Desirable Pedestrian Density

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Abstract

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Studies of the effects of crowding have been conducted in different environments, but almost exclusively within indoor spaces, while outdoor spaces have largely been unstudied. In this study, the desirability of different levels of crowding is studied on a main street in downtown Montreal. Like most of the crowding studies, the methodology used for this research is a visual preference survey; however, using videos to represent density is novel in the field. It is discussed in previous studies that respondents perceive these two methods (representation with picture and videos) differently. Other variables considered in the responses are gender, culture, location of the case study, and density level.

The main finding of this study is that there is an inverted U-shaped relation between density and desirability, which means that as density increases the desirability increases up to the critical point and then starts to diminish. The inverted U-shaped function has been observed elsewhere in studies of environmental aesthetics. Other independent variables –gender, cultural background and location– did not have a significant effect on expressed desirability.

The results of this study add to the empirical evidence of commonly held levels of desirable pedestrian density in public spaces. The U-shaped response curve is a new finding. The results of this study show that few or no people can be as undesirable as high levels of crowding. The results could lead to a better allocation of space for public use, in relation to the level of use of the space.

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1- Introduction

Because of an increasing number of situations where there is human crowding, researches have become interested in the possible effect of high density on human perception and behaviour. The effects of crowding are studied in different fields, from psychology (Baum & Davis, 1976; Baum & Koman, 1976; Desor, 1972; Freedman, Levy, Buchanan, & Price, 1972; Osgood, Suci, & Tannenbaum, 1957) to retailing (Eroglu & Machleit, 1990; Eroglu, Machleit, & Barr, 2005; Machleit, Kellaris, & Eroglu, 1994) and engineering (Helbing, Molnar, Farkas, & Bolay, 2001). Almost all of the research includes a conception of personal space, first introduced by Edward T. Hall as Proxemic Theory (1966). Proxemic theory claims that each person keeps a comfortable distance from other people, and this distance is influenced by a variety of factors. These factors can range from very personal characteristics (i.e. culture, age, and gender), to the characteristics of the interaction with others (Hall, 1966). The violation of this desired distance can induce anxiety, which can lead to stress, withdrawal, or aggression. Studies in psychology and retailing have focused on the affective response of people under situations of crowding. The retailing studies generally revealed that crowding did not induce aggression, and was in some circumstances satisfying. The literature provides a range of responses to crowding in the public environment that are apparently closely related to the situation.

Studies of the effects of crowding have been conducted in different environments, but almost exclusively in indoor spaces. Consequently, outdoor spaces have largely been unstudied. Since revitalization of downtowns is directly dependent on its desirability for

its users, which are pedestrians, planning and designing for more desirable public spaces has always been a very important issue (Robertson, 1998). Study of desirability of public spaces utilizes two factors; aesthetic and dynamic. Aesthetic factors have been studied extensively (Wohlwill, 1976), although it has been mentioned that sometimes dynamic factors, such as presence of other pedestrians, can be more inspiring (Zacharias, 2001). Furthermore, in some study of aesthetic factors of the urban environment, it has been revealed that there is not a significant relation between the beauty of the environment and its desirability (Robertson, 1992, 1998). However, the crowd factor is not studied; although it is mentioned that there is a comfortable range for the number of pedestrians (Rapoport, 1975), but no significant research is conducted yet. Therefore, this study tries to fill the gap in the literature by focusing on the desirability of different crowd level in urban public space.

2- Literature Review

The study of crowding is based on behavior and is conducted mainly in psychology and social behavior. There are four basic lines of behavioral research which relate to the issue of crowding presented by Stokols (1972). These four levels are; first, animal studies (Calhoun, 1962; Christian, 1961; Louch, 1956; Southwick, 1955); second, correlational surveys utilizing census tract data (Freedman et al., 1972; Schmitt, 1957, 1966; Shaw & McKay, 1969); third, experiments in the human use of space[1] (Baum & Davis, 1976; Hall & Whyte, 1960 ; Sommer, 1969); and the last, experimental studies directly concerned with the effect of crowding on human behavior (Freedman et al., 1972; Milgram, 1970; Worchel & Teddie, 1976). These levels will be explained briefly.

However, there are different terms defining crowding and density which have been used in the literature. Some of these terms have been used with different meanings, which may cause conflict and confusion in definitions. Due to this conflict and confusion in the literature, these concepts will be clarified before explaining the 4 levels of behavioral research.

2-1- Density and crowding

Generally, **density** is a simple physical measure that defines the number of square meters available to a person (Churchman, 1999; Stokols, 1972). Therefore, at the first glance it seems to be a very simple concept; however, a deeper analysis reveals its complexity. It is complex, first because of the nature of density itself, and the results associated with it. Secondly, due to its different definitions and uses (Churchman, 1999).

