The Mere Exposure Effect in Architecture

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Abstract. Per Schelling's model of Segregation, the population will innately segregate itself based on preferences, often leading to organization by race and class. This subdividing of communities through segregation increases social tension, discourages communication, and isolates those who are different. In 1968, Robert Zajonc proved that subjects rated a familiar stimulus more positively than similar yet unfamiliar stimuli. The mere exposure effect is a phenomenon by which people develop a preference for things solely because they are familiar with them. Architecture can diminish the impact of social segregation through mere exposure by examining the effects of architectural interventions and programs. Through mere exposure designers can create new connections between members of society by rethinking circulation paths, carefully considering the geolocation of program, and creating more effective public space. By incorporating modern social behavioral analytics into design logics, social spaces can facilitate more productive engagements between occupants.

Examining the effect of unit location on circulation and noting the most effective locations for public goods, developers and city planners will increase communication between community members. Increasing communication as a primary goal of design will facilitate the development of stronger communities. Although the tool specifically targets residential complexes, the concept is scalable. Providing a designer an automated method for evaluation and data collection based on the mere exposure effect in urban design and architecture can create more informed design of public space. The goal is to create a more diverse and sustainable community through an informed understanding of how space and program influence behavior.

Keywords: Schelling's Model of Segregation, Mere Exposure Effect, Architecture, Revit, Dynamo, Zajonc, Multifamily, Community

1 Theory

1.1 Introduction

Architectural Design has ignored the natural processes of social segregation, letting other factors dominate the occupational organization of the built environment, ultimately isolating communities and their members. By incorporating modern social behavioral analytics into design logics, social spaces can facilitate more productive engagements between occupants. Armed with tools based on current social theory, designers can create a more diverse and sustainable community through an informed understanding of how space and program influence behavior.

1.2 The Problem: Schelling's Model of Segregation

Per Schelling's model of Segregation, the population will innately segregate itself based on preferences, often leading to organization by race, religion, and class. As Schelling states, the process is not solely a result of prejudice but primarily of preference, making solutions to undesirable segregation elusive even when the population applauds diversity [4].

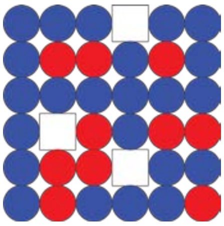

Fig. 1. Random Grid

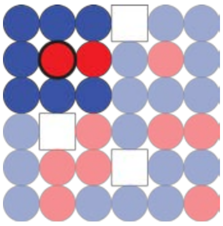

Fig. 2. Unmet Criteria

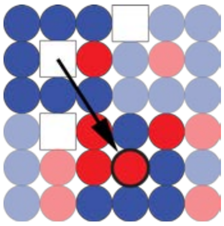

Fig. 3. Migration

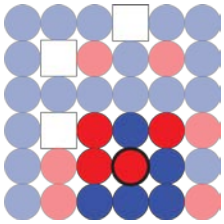

Fig. 4. Met Criteria

The mathematical model begins with a random grid of two types of objects that have a defining characteristic such as a color in conjunction with a set number of vacant spaces (Fig. 1). An overarching criterion is established to determine when an object is satisfied or dissatisfied. For instance, each color wants to be adjacent to at least 33% of like colors. If only one of the eight neighbors (12.5%) are of the same color, then the object is dissatisfied (Fig. 2). Each dissatisfied object moves to a vacant space (Fig. 3). Criteria are once again applied to the object to determine its state. If it meets the criteria, in this case 37.5% of the same color, it is satisfied and remains in place (Fig. 4).

After the initial random distribution (Fig. 5), 20 iterations were applied to the model. With only a 33% preference, the segregation of colors becomes apparent (Fig. 6). This model did not stabilize and contained spaces that continued to change indefinitely. This allegorical social model suggests that segregation will continue even with the removal of all prejudice and dislikes, at times creating locations of unrest. Segregation will occur motivated by preference alone without the aid of negative repulsors. Regardless of motivation, this subdividing of communities through segregation increases social tension, discourages communication, and isolates those who are different. The effects of isolation have been called an 'epidemic of loneliness', shortening lifespans and impacting the quality of life [3].

