Dwelling on Loneliness: Structural Drivers of Social Resiliency, Belonging, and Well Being

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Using the lens of common residential typologies found in Canada, this paper examines the possibilities structural drivers (the built environment) might offer to promote social interaction and help address the emerging state of chronic loneliness being experienced in the country. Specifically, the question is how might architects begin to dismantle common spatial constructs grounded in autonomy in search of typologies founded on negotiable space that supports the act of coming together and exchange? Research exists regarding attitudinal, relational, and cultural drivers of connection, but the impact of early, architecturally driven conceptual design decisions and their effect on social interaction and sociability remains limited. Where knowledge does exist, the trend is towards using a qualitative metric such as case study, precedent, or anecdotally based post occupancy evaluation. Through the use of simulation software known as FLUID Sociability, comparative measurements can be made between design proposals to reveal the potential effectiveness of structural drivers in promoting human connectedness and social interaction earlier in the design process. To advance the ideas, a hybridized seminar-design based graduate level course was developed to create testable hypotheses and emergent design proposals involving four common residential typologies. The typologies were subsequently tested for social performance using the aforementioned software. The results present a comparative working methodology whereby designers and architects can evaluate design options from the perspective of social interaction, and thereby provide enhanced design rationales to proactively build more socially resilient dwellings and communities.

INTRODUCTION AND BACKGROUND

> Loneliness is a very special place.
>
> —Dennis Wilson (Musician, Co-founder of The Beach Boys), *Pacific Ocean Blue*

In response to a cross country listening tour, Dr. Vivek Murthy, the 19th Surgeon General of the United States posited "the most important question [today] is not who am I, but who am I in relation to others?" [1] Murthy's self-observed discovery and subsequent proposition is rooted in a troubling global trend: the 21st century is the loneliest century on record.[2] And although people are migrating to cities at unprecedented rates, proximity does not appear to be a substitution for meaningful interaction and a shared sense of belonging. Further, digital contact methods offer new kinds of social interaction and connection, but physical information related to place, time, scale, and sensory experience seem to get lost in translation. In other words, the quality of the social interaction shifts from an experience of being present with one another, to one of having a presence (which is often peripheral, fleeting, and supported by an augmented reality). Taken together, people are unwittingly amid a socially based pandemic: One of loneliness with prevalence rates exceeding that of diabetes or smoking. [3]

Throughout history, much has been written about the unique and often personal experience of loneliness which "doesn't necessarily require physical solitude, but rather an absence of connection, closeness, kinship: an inability, for one reason or another, to find as much intimacy as is desired." [4] Loneliness can also assume many forms and exist under different durations. This means people can and do routinely experience periods of loneliness from time-to-time; however, the sensation often subsides with changing circumstances. Conversely, chronic loneliness (where people often or always feel lonely) does not generally or easily subside. "For as many as 15-30% of the general population, however, loneliness is a chronic state… Left untended, loneliness has serious consequences for cognition, emotion, behavior, and health." [5] Specifically in Canada, the location of the study within, "1 in 10 people aged 15 and older said that they always or often felt lonely." [6]

The causes of loneliness are also plentiful and the interdependence between various factors are complex and often intersectional. In other words, when discussing loneliness, pinpointing causality is challenging at best and a full discussion around loneliness and causality is beyond the scope and realm of this paper, other than to say advances in knowledge are

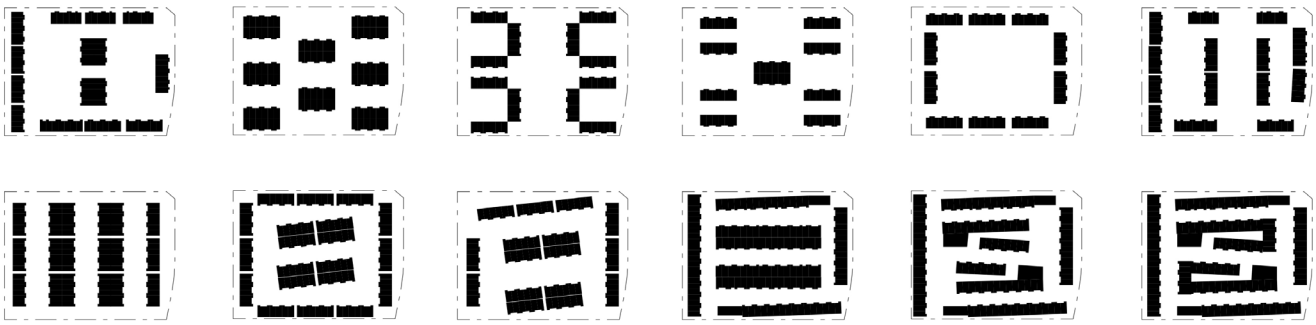


Figure 1. A series of early conceptual design strategies developed for the row house typology study. Image credit. Connor Tamborro, Jonathan Chung, Matthew Beliak, and Alice Won

occurring in the social sciences regarding attitudinal, relational, and cultural drivers of connection. [7] Given this complexity, trying to discover remedies for loneliness is no small task. Imagining a single solution to address the issue of loneliness, or trying to isolate a causal effect is probably not a reasonable pursuit either. A more probable model likely involves a multi-faceted approach, whereby many ideas ranging from personal influences to the physical environment are working together to try and find a path forward.