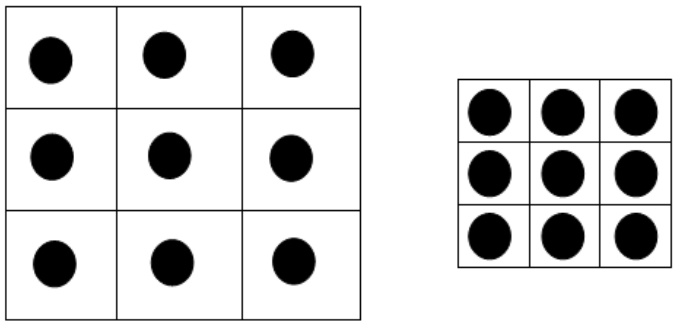
[1] This study is going further and explaining the influencing factors on perception of crowding

Although authors have defined it differently, all of them are univocal in recognizing it as being an objective, quantitative, and neutral term (Churchman, 1999). It is objective in the sense that different people may "read" it differently (Rapoport, 1975). It is quantitative because it can be demonstrated by number (e.g., number of people divided by available space). It is neutral, because the index of density, which can be achieved by simply dividing number of people by the amount of space, cannot explain its definition on its own, whether it is low or high, and even more importantly if it is good or bad. Therefore, the number of density does not include any evaluation component (Rapoport, 1975), and as such, it may have different meanings in different contexts. For instance, the density which is low in a city in China may be very high or even unacceptable in a suburb in the United States.

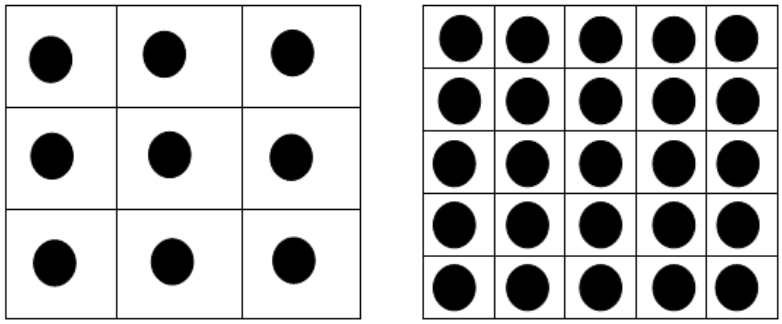
Three concepts are used in the literature to address the issue of density, and how density affects individuals' lives: Effective density, perceived density, and crowding (Alexander, 1993). What has been explained before in this section was the effective density that is the actual number of people in a specific size space. On the other hand, the concept of density becomes even more complex to know, as it is not only context dependant but also spatially dependant, as has been mentioned very briefly before. It can be perceived differently (Rapoport, 1975), which explains its objectivity. Borrowing from Stockdale (1972), density is in the eye of beholder; so that different people perceive and evaluate it differently according to different cultures, circumstances and even the type of interactions they have.

Perceived density has been defined by Rapoport (1975) as an individual's estimation of the number of people present in a given area. Different features, characteristics and activities can influence this perception (Rapoport, 1975). In the study of density, there are two main influential factors being manipulated to examine the results, the amount of space and number of people. The first is the spatial density, which is the number of people within different size of space, and the latter one is the different number of people within the same space. These two definitions may seem the same considering actual density, but the argument is that these two types of density are experienced differently (Altman, 1975; Taeuber, 1972). Figure 2-1 illustrates these two types of density with regards to the same actual density.

Figure 2-1: manipulating the social and spatial density.



Manipulating spatial density



Manipulating social density

The two situations on the right are the same regarding the actual index but it can be perceived differently

Moreover, even within the same above mentioned condition of density, other factors may play a role in influencing the feeling of density. Rapoport (1975) tried to clarify different influential factors. He explained that in perception of spatial density relationship among elements of the space such as height, spacing, and juxtaposition is important. High perceived density is interrelated to high enclosure and high activity levels, which results in high information input from environment (Rapoport, 1975; Rapoport & Hawkes, 1970; Rapoport & Kantor, 1967) that results in information overload a concept introduced by Milgram (1970).

Milgram's concept of overload is drawn from system analysis, which refers to "a system inability to process inputs from the environment because there are too many inputs for the system to cope with, or because successive inputs come so fast that input A cannot be processed when input B is presented" (Milgram, 1970). Milgram (1970) also believes that social density is affected by the type of social interaction, as it is influenced by different controlling factors such as size and nature of a group, its homogeneity, and its rules for behavior.

High perceived density and its affects on human behavior have been studied further as crowding. Density and crowding have a very close relationship throughout literatures. These two terms have even been used interchangeably without noting that crowding is just the "high" perceived density (Stokols, 1972) and it has been mostly used negatively. This negative approach toward crowding relies on the idea that high density causes aggression.