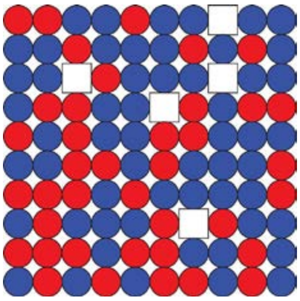

Fig. 5. Initial Distribution

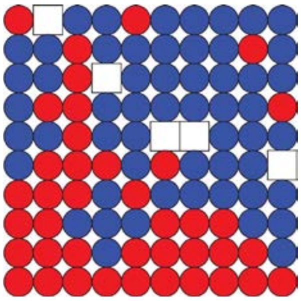

Fig. 6. After 20 iterations

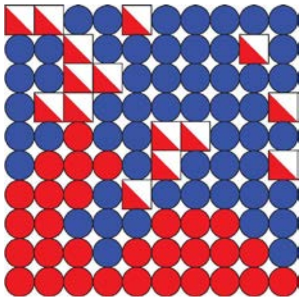

Fig. 7. Constant Transference

1.3 The Solution: Mere Exposure Effect

In the 1960s, Robert Zajonc experimented with the role of preference for familiar stimuli over novel ones. By controlling how many times a subject was exposed to a particular stimulus, Zajonc concluded that preference increases with higher exposure frequencies to a certain point and then stagnates or at times declines [5]. Specifically, Zajonc demonstrated that subjects rated an unknown symbol with more "goodness" if viewed more often (Fig. 8). In 1989, Robert Borstein presented twenty years of research reporting essential conditions and factors when mere exposure effects are weaker or stronger. Those factors include the number of exposures, time between exposures, personality types, as well as differences between simple and complex stimuli [1]. Extensive research and rigorous experimentation has been conducted to quantify the effects of exposure. This research is one of the driving principles used in marketing [2]. Simply stated, the mere exposure effect is a phenomenon by which people develop a preference for things solely because they are familiar with them.

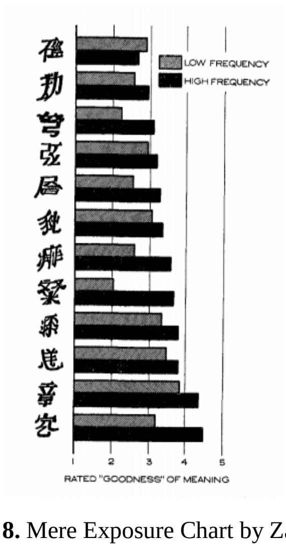

Fig. 8. Mere Exposure Chart by Zajonc

Even with 50 years of mere exposure research, architectural design has yet to implement or even introduce techniques to utilize the mere exposure effect in minimizing the impact of negative social segregation. This is in part because of the complexity of the social condition, and in part because of the lack of funding for research on post occupancy. Innovations in GIS offer opportunities to aggregate relevant data to determine the exposure effects of various arrangements within the urban environment. However, understanding and organizing the complex matrix of city organizations is still driven primarily by anecdotal evidence. The multifamily model offers a unique microcosm with numerous iterations of organization paradigms and programs. However, the development community is reluctant to release information concerning their highly crafted building programs and forms duplicated throughout the world. Although hindered with a lack of relevant data, the potential social returns of carefully considering the impact of design on social issues garner the need to create tools for modeling and testing social behavior in architectural design.

Considering what can be supposed through existing research in mere exposure, examining the effects of interjecting strategic architectural interventions and programs offer great potential gains in community building. Through mere exposure designers can create new connections between members of society by rethinking circulation paths, carefully considering the geolocation of program, and creating more effective public space.

Many undesirable segregations occur due to a designer's lack of awareness of how their design contributes to this phenomenon. Applying the theory of mere exposure to early schematic design could reveal the impacts of various designs on community and create novel solutions for public spaces. These solutions offer new possibilities to integrate community members at variable scales of the built environment, from urban design to multifamily housing. These core principles create the social platform for a tool which integrates the mere exposure effect to evaluate the organization of public spaces in multi-family housing.