That said, Dr. Murthy's insight about the rising importance of one's relations to others is an important one. For example, as day-to-day relations continue to evolve under the influence of technology and social media, so do the type and quality of experiences and connections shared with others. These quotidian experiences (everyday occurrences and interactions with one another) have often been described using references to strength. As Granovetter described it, "the strength of a tie is a (probably linear) combination of the amount of time, the emotional intensity, the intimacy (mutual confiding), and the reciprocal services which characterize the tie." [8] Again, there are many factors that influence the degree to which a relational tie forms, if one forms at all. For example, something as simple as a person's particular mood on a particular day might affect their relations with others, or an introvert might have a profoundly different experience when it comes to social interaction compared to an extrovert. But in principle, the frequency, duration, and intimacy of the contact could help in forming new relational ties between people, or strengthening existing ones. The prospect being that strengthened ties might also lead to strengthened relations with others. And this subsequent strengthening might help confront Dr. Murthy's salient proposition: Who am I in relation to others? It might also offer another inroad in the search for ways to combat the now present issue of chronic loneliness.

For designers with extensive training, knowledge, and experience working with the built environment, it often seems intuitive that design decisions would affect behavior - after all, surely the spaces people inhabit have an impact on their physical and mental health, well being, and degree of social interaction with one another. Space (as a product of the built environment) moves people (literally and figuratively) and asks questions of people; space can convey meaning; spaces can be awe inspiring, contemplative, reclusive, embracing, and a host of other adjectives that imply an active and even participatory presence with people. But what about the adjective lonely? Whether consciously or unconsciously, is the design of the physical environment making people lonelier? Or might it be contributing to the emerging patterns of chronic loneliness now being experienced? And if space is a primary currency of planners, urbanists and architects, then how relevant are structural drivers of connectedness (the built environment) to the conversation of loneliness, isolation, and social interaction?

One challenge with the proposition that the built environment affects behaviour and social interaction is studying it more rigorously, with hope for relevant and reliable design results. Furthermore, human and environmental psychology is incredibly complex: The influences on how people interact with one another are plentiful and difficult to separate into discrete input-output responses: As mentioned, introverts and extroverts navigate social settings differently; Mood might cause people to retreat or open up; and perhaps relationships have little to do with space, and everything to do with human emotion and psychological predisposition. That said, just as advertising provides implicit and explicit cues, presumably the built environment is participating in a similar dialogue with people about their behaviour. But intuitions and presumptions can be deceiving. So, when it comes to social interaction, and recognizing that designers have much less control over the relevant attitudinal, relational, and cultural drivers of connection, how much influence can be attributed to structural factors (the built environment)? Furthermore, structural drivers are the area of expertise most aligned with the skills and knowledge of the architect, and yet in terms of tackling the emerging issue of

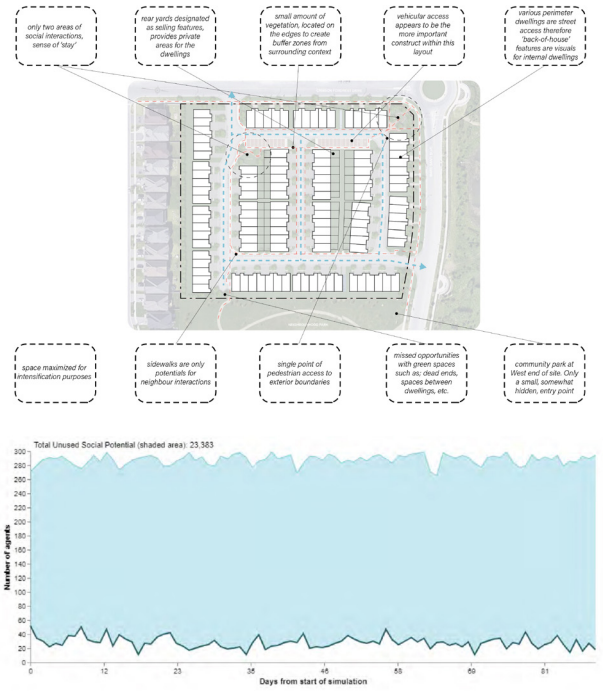


Figure 2. Top: A diagram used to critique the lack of potential for social interaction for the baseline row house typology. Bottom: The resultant graph of social potential for the baseline row house typology obtained from the sociability simulation. Image credit. Connor Tamborro, Jonathan Chung, Matthew Beliak, and Alice Won

loneliness, remain under explored and underrepresented in terms of pro-active and preventative strategies based in design.

The other important question is whether or not more certainty can be provided around the presupposition that design might affect social interaction. Studies and groups such as The Loneliness Lab in the U.K. provide relevant insight through a combination of precedent, lived design experience, informed intuition, and anecdotal post-occupancy evaluation and reflection. In other instances, researchers and designers have experimented with sensible heat maps to track movement in retail stores (interactions with products instead of between people), and used machine learning algorithms to track people and movement through public space (interaction within existing spaces). From this valuable work, designers can gain certain insights about the impact the physically constructed environment might have on certain types of social interaction. But challenges remain: Architecture still tends to operate in the realm of one-off prototypes so replicable circumstances are rare events; and projects are often complete on analysis which means at least three things: 1) Construction takes up a lot of time and energy and verification of intent occurs after the investment is already made; 2) Completed projects are more challenging to modify given the existing investment already made; and, 3) Certain post occupancy evaluations, such as surveys, can provide important qualitative and anecdotal feedback from people using the projects, but it can be hard to obtain afterward, and for better or worse, is subject to the realm of personal opinion.

These aforementioned questions and challenges were the basis for designing the course and the resultant study that follows. Specifically, the goal is to try and understand the impact early, architecturally driven conceptual design decisions might have on fostering (or hindering) social interaction by considering the comparative frequency, duration, and intimacy of resultant social encounters within common residential dwelling typologies.