Moreover, different authors have failed to distinguish between the physical condition, density which is spatial limitation and perceptional state and crowding, or the restrictive aspect of limited space experienced (Stokols, 1972; Stokols, Rall, Pinner, & Schopler, 1973). As a consequence, this lack of distinction has led to inconsistency of the results of experimental studies, because density is only one of the determining factors influencing the perception of crowding but not the only one. There remains a question concerning the difference between perceived density and perceived crowding. As mentioned before, crowding is the state of excessively high perceived density where as low perceived density could be referred to as isolation. Unfortunately, the effect of

isolation has been neglected throughout the literature and the influence of crowding has been the main focus. The available literature on crowding will be introduced in the next parts.

2-2- Crowding and behavior

Crowded is defined by the Webster Dictionary as "(1) filled with people or things; packed, (2) packed too full, (3) close together; inconveniently lacking room" (Webster, 1994). Many of the definitions of crowding are related to the notion of overload, excessive interaction and the like. These definitions are based on the concept of the negative subjective experience of certain density level (Rapoport, 1975).

2-2-1- Animal studies

A number of nonhuman studies have found that under very high population density, normal social behavior tends to break down, and a sharp drop in population occurs (Calhoun, 1962; Christian, 1961; Louch, 1956; Southwick, 1955). On the basis of these observations, the authors concluded that high population density always leads to an increase in aggressiveness, and this can also occur in humans. There are two major problems in this conclusion. First, the animal studies did not lead to consistent results that support the aggressive consequence. Furthermore, it is difficult to generalize from animal research to human, particularly due to the complex social behavior of human beings (Freedman et al., 1972).

2-2-2- Correlational surveys

Following the four levels proposed by Stokols (1972), in the second level, (i.e. the correlational studies based on census data), researches have tried to relate population density to crime or juvenile delinquency. They tried to suggest that in high density areas such as city centers, comparing suburbs or big cities to small ones, crime rate is higher (Freedman et al., 1972). However, there is inconsistency among the results. Some studies found that density and crime have low or no correlation (Schmid, 1960; Shaw & McKay, 1969), where as others found a positive relation (Schmitt, 1957, 1966). Therefore, it is difficult to conclude anything from the correlational studies as the results do not provide strong support for the hypothesis that high density increases crime. Furthermore, the logic of the correlation itself is also questionable. So there is no unambiguous result which support the hypothesis that crowd is a factor that can result in aggressiveness on its own.

2-2-3- Influencing factors on perception of crowding

According to different studies and the definitions they offer, crowding happens when:

- Density restricts or interferes with the individual goal and activity (Machleit et al., 1994)
- Restrictive aspects of limited space is experienced (Stokols, 1972)
- Amount of environmental stimuli exceeds coping capacity (Milgram, 1970)
- Privacy mechanisms fail to function successfully (Hall, 1968)

There are different factors that can shape this perception, such as Culture, Gender, spatial, social factors, etc. The effects of these factors on the perception of crowding are discussed in the following sections.

2-2-3-1- Culture

Different scholars have introduced various determining factors. Among those, personal space[1] is the most important one which has been mentioned approximately throughout all documents. It has been pointed out in different studies that any analysis of crowding must account for the fact that crowding perceptions are not only context dependent, but also culture dependent (Eroglu et al., 2005; Hall, 1968) which is explained well in the study of personal space and proxemic behavior.

The concept of personal space and "proxemic" behavior has been introduced by Edward T. Hall (Hall, 1966, 1968; Hall & Whyte, 1960), which explains the relationship between culture and the type of interaction with individual space (Hall, 1966). Hall's theory of personal space falls into two areas. First he proposes the notion of "Proxemics" that could be applied to the analysis of spatial zones used by people in different social relationships and settings. Second, he offers some general observations of how different cultures make use of space and how conflict can result from interpretations of others' spatial practices. Noting that "Proxemics is the study of man's perception and use of space which deals primarily with out-of-awareness distance-setting" (Hall, 1968, p.83). It is important to note that in contrast to general assumption, personal space is not necessarily spherical in shape, nor does it extend equally in all directions (Altman, 1975).

[1] It has been linked to a snail shell, soap bubble, an aura, and breathing room

The notion of personal space explains that there are definite interpersonal distances at which an individual is comfortable when interacting with other individuals. According to Hall, stress results when the appropriate distance is violated (Hall, 1966). Sommer (Sommer, 1969) also support the result that violation of personal space cause individuals to become uncomfortable. This suggests that it is not the amount of space available to the individual per-se, but the distance between individuals that determines the degree of stress arising from a particular situation (Worchel & Teddie, 1976).