1.4 Understanding the Impact of Circulation

Assuming that the ideal amounts of exposure will increase the preference for one’s neighbor, one first must determine how much time occupants would see each other. Modeling a simplistic statistical model for circulation in a rectangular multifamily apartment wrapping a parking deck (often referred to as a Texas doughnut reveals symbiotic relationship between occupants, public space, and circulation. The model assumed the apartment contained one gym utilized by guest for 30 minutes 4 times a week and one restaurant utilized by guest for 60 minutes 3 times a week. Each occupant would both drive to work and walk to a nearby destination once a day. The configuration contained a total number of 25 residential units (Fig. 9).

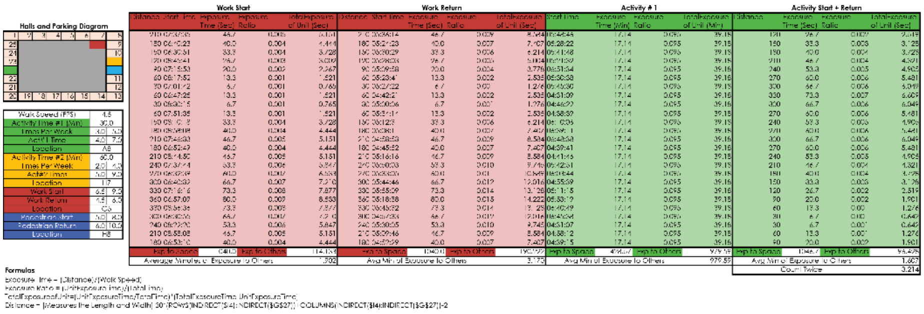

Fig. 9. A partial section of the Multifamily Housing Exposure Model which lists the distance between destinations; amenity use times, durations, and frequencies; each residents average time of exposure to neighbors; and total exposure times for all residents.

Considering staggered start times and the typical times of occupation, the model reveals that walking to all destinations combined created a total amount of exposure of less than 10 minutes between all residents per day. Participating for 30 minutes 4 times a week between the times of 4 and 7 pm will result in an average agglomeration of 980 total minutes of exposure time between residents. Participating for 60 minutes 3 times a week between the times of 5 and 9 pm will result in an average agglomeration of 1080 minutes of exposure time between residents. The staggering difference in exposure between public participation and public circulation advocates a particular role of the architect in aiding social engagement.

To understand the math behind the model, the individual exposure time to the public takes the average time per week a resident participates in a public activity such as walking to the car, eating at a restaurant, or working out in a gym. The average number of uses per week is then divided by 7 days. That number is multiplied by the average duration of the activity. For instance, if someone uses an amenity twice a week for 70 minutes then they would be in the amenity an average of (70*2/7=) 20 minutes a day.

To determine the total exposure time to other residents, the individual exposure time to the public is divided by the total exposure opportunity. For instance, if the restaurant serves dinner from 5:00 pm to 9:00 pm, that would be 4 hours of opportunity. This forms the exposure ratio (20 min/240 minutes=) of 0.0833. All the exposure times of other residents are added together then multiplied by the exposure ratio. If 25 residents lived in the apartment who used the amenity with the same assumptions that would total 24 other residents at 20 minutes each or 480 minutes of average time in the amenity each day. Finally, the exposure ratio (.0833) is multiplied by the aggregate exposure time by all others (480 minutes) to find how much time each resident could see other residents (40 minutes). Roughly interpreted this means that on average, the resident is in the room with two other people. The math is overly simplistic but provides a road map of how organizational strategies affect exposure times.