METHOD

To foster a more nuanced and empathetic approach surrounding the subject matter of loneliness and design, a graduate level seminar course with a limited five week design component was developed in a Master of Architecture program. By using a hybrid seminar-design format students were able to use a multiplicity of analytical techniques to unpack the potential impact the built environment might have in contributing to patterns of loneliness and social isolation or fostering social interaction. The other intention of hybridizing the traditional graduate seminar format was to allow the introduction of a design based research component that would allow students to test the theoretical frameworks being learned. Prior to the design component of the course though, students first developed knowledge about the subject matter of loneliness and social interaction in three primary ways which are described next.

Lectures, Literature Reviews, and Precedent Analysis

A series of introductory lectures pertaining to the myriad facets of loneliness were developed and delivered in a conversational setting. The lectures attempted to synthesize knowledge from disciplines across the social sciences and humanities. The lectures provided foundational knowledge about loneliness and belonging, including but not necessarily limited to concepts of fostering social capital, social inclusion-exclusion, social trust-distrust, social cohesion-discord, gathering, opportunity structures and a host of other factors directly and tangentially relevant to understanding social interaction as it relates to architecture. As part of the series, the course invited collaborators from the Canadian Mental Health Association (CMHA) to participate in the course. At the time, the CMHA was developing a public policy document titled Solutions for Belonging: Community Framework to End Chronic Loneliness. As such, students became exposed to the on-going public policy work focused on tackling loneliness from a different but related angle.

Occurring in parallel with the lecture series was a literature review focused on the various ways in which architects and the disciplines of planning, urbanism, and architecture have previously explored the relationship between structural factors and