Relevant to Canadian context it is interesting to mention that in North America, the "proper" distance to stand when talking to another adult male you do not know well is about two feet, at least in a formal business conversation (Hall & Whyte, 1960). Additionally, there is difference between French-Canadian and English-Canadian culture that Sommer asserts that the French Canadian personal space is smaller than the English Canadian. This finding is interesting given the Canadian context that this current study is going to focus (Sommer, 1969).

2-2-3-2- Gender

The personal space is not the only influential factor on the perception of density. Other "Personal factors" can also manipulate the perception of density. To begin with, consider the difference in gender. Females tend to experience less crowding and display less stress than males (Stokols, 1972). Moreover, females appear more comfortable in smaller room than a large one, whereas men respond more aggressively to spatial limitation (Baum & Koman, 1976; Stokols et al., 1973). Although, there is disagreement in this regard arguing that gender does not affect the perception of crowding (Desor,

1972). But most of the literature supports this idea that gender has effect on perception of crowding, and the theory of personal space is also supporting the concept.

2-2-3-3- Spatial factors

As mentioned before, the amount of space is a factor affecting the perception of crowding. Subjects experience greater crowding in a small room than in a large one, even with the same density level (Stokols et al., 1973). Furthermore, psychologists have found that in a model room experiment, colour and visual complexity are other influential factors (Baum & Davis, 1976). For example dark colours increase the crowding perception. However, it may not be as influential as visual complexity. In manipulating the visual complexity, it is found that the more visually complex environment is more suitable for more social interaction. Because visual complexity increases the expected density (Baum & Davis, 1976). The explanation is that the more visually complex environment is more suitable for social activities. For instance, a room with pictures on the wall is appropriate for a social activity cocktail party, compared to an airport waiting lounge, which is a less complex environment and is for individual activity.

2-2-3-4- Social factors

In an effort to define crowd, Desor (1972) describes that being crowded is the reception of excessive social simulation and not merely the lack of space (Desor, 1972). In addition, social consequences of high density are more influential than spatial consequences (Baum & Koman, 1976), but not necessarily negatively. Firstly, one's criteria of crowding vary with the ongoing activity (Desor, 1972), which means spaces

characterized by social activity would have larger perceived capacities than those characterized by non-social activity (Desor, 1972). Also Freedman et al. (1972) have suggested that the stressful effects of density increases as the number of interacting organisms become greater. Furthermore, Desor (1972) has proposed that the perception of crowding is directly related to the level of social stimulation affect on an individual that can even be the direction of movement that may be cohort (moving of the crowd in distinct direction and line), or mixed (Helbing et al., 2001).

2-2-4- Effect of crowding on human behavior

A chronological overview of the documentation on crowding begins with a total negative perspective by Zlutnich and Altman who believe crowding to be the source of disease, physical malfunction, mental illness, crime, riots, war, drug addiction, alcoholism, family disorganization, psychological withdrawal, aggression and an overall decrease in the quality of life (Zlutnich and Altman cited in Freedman et al., 1972). Afterwards, it was found that density does not have a significant effect on either nervousness or aggression (Worchel & Teddie, 1976). And, it has become a valid argument that it may even have a positive effect on people's experience from the environment. For example, people who visit large cities can feel excited about the experience of spending time with the crowd (Milgram, 1970). Therefore, some degree of density and intensity of contacts with other people is, at times, desirable (Hall, 1966).

As discussed, people's expectations can have an important effect on the feeling of crowding. For example, pedestrians visiting a downtown pedestrian street expect or even seek a certain number of people that if the crowd was much more or less than their

expectation they would feel crowded or isolated. Meanwhile, the study of residential density and psychological health showed that living in highly populated neighborhoods can cause stress and social problem (Evans, Palsane, Lepore, & Martin, 1989).

On the other hand, the retailing literature also stands by the positive effect of human crowds in customer satisfaction (Eroglu et al., 2005). Overall, there is not a strong support of the hypothesis that crowding itself can cause aggression. Or at least it is not the presence of other people and, causes a negative experience. Moreover, in retailing literature it has been theorized that high retail crowding (the amount of merchandise) can result in more intense feeling of crowding which may not be desirable for task oriented shoppers[1] (Eroglu & Machleit, 1990). This suggests that the total effect of spatial crowding on shoppers is generally negative in terms of psychological satisfaction (Eroglu et al., 2005). These factors were more related to the characteristics of the built environment, but social factors can also have influence on the perception of crowding.

From a retailing point of view human crowding positively affects shopping satisfaction which provides support for the inverted U relationship (The satisfaction from the environment increases by the increase in number of people but it falls when the crowd reaches a certain point) in the crowding literature (Eroglu et al., 2005). However, "the notion that higher crowding levels can produce higher shopping satisfaction might seem counterintuitive at first, it is not contradictory to evidence and theory in the environmental psychology literature which explains the concept of optimal social contact" (Eroglu et al., 2005, p.1152).