The model offers three insights into the residential social dynamic. First, circulation has little impact on exposure to other residents. Even creative endeavors cannot statically justify community building as a primary goal. Second, circulation does however impact the amount of exposure to activities. The residents will pass by public spaces multiple times a day, increasing exposure to public programmatic elements thus increasing preference for those elements. Finally, Community members accumulate significantly higher exposure times to each other when they occupy public space and participate in local activities. The participation in public space results in nearly 10,000% more exposure than public circulation. In conclusion, if architects can create circulation patterns that increase exposure to public space, or position public spaces at locations that maximize their exposure through circulation, preference for that space will encourage occupation. The occupation of public spaces increases exposure to other community members, increasing preference for those members. Thus, design vicariously can increase the residents' exposure to each other by increasing their exposure to public space.

1.5 The Foundation of the Design Modeling Tool

Three assumptions based on the Schelling's model of segregation, the mere exposure effect, and the multifamily housing exposure model form the foundation for the design modeling tool described here. First, one must accept that preferences influence how communities are formed. The uniformity of innocuous preferences creates a basis for collaboration and conflict resolution of larger issues. Second, one must realize that preferences are influenced by exposure and continually evolve, offering an opportunity to align local communities through common experiences. Finally, designers must create circulation patterns that encourage the observation and occupation of public space, knowing that the public participation provides the best opportunity for creating preference for other community members. To sum up, utilizing diverse types of public amenities while increasing exposure to them through circulation; design can increase preference for public spaces which increases exposure between community members, encouraging communication towards the creation of a better sense of community.

2 Development of a Computational Tool

2.1 Analyzing the Texas Donut, a Multifamily Model

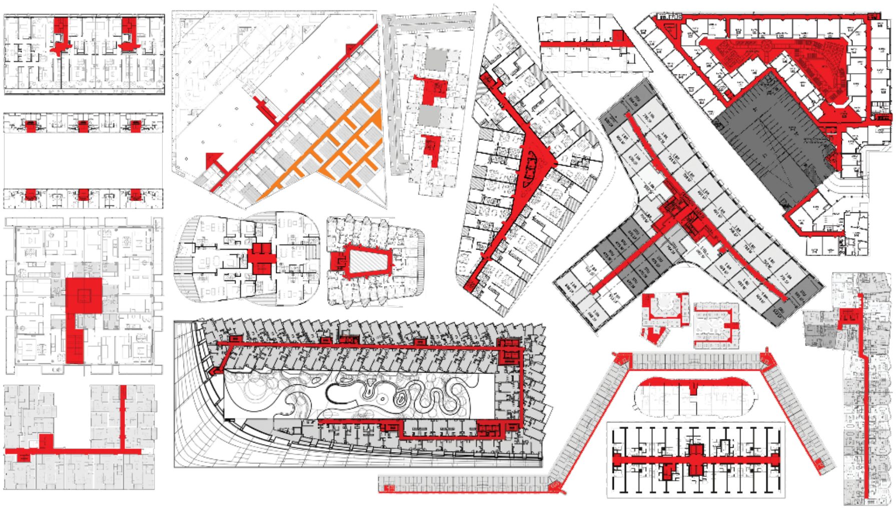

Fig. 10. Circulation Diagrams of Multifamily Plans

The multifamily model offers the most reasonable resource for analyzing the mere exposure effect in design due to its scale and diversity in program (Fig. 10). Because of the innate necessity of the automobile in southern culture, the 'Texas doughnut' has become one of the dominate multifamily types (Fig. 11) in the area. The use of the tool on the Texas doughnut aims to consider the impact on a range of socioeconomic groups.