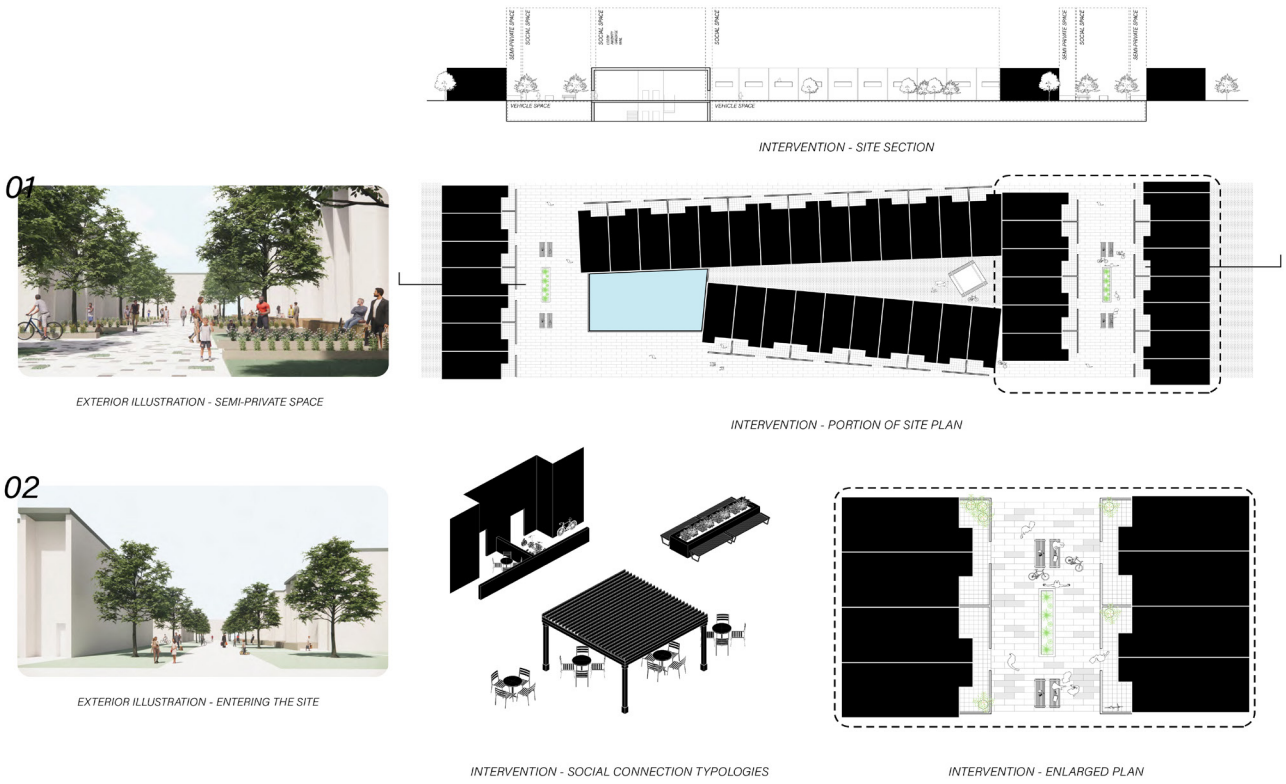


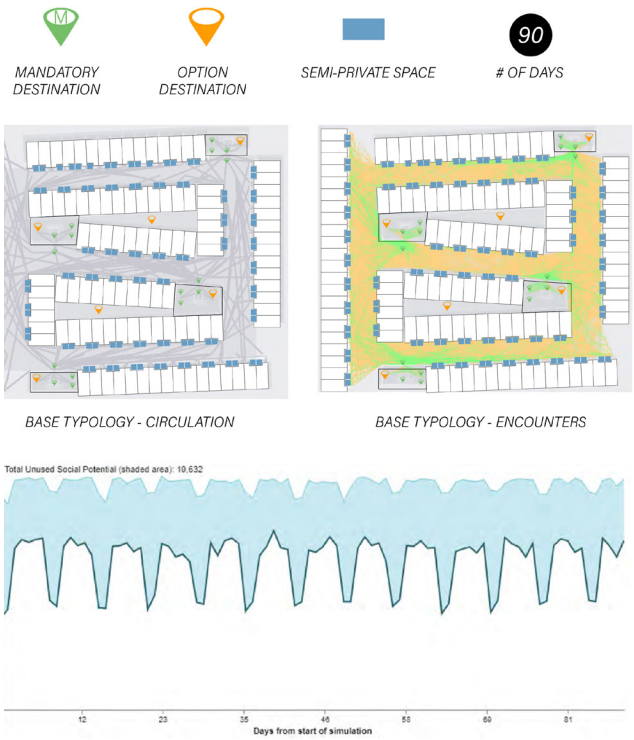
Figure 3. Following the baseline simulation, conceptual design work in plan and section focused on incorporating various structural drivers (open courtyards, semi-public zones, areas for chance encounters) that could then be comparatively tested for relative impact on social interaction. Image credit. Connor Tamborro, Jonathan Chung, Matthew Beliak, and Alice Won

social interaction. Students were tasked with literature reviews and creating associated graphical abstracts for each article or study that distilled the results, and interpreted essential points of consideration related to the impact of structural drivers on connectedness, belonging and social interaction. The format of the graphical abstract was used to promote the efficient sharing of information and learning which would be applicable in the design portion of the course.

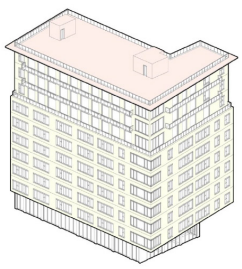
Lastly, the third preparatory task involved the selection of a dwelling environment to be used as the basis for critique and design charrette intervention. Students first had to select a dwelling of personal interest. Selections ranged from apartment buildings the students were living in, to transitional dwelling buildings, to dormitories being lived in on campus, to solo-dweller high rise condominiums, and even residences of elderly grandparents. Under the guise of the knowledge being learned in the lectures and literature reviews, students were asked to look at these dwelling environments critically, searching for overt and covert ways that the built environment might be exacerbating loneliness. Following this critical analysis, a series of weekly design charrettes were used to ideate how the projects might be modified to heighten opportunities for social interaction, social inclusion, social trust, and social cohesion.

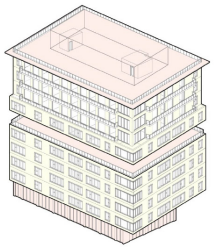
Dwellings

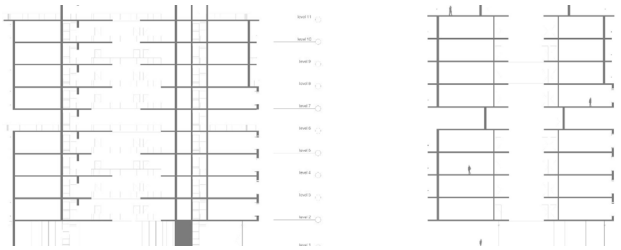
Following this preparatory work, the course made a transition to an approximately six week design component whereby students were assigned one of four common Canadian residential typologies. The intention was to focus on dwelling environments because this is where people spend a significant amount of their waking time. Whether consciously designed this way or not, dwelling environments are the backdrop for living life and forming (or perhaps hindering) critically important social interactions and relationships with others. If chronic loneliness is on the rise, one cannot help but wonder if the structural drivers that influence the way people dwell are in part responsible for this emerging sensation and cultural challenge. Like most experienced experts in a field of study, designers of the built environment often develop a type of informed intuition, formed over years of learning and scrutiny, about the types of spaces that might bring people together for moments of exchange, interaction, and sociability; however, separating out



Existing Typology *Proposed Typology* *Longitudinal and Transverse Sections of Modified Mid Rise Typology*

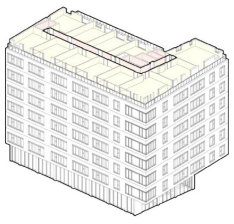


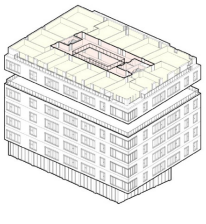


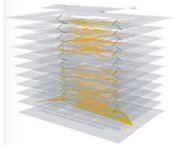


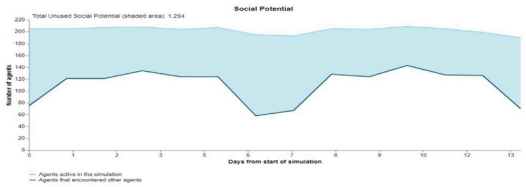
Massing

Modified Mid Rise Typology Social Potential Graph









Circulation

Private Space
Public Amenity

Private Space
Public Amenity

Figure 4.Top Half: The resultant sociability simulation results for the final version of the modified row house typology. Image credit. Connor Tamborro, Jonathan Chung, Matthew Beliak, and Alice Won with encounter, greeting, and conversation data summary by author. Bottom Half: Design process and simulation work and results undertaken for the mid rise residential typology. Image credit. Kayleigh Jeffrey, Dalia Qasem, Emily Eikeland, Tavleen Mann with encounter, greeting, and conversation data summary by author.

the various realms of influence is nonetheless important to help hone one's understanding of what may or may not matter.

Dwellings are also an important part of the urban and rural fabric of towns and cities. The contribution of dwelling environments to the formation of neighbourhoods and to neighbours also seems particularly relevant to fostering a more connected existence in relation to others. In many instances, dwellings are also the building blocks of communities and community. In other words, dwelling matters: It matters not only where we dwell, but how we dwell, and how else we might dwell in the future. As such, part of the reason in using dwelling typologies was to try and pay close attention to the impact structural drivers (which are inevitably embedded into the built environment) might be having on social interaction.