[1] Task oriented shopper is referred to the person that directly goes to a specific aim he has and does not walk around

2-2-4-1- Inverted U-shaped function in psychology of aesthetics

The inverted U-shaped arousal theory has been mainly discussed in psychology of aesthetic that is principally done in the realm of psychobiology (Berlyne, 1971, 1974). Psychobiology is the study of behavior that concerns the unconscious mental processes (Berlyne, 1971).

In the aesthetic behavior study, the behavior of the artist creating (or performing) a work or the behavior of the appreciator while being exposed to the art work was investigated (Berlyne, 1971). The art work can be in different forms from a poem or painting to urban built environment.

Concerning the built environment, it has been found in an environmental preference study that "the characteristics of the visual environment selected as likely to relate to preferences for urban scenes included, novelty, complexity, order, naturalness, openness, upkeep and prominence of vehicles" (Nasar, 1984, p.79).

In the study of novelty and complexity, Berlyne (1971) and Wohlwill (1976) have explained that with an increase in uncertainty or arousal pleasure increases up to the point after which it decreases. Therefore, there is an inverted U-shaped function between the amount of environmental stimuli and the pleasure. Other authors have discussed the optimal level of pleasure for the amount of environmental aesthetic input. Among those; Oostendorp and Berlyne (1978a; 1978b) and Gärling (1976) in studies of architectural properties and environmental settings also confirm the relationship between the amount of stimuli and preference with empirical evidence. These studies support the existence of a relationship between the environmental stimuli and desirability, which also confirms

the pleasurability of a relative level of crowding. Furthermore, the preference of optimal crowding can also be explained with considering social factors which refers to the desire of seeking for social interactions.

Therefore, these studies confirm the concept of information overload by Stokols (1973). This concept explains that humans have specified capacity, and when the environmental stimuli exceed the coping capacity, overload happens.

2-2-5- Crowding; desirable or unpleasant

There are two different points of view toward crowding that on one hand it has been explained as unpleasant, and on the other hand has been introduced as desirable. Between these two levels a neutral point of view is missing in this realm. It has been stated previously (Eroglu et al., 2005; Rapoport, 1975) that there is an invert U shape relationship between density and desirability. It means that by increasing the density index desirability level improves until it reaches the most desirable situation. After that point the desirability drops as the density grows further indicating that the extremes are not desirable; isolation and excessive crowding.

Like excessive crowding isolation is also not desirable in public places since it decreases the sense of security (Jacobs, 1961) and furthermore, humans as social animals seek social interaction and they find it desirable. The latter reason makes big cities more appealing (Milgram, 1970). Moreover, over-crowded public places can increase aggressiveness if their personal space get violated; however, special events such as festivals, concerts and sport matches are exceptions which have been explained before.

2-3- Methodology

2-3-1- Stated Preference

The study of crowding and behavior is based on two main theories of preference; revealed and stated. Revealed preference has been used by (Baum & Koman, 1976; Desor, 1972; Freedman et al., 1972; Stokols et al., 1973). This type of study is based on the observation of subjects are placed in different situations, then analyze their behavior. The stated preference method study falls into two parts. One is by preparing a scenario explaining the situation. The other is simple observation with no specific situation being explained which is more general and is not limited to specific condition. The study of personal space and proxemic behavior is mainly done by the latter method.

The second method that is mostly done in the more recent studies, and specifically in the retailing literature is stated preference (Eroglu & Machleit, 1990; Eroglu et al., 2005; Machleit et al., 1994). Like the observation method it can be done with or without a scenario.

There is considerable debate in the attitude-behavior literature about the predictive ability of attitudinal questions that inquire about stated preferences, rather than revealed preferences or actual behavior. Those who favor revealed preferences argue that stated preferences are likely to provide careless or inaccurate information about true preference or behavior (Audirac, 1999). Paul Samuelson (1948), the pioneer of revealed preference, rejected them in an effort to separate utility theory from psychological and

philosophical theories of consumer preference. Since stated preference cannot be observed, they had no role to play in explaining consumer behavior (Audirac, 1999).

While both revealed preference (RP) and stated preference (SP) data can be used to analyze preferences, there are certain advantages to using the latter method in this case. In using consumer revealed preferences, often a limitation arises because only the final choice is observed. This makes it difficult to ascertain how subjects came to their final decision. This complication arises because the number of choices that are available to each individual may be very large and information on those alternatives that went into an individual's decision may not be fully known. Even in cases where all possible alternatives are known, it is difficult to assess whether the decision makers considered all available alternatives. In addition, the exact tradeoff of interest may not be readily available. Even in cases where the exchanges seem to be available, one cannot be certain that the pedestrian is acting out his or her preference for the attributes we are observing. The lack of appropriate data can pose a major challenge in this respect. Stated preference surveys overcome these complications because the experimenter controls the choices. In SP settings, the experimenter determines the choices and the respondent considers. While this may not reflect the actual choice that individual would make because of the constraints the survey places on the choice set, it allows us to measure attribute differences between the presented alternatives (Krizek, 2006).

