores, while Profiles 1 and 4 scored lower. Profile 3 had varied scores due to their diverse needs as students and workers. Apartments were less flexible, but all groups showed significant adaptation efforts, proving people's resourcefulness in improving their living and teleworking spaces. Interestingly, those with more resources also made significant adaptations, maximizing their dwellings' flexibility.

The existence of significant adaptation efforts in all groups shows that people used the resources available to them to improve their residential situations and teleworking arrangements. Contrary to the belief that participants with more resources would potentially make fewer adaptations, this shows that they were probably maximizing the opportunities conferred by their dwelling's flexibility. In other words, more flexibility is desirable since it channels adaptation efforts more smoothly.

Table 1 Flexibility and adaptation effort scores. Source: (Authors' tables 2024).

		Flexibility Score			Total
		1	2	3	
MFA Group	1	1	2	0	3
	2	0	2	4	6
	3	1	3	2	6
	4	2	4	2	8
	Outliers	1	7	2	10
Total		5	18	10	33

		Adaptation effort Score			Total
		1	2	3	
MFA Group	1	0	2	1	3
	2	0	3	3	6
	3	1	3	2	6
	4	2	1	5	8
	Outliers	2	3	5	10
Total		5	12	16	33

Cluttered spaces were an important theme. They are unproductive due to distractions or saturation. Clutter complicates transitioning to telework via decreasing well-being (Rogers and Hart 2021), suggesting that covering open shelves and helping organize office material in proper compartments is a safe design strategy both for telework productivity and shielding mental health. A significant theme addressed is the mental health of participants and its link to adaptation efforts. The assumption is that mental health issues complicate daily life over time, slowing adaptation. This phenomenon was partly verified within the sample of teleworking mothers, effectively seen in participants who were significantly stressed at the pandemic's start or those experiencing unfortunate events like winter falls and severe health issues. Their accounts evidence a sustained and prolonged adaptation effort which was qualified as slow or insufficient.

4.2 Results across four profiles

Profile 1. Young single-parent or recomposed family mothers living in apartments faced unique challenges. They creatively adapted to small spaces, often shared with children, which required innovative solutions. Adjusting work hours has been crucial to balance their professional and familial duties, with many opting for flexible work schedules. Childcare is a significant concern, with reliance on family members or friends for support. Noise management from work tasks and children's activities presented a challenge, leading to the need for multifunctional spaces that serve both work and family purposes.

Profile 2. Self-employed mothers with young children developed specific strategies to manage their dual roles. Establishing a dedicated home office is a common approach to maintaining productivity. Childcare assistance, either through professional services or family help, is crucial during work hours. These individuals typically adhere to structured work hours to efficiently balance their business commitments and childcare. Many have adopted hybrid work, i.e., they constantly shift from their home office to their traditional workplace. By combining telework with on-

site operations, enabling efficient supervision of employees, their storage and communication needs must address a certain level of standardization to keep transitions smooth.

Profile 3. Studying and working on-site mothers with children balanced on-site work, study, and childcare. A significant support system comes from extended family networks that assist with childcare during working hours. Synchronizing work and study schedules with their children's routines helps minimize schedule conflicts. Utilizing breaks during the workday to spend time with their children is a common practice that solicits design flexibility.

Profile 4. Self-employed middle-income mothers in small dwellings have their unique set of practices. Many have established dedicated home offices to create a professional workspace within their living quarters. The flexibility of self-employment allows them to adjust work hours as needed to accommodate personal and family requirements, thus minimizing the impact on family life. Some choose to occasionally work from third places to maintain a clear separation between their professional and personal lives, probably highlighting a need for work-life balance.

4.3 Material adaptations

Profile 1 participants relied heavily on technology for space management and the utilization of communal areas in their apartments, with consequences on home material culture (Clark and Lupton 2021; Watson, Lupton, and Michael 2021). The risk of heightened technology use and dependence had been researched before (Baillie and Benyon 2008; Berkowsky 2013; Glucksmann and Nolan 2007), showing that women's roles as mothers and workers can be strained. As expected, this was problematic when resources were scarce or when daycare centers closed. Those in old apartments with low flexibility experienced adaptation difficulties, leading to quality concerns in the case of student participants (Francis and Weller 2021). For Profile 2, material adaptation involved the transformation of different home areas into multifunctional spaces and professional offices to cater to various needs, protecting these participants from mental health impacts when compared to Profiles 1 or 4. When compared to all other groups, Profile 2 participants showed an interest in customizing their office spaces with a professional taste, probably reflecting their roles as business owners, not just as workers. In Profile 3, participants created specific work and study areas within their medium-sized dwellings, emphasizing the importance of noise-canceling devices to maintain productivity and focus during on-site work and online education. Profile 4 participants adapted smaller spaces for work, and some sought external spaces for relaxation, recognizing the limitations of their small dwellings and apartments size and layout. For more details on each profile's adaptations, see Appendix G.

Teleworking involves the creation of workspaces for mothers and their children when distance learning (Andrada-Poa, Jabal, and Cleofas 2022). Mothers had to find new ways to free up space for the use of digital communication technology (Tavares et al. 2021). Nevertheless, supervision was needed in the case of small children, so this often meant being able to have a view from their home office of their children's workstations. This very complex spatial arrangement was nevertheless possible for some. The materiality of the house could lend itself to more flexible adaptation, as has been noted in recent research (Bettaieb and Alsabban 2020). For some low-income participants in Profiles 1 and 2, having few economic resources and an architectural distribution with plenty of open areas, i.e., few partitions and complex families, made things worse, which aligns with the commonalities observed in participants, especially apartment dwellers, belonging to Profile 1. Due to the Province of Quebec's Nordic climate, many participants adapted by using their basements, which solicited renovations, which contributed to adaptation inequalities, as forecasted at the start of the pandemic (Bonacini, Gallo, and Scicchitano 2021), despite research on organization family-friendly measures in the years leading to the pandemic (Mansour and Tremblay 2018).