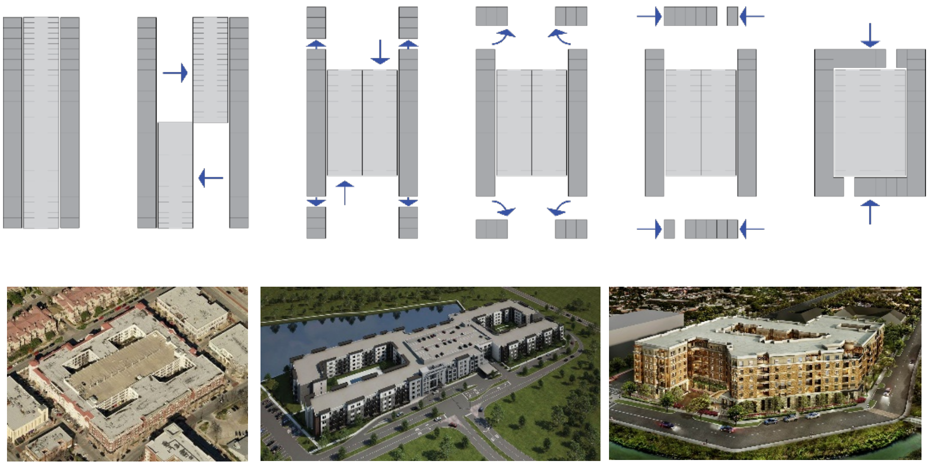

Fig. 11. Diagram of formation of Texas doughnut (above); images of typical Texas doughnut formations (below). Images from unknown authors, web references listed from left to right [6], [7], [8]

The computational tool, built in Autodesk Revit BIM modeler Dynamo, uses an existing Revit model. In the rooms category, a shared parameter called circulation is created to label public spaces and corridors. Another shared parameter in the category doors is created to create destinations. The inputs to the script are a Revit floor plan for a multifamily apartment; the rooms designated as Circulation; doors labeled with the appropriate tags; and the frequency of use for each type of path. The script outputs a heat map of high traffic and low traffic areas; and all circulation patterns from apartments to each specified destination.

The script converts all the rooms into a single surface and divides it into a grid for pathway analysis. Each labeled door is divided into types and organized to create destinations from the apartments to each destination such as an amenity, utility, main entrance, parking entrance, and pedestrian exits. The Lunchbox node Curves.ShortestWalk determines the shortest path from every door to every destination using the length of each grid line. For multiple pedestrian exits or multiple entrances to an amenity, the tool uses a minimum distance function to pick the most likely path. The tool draws each path in the Dynamo script visualizer and has an option to draw it directly on the Revit model.

When considering how space is traversed in the multifamily model, some assumptions were made. On average, the typical resident would use the pedestrian exit twice a day in order to go on a walk, visit a local pub, or go to the store. The resident would take out the trash every other day, go to the gym every other day, and go to the main entrance every other day to receive guest or food delivery. Finally, the car would be used to go to and from work once a day and to run an errand every other day. These assumptions are based on conjecture and can be modified in the script via user controlled sliders. After determining all circulation possibilities, the tool assigns the user score for each path to calculate the approximate exposure time at each point in the circulation path. The weighted score of each point is graphically represented by a heat map. The heat map uses the colors red for low frequency, green for average frequency, and blue for high frequency.

2.2 Using the Tool

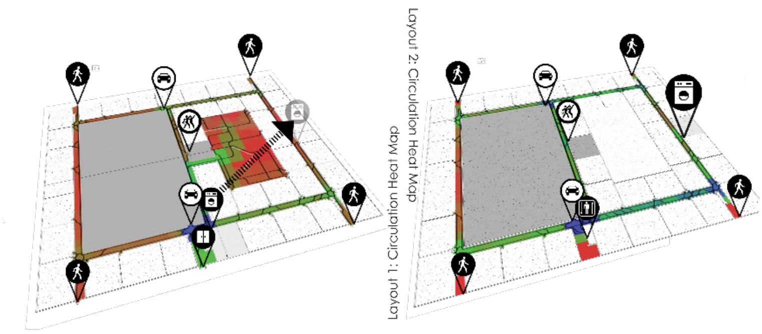

Fig. 12. Layout analysis 1 & 2 of a Texas Doughnut.
Key [Image Description]-[Meaning]: Washing Machine-Utility, Exercising People-Amenity, Doors or Elevator-Main Entrance, Car-Parking Entrance, person walking-pedestrian exit for the next 4 figures.