To make it clear, in the case of study of pedestrians, one method is correlate the number of pedestrians visiting a place with desirability; or observing subjects' behavior and developing some measures to analyze their preferences. These methods are the

revealed preference. Whereas in SP, pedestrians' preference is asked directly. Therefore stated preference seems to be the most appropriate method in this study.

2-3-2- Dynamic versus Static displays

In stated preference study, there are three different levels considering the level of realism. The first, and the most real one, is putting people in different situations and asking for their preferences. The second level is to show video outside in a real environment. The third is to show static imagery of a real environment. All of these methods have advantages and disadvantages. The most ideal method is to put people in different conditions, because it is the most realistic method, but so many variables exist that cannot be controlled and it is so time consuming, that subjects may even forget the other conditions.

Therefore, although this method might be the most realistic one, the results are hard to conclude. The other method is showing pictures (Eroglu & Machleit, 1990; Eroglu et al., 2005; Machleit et al., 1994). These pictures can be taken from different real situations, and they can be one picture where different variables are manipulated by editing. The last method may not be as real as locating people in the real situation, but they are reliable in the sense that various variables can be changed independently.

Although this method can be appropriate in various studies, it cannot be used in the study of crowding. Borrowing from Stokols (1972), while amount of space in a given area may appear limited to an outside observer, it will not inevitably seem inadequate to the occupants of the area. Therefore, because the picture is taken from the outside, and it

cannot simulate the feeling of participation in crowd, the results might differ but, this hypothesis is still debatable.

Between these extremes there exists a method which is more ideal in its reliability and ability to illustrate feeling of participation. This method involves taking video from different situations focusing on the variable to be studied while the other variables are kept constant. This method is a new way to study crowding but it has been recently used in the study of route choice for cyclists (Kocur & Hendrickson, 1982; Krizek, 2006; Parkin, Wardman, & Page, 2007; Tilahun, Levinson, & Krizek, 2007).

In two studies (Krizek, 2006; Tilahun et al., 2007) of cyclist preference, the aim of the trip was explained for the respondents, and then different variables were shown in 10 second video clips, taken from a cyclist perspective. The clip loops three times, and the respondents are able to replay it if they wish so, and after which they choose their preference between two situations.

Using video can be influential, because the real environment has dynamic rather than static qualities. The visual world, for example, continually undergoes change both from dynamic environmental events, such as the movement of trees in the wind, and from visual changes generated from our own activities, such as locomotion (Heft & Nasar, 2000) which cannot be presented in static displays.

A small number of researchers and designers in the environment-behavior area have discussed the importance of dynamic simulation of the environment (Appleyard, Lynch, & Myer, 1964; Lynch, 1960; Thiel, 1997), but studies are mostly based on static displays. On the other hand, in a study of comparing dynamic and static pictures in

evaluating environmental scenes Heft and Nasar (2000) believe that assessments of static displays do not simply parallel those of dynamic displays. In their study they found that preference ratings are higher for static displays, but preference ratings in the dynamic condition are more strongly correlated with a wider range of variables; moreover, epistemic ratings are higher for dynamic than static displays (Heft & Nasar, 2000).

2-3-3- Summary and proposed approach

Urban and transportation planning has begun to emphasize multimodal approaches to meeting the challenges of congestion, air quality, infrastructure and quality of life by promoting active modes of transport, especially walking. One approach is to capture people's preference to improve their experience as a pedestrian. In different literature beginning with Rapoport the effect of built environment on pedestrians has been discussed widely. It has been discussed that dynamic factors such as crowding has a significant effect on the desirability of the route for the pedestrians, for example in recreational context crowding can be attractive (Zacharias, 1997). To the extent that "places where others are visible or where there are signs of public activity were more important than architecture in personal choice of path" (Zacharias, 2001, p.11).

In urban planning studies of crowding, it has been mentioned in the level-of - service criteria that people may feel uncomfortable walking at a lower than normal pace due to crowd (Khisty, 1994). Furthermore, they tend to maintain a buffer zone of around 0.45 m between themselves and the edge of a building, a smaller distance to stationary items of street furniture and a large distance between themselves and other pedestrians (Willis, Gjersoe, Havard, Kerridge, & Kukla, 2004). In such studies it has been

mentioned that the volume flow through pedestrian space may increase as number of people increase but also tends to diminish after an optimal point (Dixon, 1996).