4.4 Working mothers and telework: Towards design guidelines

Different telework adaptation patterns among various groups of participating mothers underscore the importance of developing a unified set of strategies for home office design (Srivastava et al. 2024). These strategies aim to establish standards that are not only beneficial to mental health but also cater to the diverse needs of different family structures and working conditions. For mothers living in apartments, either single-parent households or in recomposed families, transforming small spaces into additional office areas is crucial for maintaining supervision and family contact, and avoid solitude. These spaces need to be flexible, well-lit, soundproof, and ergonomic, with plenty of storage space and flexibility. In the case of self-employed teleworking mothers with young children, the preference for hybrid work models necessitates dedicated and professional home offices with visuals of children's rooms or family areas. Incorporating fenestration is essential for a calming effect and stress reduction. Their storage needs are high due to the multiple tasks they accomplish within their companies and the need for a very professional image tied to their managerial roles.

For those self-employed mothers (profiles 2 and 4), a professional and portable home office environment is essential, particularly for those engaged in frequent meetings and who occasionally work from third places, implying movement. This strategy includes well-ventilated, ergonomic, and soundproof spaces. The basement can be used for teleworking if well equipped, especially as a way of creating a spatial boundary to enhance work-life balance. In the case of studying mothers with young children, some working on-site, design solutions should focus on convertible spaces, modular partitions, and multiple office nooks to accommodate familial, personal, and professional adaptations involving multiple roles and changing needs, with clutter reduction capabilities. Occasional breaks mean their office spaces should be easily transformed. Office supplies should be easily stored, and if possible, the modular space should be transformed for another use, including the possibility of storing screens or computers in custom storage spaces.

From these considerations, the following design and specification criteria are suggested.

1. Multifunctional spaces. The dwelling unit should include flexible and multifunctional office spaces, with an emphasis on modular furniture that can be transformed for other uses during breaks. Consider integrating hinged tables in areas like stairs or living rooms and avoid placing office furniture in bedrooms unless a movable separation is feasible.
2. Quiet Zones and Quiet Nooks. Incorporate both open and closed quiet zones using sound-absorbing materials for walls, ceilings, and partitions. Consider movable, modular barriers for flexibility in the guise of pivoting partitions and doors and temporary visual interruptions as cues for other members to know the zone is being used.
3. Basement Office Spaces. Basements can be utilized for office spaces for emergency situations, especially those with half windows. For basements without fenestration, use soothing colors, ambient lights, and plants to enhance the environment. To enhance work-life balance, use different colors and motives accentuating the difference with the ground floor.
4. Innovative Small Office Spaces. Transform small, underused spaces into multifunctional, soundproof office areas for occasional use. This transformation can be accomplished using underused closets or similar storage areas within existing dwellings. Ensure full isolation in basement areas to avoid future remodeling costs.
5. Open Spaces with Movable Partitions. In open space designs, include movable partitions to separate areas like the kitchen or living room temporarily. Ensure clear visuals from workspaces to common areas and soundproofing.
6. Balconies as Multi-season Offices. Large balconies should be designed to accommodate perimeter glass, enabling their use as multi-season office spaces for Nordic climates.
7. Intermediate Outdoor Spaces. Encourage the use of glass-enclosed verandas or porches to provide well-fenestrated outdoor workspaces for breaks and relaxation. These intermediate spaces are particularly useful for the fast-paced self-employed, allowing them to store office material easily.
8. Dedicated Office for Working Couples. Provide dedicated office spaces with separate L-shaped desks and soundproofing for couples. Include at least one alternative office space for occasional use when meetings coincide during the day or when supervision is warranted in the case of couples with small children.
9. Key Elements for Multifunctional Spaces. Emphasize natural light, cross ventilation, warm materials, ergonomic furniture, soundproofing, and ample storage in all multifunctional spaces, including nooks, balconies, and verandas.
10. Portable offices. The experimental concept of the portable office can be beneficial for those who migrate between their home office and third places. Modular desks with additional screens, set up to easily receive and disconnect laptop computers in various places of the dwelling, as well as storage spaces for briefcases and hard drives or other office supplies, could benefit the self-employed on the move.
11. Adaptability of Residence Systems. Ensure the adaptability of the home's systems, including internet connectivity, electricity, plumbing, and heating, to facilitate their use in various areas like the basement and outdoor spaces.
12. Children's Rooms. Include space for a full-size, functional desk in children's rooms, with lighting outlets on walls for flexibility when the room is used as an office by adult family members or children, which happens often in the case of recomposed families.

CONCLUSION

This study extracted design guidelines by categorizing material adaptations using ChatGPT-4 along four previously identified groups, followed by a detailed qualitative analysis. This sequential approach proved crucial in systematically identifying (Hoyningen-Huene 2013) the diverse adaptation patterns of teleworking mothers, highlighting the necessity to understand user perspectives. As the pandemic progressed, these mothers evolved their telework approach—shifting from viewing the situation as a temporary arrangement to actively modifying their spaces to meet changing needs and expectations. This study ultimately sheds light on the fluid nature of residential architecture, underscoring its need to be responsive to the evolving life circumstances of its inhabitants, particularly in crises like the COVID-19 pandemic and amidst the growing trend of telework.

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