Finally, the simulation software (discussed further below) is currently more sensitive to residential scenarios with clear delineations of public, private, and semi-private type spaces. This influenced both the use of residential typologies in the study, and the specific typologies chosen.

Admittedly, there are a multitude of residential types that could be explored (such as long term care facilities, lower rise multi-unit residential buildings (MURBs), affordable housing scenarios), but for this study the four chosen typologies were: 1) Detached single family (a typology that makes up over half of all the dwellings in Canada); 2) Semi-detached row house or townhouse; 3) Mid-rise condominium (approximately eight to ten stories); and, 4) High-rise condominium (twenty or more stories). From here, groups of four students were assigned to each typology in order to study the degree to which early, architecturally driven conceptual design decisions (structural drivers) might foster (or perhaps hinder) social interaction. One of the objectives was to explore whether or not design thinking and quantifiable metrics for evaluating social interaction could be fore grounded earlier in the design process. Other related objectives included understanding whether the aforementioned design intuition about connective spaces is well founded, analyzing and quantifying the relative impact of early structural design decisions being made, and learning if there are certain parts of designs being overlooked or possibly undervalued or overvalued in terms of promoting social interaction and connectedness in places of dwelling.

FLUID Sociability

To try and test these ideas the study opted to use a simulation software known as FLUID Sociability. FLUID is an "agent-based modeling software design tool" designed "to make the possibilities for social interaction in buildings more discursive - that is, able to be talked about comparatively and with quantitative precision." [9] The software is being developed by the architectural firm Human Studio. Once finalized, it is intended to be an open source, not for profit initiative. It should be noted that Human Studio was a collaborator in the creation of the design portion of the course, provided additional instruction around the use and purpose of the software, and even offered technical assistance to the students during the simulations.

As described in a paper presented at SimAUD 2021, the name of the software FLUID is an acronym. The letter F stands for Frequency (how many physical opportunities are there for social interaction?); The letter L stands for Legibility (how easy is it to understand each other?); The letter U stands for uniqueness (is the interaction distinctive for the individuals or is it just a "hi"?); the letter I stands for intimacy (how personal is the interaction?); And the letter D stands for duration (how long is the interaction?). Interestingly, these parameters generally resonate with the characteristics related to the strength of relational ties discussed previously, but the FLUID software creators note the categories represent what they "see as the five factors that support and/or create positive social interactions. The identification of these factors is not research-based." [10] Nonetheless, it is these types of interactions that FLUID helps represent through the simulation. One key output recorded during a simulation is ***encounters*** which as noted above is intended to measure frequency and how many physical opportunities there are for social interaction. The output provides both total encounters and encounters per agent per day. Another output is the number of ***greetings*** recorded (intended to help look at legibility and distinctiveness of the encounter), and a third output is conversations (intended to help look at uniqueness, intimacy, and duration). These were the three primary outputs used in the study.

It is also important to note that the objective of FLUID "is not to predict how people will interact in a building. This has multiple contributing factors and will vary widely across cultures, and given the make-up of individuals populating the given building." [11] Instead, the focus is intentionally on facilitating comparative analyses between options. Through simulation, design proposals can be populated with people - known colloquially as agents - in order to quantitatively measure embedded parameters such as encounters, greetings, and conversations. For a more comprehensive understanding of the inner workings of the FLUID software, the reader is hereby encouraged to read the full 2021 SimAUD paper.

Further, it should be noted that within the structural factors mentioned previously, The Loneliness Lab notes there are generally three contributors to connective place making: the hardware, the software, and the codes. The hardware involves the physical environment (buildings and spaces), the software involves the programming (activities, events and services), and the codes involve the policies and standards (incentives, regulations). [12] This study focuses almost exclusively on the hardware: The configurations, arrangements, adjacencies, and opportunities created through physical space that architects might propose to try and influence social interaction.

Modelling. Assumptions, Hypotheses, and Simulation

Taken together, a design process was formulated around the premise of comparative analysis. In order to accomplish this students were first asked to model an assigned dwelling typology in Revit known as the baseline condition (currently FLUID is a plug-in primarily for Revit). In the interest of expediency and time available for the exercise, students were encouraged to find an existing project in a Canadian city with ample documentation that could be quickly and easily modeled to form the baseline condition. By using an actual project (already constructed or proposed) teams were able to divorce themselves from the generation of the base condition. Following this students were asked to learn the FLUID Sociability software, including the process around setting up a Revit model for a future simulation. Finally, students were tasked with running a FLUID simulation for the baseline condition, while recording the data and results, suitable for a verbal and visual presentation at the end of the project. Simulations in FLUID are conducted by specifying the number of days the agents will inhabit the project. Processing time is related to the size of the project and the number of days, and no minimum or maximum simulation time was specified.

Using the knowledge being accrued in the more traditional seminar portions of the course, and following the creation and simulation of the base condition, students were asked to analyze and critique the resultant social performance and social interaction observed in the initial simulation. From here students were then asked to research and explore a series of architecturally based spatial interventions expected to improve the social interaction within the typology. Based on this research and exploration, students were then asked to translate at least one, but preferably more than one of the interventions into a design assumption that might be expected to improve social interaction. After establishing the assumptions, students formulated a design hypothesis, specific to the typology, that could be tested. At the heart of the hypothesis is a speculation about how the proposed structural drivers might impact social interaction. After formulating the design hypothesis students set to work on re-designing and re-modelling portions of the typology. The emphasis was on being creative, taking risks, and generally assuming the role of the mad-scientist, experimenting with conventional and unconventional, yet plausible alternate realities and building designs conceived under the lens of enhancing social participation and belonging. Successive iteration was also encouraged: Wherever possible, preliminary design ideas were to be taken into FLUID early to check if proposals were indeed making a measurable difference.