In Fig. 12, layout 1 has a front-loaded condition. When the parking, utility, amenity, and front exit are close together, areas of isolation are prevalent throughout the corridors, denoted in red. This arrangement is effective when the residents do not avoid each other and use the facilities in the front. However, it would be relatively easy to avoid interaction by getting an apartment on the left corridor or right corridor. The right diagram of Fig. 12, shows that moving even one of the major destinations results in an immediate change in movement as well as a leveling out of corridor exposure creating more opportunity for the architecture to engage its users. Blue spaces now show up at four junctions, indicating high levels of exposure. Two of the hallways f increased level of circulation based exposure. However, the far-left corridor still has a low level of exposure.

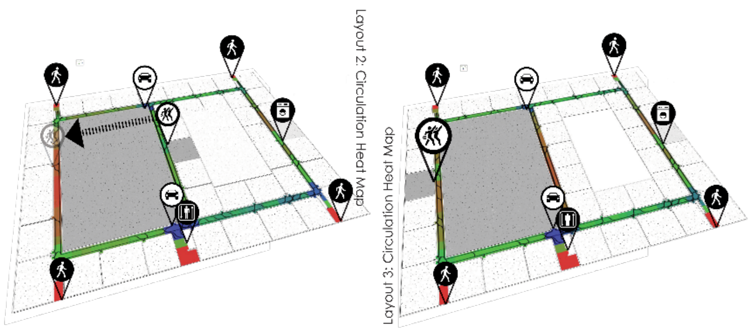

Fig. 13. Layout analysis 2 & 3 of a Texas doughnut

In Fig. 13, moving the amenity to the exterior in layout 3 has little positive impact. The area of isolation moves to the center but suggests mild improvement over the left side of layout 2. The area around the amenity has a hint of red deteriorating the previous circulation through the center of layout 3. When considering amenities, this is by far the least effective arrangement evident by the most amount of red. In Fig. 14, layout 4 takes a more dramatic approach by moving utilities and amenities to the corners and separating the parking entrance from the main entrance. This arrangement has circulation throughout all hallways. It would be difficult for a resident to avoid other residents in this configuration. The areas of isolation are minimal and high traffic areas (blue) creeps into every corner.

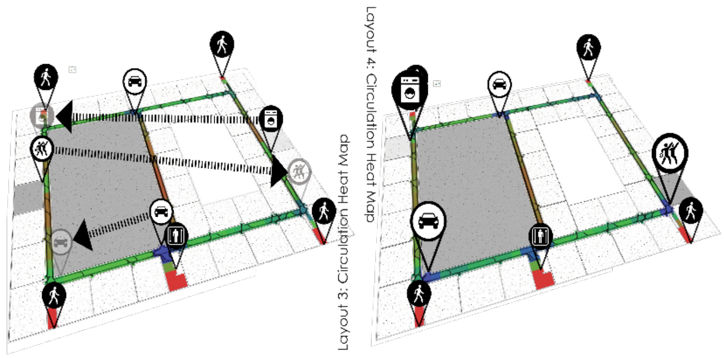

Fig. 14. Layout analysis 3 & 4 of a Texas doughnut

In Fig. 16, layout 5 tests more significant changes to investigate alternative opportunities. The heavy red area on the left corridor returns to the heat map, signaling the left corridor has little to no exposure. Moving the parking to one side isn't a reasonable option because it will force residents of the right corridor to have unnecessarily long walks to their cars. The increased exposure is falsely inflated which doesn't create a realistic solution.