As we have seen in the relevant literature there are different approaches toward density and crowding. One is a negative approach, which mainly discusses the result of crowding as stress and aggression while to the other extent it could be an exciting and satisfying experience. To date, there is no objective discussion which evaluates the appropriate amount of crowding, although one work has mentioned an invert U relation between (Altman, 1975) crowding and desirability but it has been left very qualitative and the debate is not complete.

On the other hand, crowding is extensively discussed in the proxemic studies which introduce different variables influencing the personal space and therefore the tolerable density. These main variables are gender and culture. However, this approach only discusses the relation of static subjects and mentions that the assumptions may change as subjects walk. Yet, the walking subjects remained unstudied.

Due to the current tendency toward pedestrianization, especially in downtown areas it is important to remember that people visiting a downtown district expect a certain number of people. If the city fails to provide the desirable crowd, people feel isolated (An experience which is not sought). Or if the crowd is more than their tolerance they feel cramped so they doubt the next visit. Unfortunately there is no such study especially in an urban environment which explains the desirable range for crowding.

In conclusion, an overview of the existing literature shows that there are some factors which influence the perception of crowd, among them; social stimuli have the

most determining effect. Furthermore, there is no strong literature introducing crowd, per se, as a negative effect that can cause aggressiveness. On the other hand, crowding sometimes is even desirable or sought. Although it has been mentioned that there is a comfortable range of density, but it has not been theorized so far.

Therefore, the aim of the current study is to investigate the association between pedestrian density level and desirability in public space, moreover, to examine the effect of gender, culture and street width on it.

3- Hypothesized factors in density preference

The literature suggests there are different factors that have been determined to have effect on people's perception of crowd and therefore on their preference. These factors are pedestrian density, gender, culture and methodology used for measuring. These are also other factors such as colour of the room, complexity and interaction type that were not relevant to the environment of this study. The colour of the room has been ignored, since the experimented condition in the current study is outdoor public space. Moreover, the complexity and interaction type between people is also disregarded because the field study has been narrowed to downtown commercial streets that have roughly the same characteristics regarding these two factors.

Therefore, the main and the secondary hypotheses is that an inverted U-shape relationship between people density and preference. Furthermore, gender, culture and experimental method can have influence on it. Females tend to accept more crowd therefore their preferred desirability is higher comparing to male subjects. Moreover, Montrealers are expected to enjoy more crowd. On the other hand, comparing the two experimental methods it is expected that respondents perceive more crowd looking at the pictures.

4- Methodology

The method used in the present study is to create a simulation of a downtown commercial street having different levels of pedestrian density. With this, the study will run a visual preference experiment, and find out how preference is attributable to each density level. Because the validity of the result depends on the validity of the scientific assessment of the density impact, it is useful to review how this scientific assessment works. Therefore several issues should be explained. Those are, method used for simulation, stated preference survey, use of semantic differential scale, demographic difference (sample characteristics), and temporal stability of preferences. These issues will be discussed along with step-by-step explanation of methodology. However, a pilot study was run initially to examine if the participants can distinguish the density level according to number of people and also to reveal any problem in the methodology since it is a novel method.

4-1- Pilot study

The situation of the pilot study resembles the situation of the main study therefore for further explanation see the process of the experiment using 15 respondents. However, the pilot study did not have a scenario. It was revealed that without the scenario, respondents got distracted with the appearance of people or they imagined themselves in different situation like being in rush. Therefore, a scenario was developed to direct the respondents toward judging on the density. Furthermore, in the process oh the pilot study, it was shown that respondents differentiate between videos and pictures of zero

(person/minute) density level. Because in some of them there was no one in the background while in the others a few people could be seen in far background.

Therefore, in developing the main study these factors were take into consideration; the necessity of having a precise scenario and separating two possible zero density; with and without people in the background.

Furthermore, apart from this pilot study 4 judges were used to express the perceived the density levels in videos and pictures qualitatively to determine if the respondents can understand the density level.

4-2- Stated preference survey

As it has been explained in the literature review that there are two main methods that have been used to study crowding and behavior; revealed and stated preference. Between these two methods, the stated preference approach suits this study better since in the current study the reason for preferring one situation over the other has been studied and revealed preference would be very general and prone to fallacy (Krizek, 2006).

In addition, between the two choices of with and without scenario in stated preference, the role-playing scenario was chosen for the current study. According to a pilot study, it has been shown that without the scenario, subjects could not concentrate on the density and other variables such as pedestrians in the video could distract them. Moreover without the scenario other variables such as aim of walking, time pressure and characteristics of environment could intervene in the main focus of study.

4-2-1- Role playing scenario

In the beginning, a scenario was read to the participants that explain the situation and instruction. 16 pictures were shown in random order. For the second section, using videos exactly like the previous procedure, the scenario was repeated to the respondents to make sure they were still imagining the mentioned situation. However, this time they watched a sample video.