Following this initial process of exploration, students worked toward a final design for the new or modified typology. A final model was then created and a final simulation was undertaken in FLUID. Students then summarized the findings, reflected on the learning process, and related the discoveries back to the initial hypothesis. The work was then compiled into a graphic report that included reflections, critiques, and conclusions about the process and about the use of human based simulation (specifically FLUID) as an early phase design tool. Lastly, students were asked to present the work back to their classmates which became the basis for further seminar discussion, critique, and debate about the merits (or lack thereof) in using this type of simulation as a design tool to help imagine how structural drivers might impact social interaction and loneliness.

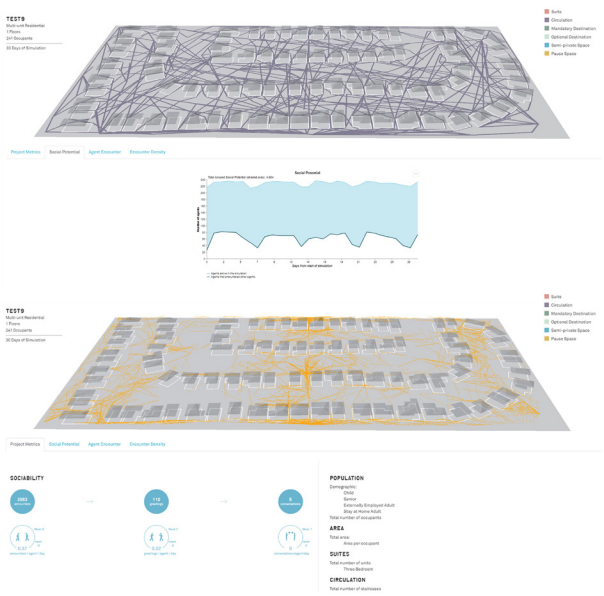


Figure 5. Simulating baseline social interaction in the detached single family residential typology. Image credit. Corina Amoraarei, Austin Yao, Fang Xu, Mathieu St. Denis

RESULTS

The following section presents the results of the methodology undertaken for two of the studied typologies.

Dwelling on the Semi-Detached Row house or Townhouse Typology

After settling on an existing row house development in a major Canadian city, the baseline model was created and subjected to a 90 day FLUID Sociability simulation. Home to 314 people, the baseline simulation resulted in 3,208 encounters, 41 greetings, and 1 conversation among the residents. Although this may seem high at first, when reviewing the “encounters per agent per day” the recorded number was 0.11. Almost immediately, the numbers observed began to confirm suspicions as designers that vehicular focused, lower density developments are probably not great environments for social interaction.

Following a critique of the baseline condition, key missing factors were identified that might be impacting social interaction. Examples included a lack of opportunity for contact, a lack of proximity to others, and a lack of appropriate space for residents to interact. Following a review of precedents that seemed to intuitively address these shortcomings, students made the following assumptions:

"Density and vehicle access of the complex are the larger focal aspects of this plan. The density and regulated size of the roads push the limits [of] social interactions to the outskirts in regard to small areas of exposure such as: 2 small 'pavilion' areas and sidewalks." Student Team for Row House

From the assumptions, the following hypothesis was formulated:

"To create greater connections within neighbours and [the] surrounding community environment, the breaks within the row houses shall be established effectively. The vehicle access shall be decreased, thus giving larger importance to the 'greenery' and the 'circulation' of the pedestrian." Student Team for Row House

In many respects, the student team was also testing a common intuition for designers of the built environment: If vehicular prominence can be reduced, and more explicit emphasis can be placed on green space and the public realm and pedestrian realm, then opportunities for social interaction will seemingly improve. To begin testing the hypothesis, a series of quick simulations (see Figure 01) were run on different conceptual models in plan and section to help understand which alternate design options might have the most potential to impact social interaction.

Row House: Modified Design Proposal 01 and Simulation 01

This conceptual model trial-and-error process helped the design team focus on a design strategy that quickly produced a significant jump in the various markers being studied, with other design considerations remainiing relatively similar (density, unit sizes, floor area ratio). During the same 90 day simulation period, encounters increased to 46,791 (from 3,208 initially) and greetings increased to 2,338 (from 41 initially), while conversations remained unchanged at one. Interestingly, studying conceptual designs that were focused on trying to promote social interaction also resulted in a few additional dwelling units being accommodated within the same site area. This meant that the number of residents in the simulation increased from 314 to 354, but this 40 person increase does not seemingly account for the nearly fifteen fold increase in the measured encounters. Although maintaining the exact same number of residents in a comparative simulation would be desirable to limit the changing variables, this revealed a potential unanticipated benefit: Designing for social interaction might improve health and well being and provide an improved economic rationale for project developers.

Row House: Modified Design Proposal 02 and Simulation 02

Following the first simulation, further conceptual design work focused around structural drivers was tested for relative impact. For example, open courtyards, semi-public zones, and areas for chance encounters were incorporated into the design. During another 90 day simulation, encounters increased to 51,801 (from 3,208 initially) and greetings increased to 2,680 (from 41 initially), while conversations this time around increased to 123. Again, making these decisions based on social interaction also resulted in a few additional units on the site, which meant the residents increased from the baseline condition of 314 to 336 (22 additional people) in this iteration, but again, this does not appear to account for the fifteen fold increase in encounters.