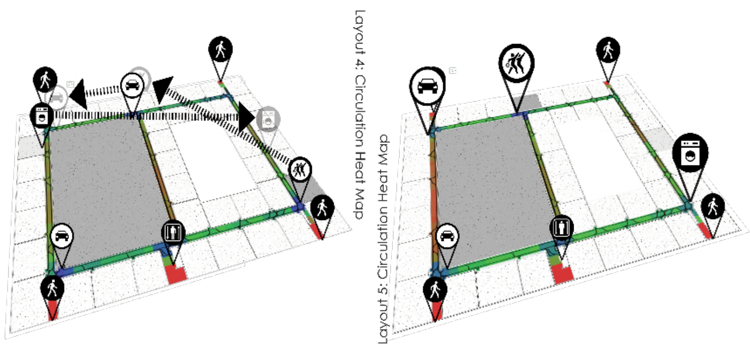

Fig. 15. Layout analysis 4 & 5 of a Texas doughnut

2.3 Models from Other Architects

To assess the effectiveness of the tool, other design styles need to be tested. Creating unique shared parameters to define pathways and destinations allows the computational tool to be adapted to most modeling styles in Revit design. The model to the right designed by FMK Architects (Fig. 16) has four apartments across from the amenities and main office. Each floor has 8 apartments with an open-air corridor. The script fails because it relies on exit doors as destinations and did not consider open air configurations. Doors and walls were inserted into the model for this analysis. In service of a more effective tool, a door family that consists of a two-dimensional rectangle placed at exterior transitions allows for reasonable modifications that do not interfere with the built-in Revit visualization, making the script more adaptable. This model doesn't challenge the analytical possibilities of the tool only attempts to demonstrate its adaptability.

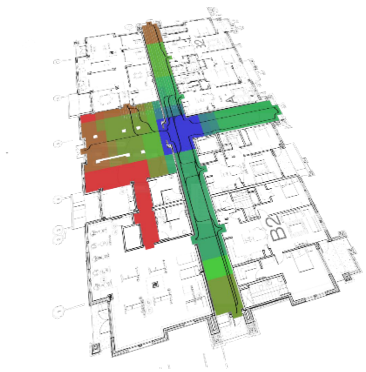

Fig. 16. FMK Architect Model Analyzed

2.4 Conclusion

The tool described in this paper aims to foster the beginning of a critical dialogue about social connections and community building. The tool offers a form of analysis to begin gathering data to compare hypothetical results with the actual results in post occupancy analysis. The multifamily model warrants the same consideration in the architectural dialogue as museums, parks, and universities which are so eloquently discussed and carefully considered in projects such as Daniel Libeskind's Jüdisches Museum Berlin, Bernard Tschumi's Parc de la Villette, and Rem Koolhaus' McCormick Tribune Campus Center. The potential returns on effective amenity placement and circulation patterns within the multifamily residential design field could expand the influence of architecture to impact the usability and comfort of the typically overlooked components of these types of projects. As designers expand their craft beyond materials utilizing social behavioral analytics, the scalability of the model would naturally expand into urban design through an informed understanding of how architecture affects the social character of its occupants.

Considering both the effect of unit location on circulation and noting the most effective locations for public goods; designers, developers, and city planners will increase the overall communication between community members. Increasing exposure and therefore the likelihood of direct communication as a primary goal of design will aid the development of stronger social communities. Although the tool specifically targets residential complexes, the concept explained here is scalable. Further development through experimentation and data collection of the mere exposure effect in urban design and architecture could aid the informed design of public space and pathways.

References

1. Bornstein, Robert F., Sep 1989:. "Exposure and affect - Overview and meta-analysis of research, 1968–1987." Psychological Bulletin, Vol 106(2): p. 265-289.
2. Grimes, A.; Kitchen, P. J., 2007: "Researching mere exposure effects to advertising." International Journal of Market Research 49, no. 2: p. 191-219.
3. Khullar, D., 2016: "Loneliness is a Health Hazard, but There Are Remedies." New York Times (New York), December 22, 2016, p. A3.
4. Schelling, T. C., 1969: "Models of segregation", American Economic Review, 1969, 59 (2), p. 488–493.
5. Zajonc, R. B, 1968: "Attitudinal effects of mere exposure." Journal of Personality and Social Psychology 9, no. 2, Pt.2: p. 15.
6. [Texas Donut] [image]. (n.d.). [Photograph]. Retrieved from http://oldurbanist.blogspot.de/2013/06/common-garage-parking-in-practice-part.html
7. [Texas Donut] [image]. (n.d.). [Photograph]. Retrieved from http://www.dailyherald.com/article/20170117/business/170119057/
8. [Texas Donut] [image]. (n.d.). [Photograph]. Retrieved from http://buildingwithpurpose.us/clt/wp-content/uploads/2013/07/CrescentDilworth.jpg