Row House: Modified Design Proposal 03 and Simulation 03

Further iteration in the row house typology at the schematic design level looked at providing more opportunity structures where people could come into contact with one another and even more shared spaces for people to engage with one another (see Figure 3). Associated schematic visualizations show how the process used only enough detail to test major assumptions, without getting hung up on smaller items that operate at the scale of the architectural detail. A final 90 day simulation resulted in 55,934 encounters (from 3,208 initially) and 3,042 greetings (from 41 initially), while conversations this time around increased again to 155.

Dwelling on the Mid-Rise Typology

After selecting and modelling an existing mid-rise development in a major Canadian city, the baseline model was subjected to a 14 day FLUID Sociability simulation. Home to 202 dwellers and 114 dwelling units of various sizes (one, two, and three bedrooms), the baseline simulation resulted in 329 encounters, 21 greetings, and 1 conversation among the simulated residents. In this case the "encounters per agent per day" works out to 0.12. At first this seems low for a building with greater density where one might assume people will encounter other people more often, but in this case, intuition might also be used to reflect on how often people encounter other people in a typical double loaded corridor mid-rise residential typology. Of course, the actual answer would need to be studied through post occupancy evaluations, but perhaps the insight here is that encounters in these typologies are not as common as one might imagine or perceive.

Following a similar process of critique and precedent review, key missing factors impacting social interaction identified for the mid-rise typology included a lack of front zones

(transitional social spaces in and around mid-rise buildings where neighbours and the community can meet and interact), a preponderance of under utilized and vague left-over space around the building, the possibility of crowding in denser buildings which can hinder interaction, a lack of communal space or non prescribed use areas throughout the building, and minimal connection to nature, green space, and the outdoors which can also promote interaction. This type of analysis allowed the students to uncover latent opportunities throughout the project that could potentially be re-designed to promote social interaction.

In this instance, the following assumptions were articulated:

"Distributing public amenity spaces throughout the mid-rise, and eliminating the double-loaded corridor [will] create a 'front yard' dynamic [and] promote meetings + interactions between residents." Student Team for Mid Rise

From the assumptions, the following hypothesis was formulated:

"By eliminating the double-loaded corridor, introducing an atrium to create central public space that connects all floors together, and creating a floor with a full-access amenity space will encourage connectivity and increase unintended interactions between residents, as it provides opportunity for people to gather for longer periods of time, therefore raising the chances of encounter." Student Team for Mid Rise

As such, another common intuition for architects and designers was inadvertently being tested in this study: Dwelling units organized around double loaded corridors (a design feature that is ubiquitous with this typology) limit social opportunities and focus on the efficient use of space and movement of people, rather than providing a space of human dialogue and exchange. To test the hypothesis a new typology was designed that transformed the double loaded corridor into a more dynamic social space, while also introducing designed responses to the latent opportunities mentioned previously. By including these strucutral drivers in the design, there was specualtion in the hypothesis the typology would become primed for more social interaction.

Mid-Rise Modified Design Proposal and Simulation

For this study, a slightly less iterative approach was used in re-designing the typology and more emphasis was placed on incorporating a number of more significant structural drivers right from the outset. In doing so, the typology also saw a significant jump in the measurements of social interaction across the 14 day period measured. Encounters increased to 3,382 (from 329), greetings increased to 250 (from 21), and conversations increased to 19 (from 1).

Similar to the row house typology discussed previously, emphasizing social interaction in the design had the side benefit of adding six additional dwelling units to the project. Accordingly, the modified design had 212 people (increase of ten from the baseline) housed in 120 dwelling units (increase of six from the baseline). Although ten more people were included in the simulation, based on the numbers it is unlikely that this slight increase in people accounts for the approximately ten-fold increase seen in encounters and greetings, and the nineteen-fold increase seen in conversations.

DISCUSSION

Whether used to suggest new movies to watch, or what advertisements to show, or what driving routes to take, predictive algorithms and associated software that merge elements of design and environmental psychology are becoming a more regular part of navigating the world. The programs are currently being made by humans, to predict what humans might do or might want to do based on a selected range of inputs, which inevitably means there are embedded (conscious and unconscious) biases during the development, testing, and use phases. Machine learning and artificial intelligence attempt to improve this along the way, but in actuality may be reinforcing and confirming the bias that already exists, thereby perpetuating it further downstream. Of course, these outcomes, inadevertent or not, are concerning. This also seems particularly relevant when human subjects are involved, as opposed to non human metrics such as how much energy a building might be expected to consume or how much daylight might be expected to fall within a space.

Humans are much more complicated inputs than building envelope assemblies or light waves, and the factors influencing social interaction even more so. Suffice it to say, the issues around predictive software simulation warrant a much larger discussion than what is possible here. It is worth acknowledging again though that FLUID is attempting to be comparative: That is, two different models simulated under the same set of defining assumptions. Change the assumptions, and the effects are re-applied to both instances. That said, further validation between the simulated outcome and the actual outcome is necessary. This means that in looking for ways to try and measure the impact of structural factors on social interaction, FLUID (and future predictive simulation involving humans for that matter) is not without its ethical, pragmatic, and feasible challenges, but the comparative nature may offer designers a glimpse of an opportunity to assess relevant and relative difference between options. If so, it becomes possible to imagine supplementing precedent, lived design experience, informed intuition, and anecdotal post-occupancy evaluation and reflection with strategies that potentially involve a more reliable and quantifiable metric. This may even help with evidence-based approaches to designing for social interaction, which in turn might become part of a larger framework to address the lack of emphasis on social interaction in design, and to help address the emerging pattern of chronic loneliness.

With this in mind, and recognizing that this study is admittedly limited in scope, the use of testable hypotheses indicates (at least preliminarily) that structural factors can influence certain markers of connectedness and social interaction in a given design. For example, the significant jump in encounters between people in the studies points to a relationship between the type of space people are inhabiting and the degree to which physical contact occurs. As a starting point, this marker seems important because people first need to see one another more often (to develop familiarity, trust, recognition) in order for a more meaningful social interaction to develop over time.

Conversely, the study also pointed to the notion that greetings and conversations (markers of more sustained or meaningful interactions) are perhaps more challenging to influence through structural drivers. Is this an indicator that there is more work to do in the design quality of the built environment, or is it highlighting the limitations of structural drivers? In this way, perhaps encountering people with similar interests or similar personalities is more relevant when compared to the type of environment where the encounter happens. Or the low number could be a result of trying to simulate the complexity and richness of human encounters and interactions within the limitations of computer code and software programming.

Another potentially important affirmation (as design intuition might suggest) was how critical informal, interactive spaces (interior or exterior) are for increasing the potential for social interaction in dwelling typologies. This was coupled with a sobering realization of how big of an increase can be seen from structural drivers that often seem born of common sense design principles. As demonstrated, in certain instances the resultant impact was upwards of ten to fifteen times the baseline condition, and many of the assumptions and proposals that were implemented would probably be seen by experienced designers and architects as intuitive gestures. In other words, it is not so much that the trained designer's intuition is way off base, but rather the impact might be greater than initially suspected. This points to the notion that structural drivers (or lack thereof) might be having a much bigger impact than can be anticipated from other methods of inquiry such as precedent or case study.

More specifically, the mid-rise study provided a degree of validation to the oft held notion that double loaded corridors are probably not the most ideal way to move people through residential buildings if social interaction is of concern. By transforming the double loaded corridor into something more than circulation - a social space where people can still circulate but also engage with one another in a more meaningful way - these typologies might be missing out on opportunities to create more desirable places to live, without sacrificing the economic viability of the project. Instead, the studies offered more developable units, while simultaneously making it a more socially conducive place to dwell and call home. Under this type of guidance, perhaps small negotiations between the parties involved in city building could provide project development teams and municipalities synergistic benefits (more units, a more cohesive city fabric, and improved physical and mental health by attending to loneliness in a pro-active, design focused way). For example, would these types of negotiations be more palatable if the parties knew the result could be a 1,000% increase in personal encounters for the dwellers?

Another important insight gleaned from the row house study is that over a series of design iterations there seemed to be a 'topping out' of each recorded metric. For example, the first set of design interventions resulted in a significant and marked change in encounters, greetings, and conversations, but subsequent adjustments (although still relatively effective) started to signal a potential limit to how much more social interaction could be expected from structural factors alone in a design.

Correspondingly, it may have also signalled that certain decisions might carry more impact than others. This could prove valuable in helping prioritize where a project would benefit most from additional investment when it comes to fostering social interaction. Further, a quantifiable metric might also help make a case to include, improve, or increase social spaces in projects, which in turn might also help in addressing the next emerging socially based pandemic: loneliness.

ENDNOTES

1. Vivek Murthy: The Loneliness Epidemic, https://katebowler.com/podcasts/vivek-murthy-the-loneliness-epidemic/
2. Noreena Hertz, The Lonely Century (New York: Currency, and imprint of Random House, 2021), 5-6.
3. Vivek Murthy: The Loneliness Epidemic, https://katebowler.com/podcasts/vivek-murthy-the-loneliness-epidemic/
4. Olivia Laing, The Lonely City: Adventures in the Art of Being Alone (New York: Picador, 2016), 3-4.
5. Hawkley, Louise C., and John T. Cacioppo. "Loneliness Matters: A Theoretical and Empirical Review of Consequences and Mechanisms." Annals of behavioral medicine 40, no. 2 (2010): 218–227.
6. Government of Canada, S. C. (2021, November 24). Canadian social survey: Loneliness in Canada. Canadian Social Survey: Loneliness in Canada. Retrieved November 8, 2022, from https://www150.statcan.gc.ca/n1/daily-quotidien/211124/dq211124e-eng.htm
7. Williams, Jo. "Designing Neighbourhoods for Social Interaction: The Case of Cohousing." Journal of urban design 10, no. 2 (2005): 195–227.
8. Granovetter, Mark S. "The Strength of Weak Ties." The American Journal of Sociology 78, no. 6 (1973): 1360–1380.
9. Haden, Bruce, Clement, David, and McCuaig, Ryan. FLUID Sociability: Modeling Social Interaction in Buildings, Symposium on Simulation for Architecture + Urban Design, 2021
10. Haden, Bruce, Clement, David, and McCuaig, Ryan. FLUID Sociability: Modeling Social Interaction in Buildings, Symposium on Simulation for Architecture + Urban Design, 2021
11. Haden, Bruce, Clement, David, and McCuaig, Ryan. FLUID Sociability: Modeling Social Interaction in Buildings, Symposium on Simulation for Architecture + Urban Design, 2021
12. Haden, Bruce, Clement, David, and McCuaig, Ryan. FLUID Sociability: Modeling Social Interaction in Buildings, Symposium on Simulation for Architecture + Urban Design, 2021
13. Insights from the Loneliness Lab Community. *2020 Using design to connect us*, The Loneliness Lab, Autumn 2020. *The Loneliness Lab, 2020,* https://www.lonelinesslab.org/knowledge-hub/using-design-to-connect-us. PDF download.