A verbalized scenario was used to simulate shopping experience. The role-playing scenario technique has been used in most of the research focusing on perception and specifically on the perception of crowding. The scenario described walking on a downtown commercial street.

> "Imagine a nice summer day. You come to downtown to walk on the street. You are very relaxed and have plenty of free time. There are various shops around you. You face different levels of crowd. Sometimes it is very crowded and sometime there is no one around you. You want to pass time and enjoy spending time walking and observing."

During the experiment, participants were instructed to imagine themselves in the particular situation described in the scenario. The importance of internalizing the situation was emphasized several times through the experiment.

The objective of this study required the capture of different density levels on video, which were obtained by filming at different times in the same locations. Furthermore, since time pressure and the purpose of walking has a major effect on

people's tolerance of crowds (Eroglu & Machleit, 1990), a unique situation was described to the participants using the same scenario.

The main purpose of the scenario was, to simulate the same state of mind for all the participants; to prepare the respondent for the survey; and finally, to draw their attention to the purpose of the research. The last issue was seen to be necessary after completing the pilot study.

4-2-2- Semantic differential scale

The semantic differential scale (SDS) is a scaling tool that has been used frequently for measuring social attitudes Osgood, Suci and Tannenbaum (1957), particularly in the fields of linguistics and social psychology. It was first devised by. In the current study the respondents have scored the desirability by choosing 4 as highest and 1 as lowest.

There might be concern over using this scaling method, but a meta-analysis review revealed that different methods of scaling such as semantic differential scaling, ranking, Q-sort and placing on a table, generated almost identical results (i.e. correlated at r=.990) (Arthur E Stamps, 1999b). Therefore, since scaling methods are interchangeable, the semantic differential method was considered most suitable, because it was easier for the participants to choose within different scales.

4-3- Development of experimental material

The experiment presented representation of a commercial street on colour-slides and video clips, rather than placing subjects in an actual urban environment. There might

be concerns over the method of simulation, but Stamps (1993) has shown that the correlation between ratings obtained on-site and ratings obtained from colour slides is significant at r =.83 (Arthur E. Stamps, 1993). In this study, using pictures (dynamic and static) were preferred since the variables are more controllable. In addition in this study, the two different methods are being compared to examine if these two methods can influence the results and which method has priority over the other.

4-3-1- Recordings of people on the street

Videos were taken with a 10 megapixel Canon digital camera, which was maintained in position a tripod. Each video is 10 seconds in duration. In the process of collecting video clips several criteria were specifically observed:

1) The camera was mounted at eye level so that it can correctly represent human experience of the environment.
2) Different levels of density from the lowest which indicates to no one on street to the highest were filmed (from zero to 27 pedestrian per minute per meter width of the available sidewalk).
3) Weather conditions were neutral since it may affect the results (no rain, no snow and no strong wind)
4) The camera view-point was kept the consistent within the same location with fixed direction, focus and zoom
5) Videos were played mute to avoid the impact of different sounds as contaminating variables.

After the process of filming by counting the people passing the camera in duration of 10 seconds lowest and highest density were determined and four different levels were chosen by author which are as follows (the scale is person per hour per meter width):

1) 0 (completely empty street)
2) 0 (with people in the background)
3) 13(half the highest density) (person/minute)
4) 27 (person/minute)

Then, a pilot study was conducted to make sure that the measured density levels can demonstrate the density the best and can be distinguished by the respondents.

4-3-2- Still frames from the videos

The pictures were extracted from the videos. Since, pictures and videos are being compared the pictures should be a very good representation of the videos. Therefore, a frame, that can demonstrate the identical situation and a certain level of density, was chosen. The chosen frames illustrated the average number of pedestrians passing on the sidewalk in the ten seconds. Since the duration of the videos was not long there was not a considerable fluctuation in the number of people passing the camera in each video. Furthermore the pictures were approved in the pilot study to check if the proper density was distinguishable for the subjects.

4-3-3- Laboratory setting for the experiment

The hypotheses was tested in laboratory setting which remained consistent all through the survey, since, various testing environments could introduce extraneous

variables which can have influence on the respondent's feeling and may lead to biased results. Trials were run during the day with natural light. All respondents were called in the experiment room individually, so as to avoid the effect of other respondents and distraction. The environment and situation were kept consistent for all subjects.

4-4- Sample characteristics

The sample size is 49 people, all the respondents were students aged between 20 and 35 (table 5-1). All participants were all Concordia students, and participated in the research voluntarily after being recruited personally by the researcher.

Table 4-1: Sample characteristics

	Male	Female	Total
Local*	12	8	20
Non local	17	12	29
Total	29	20	49

*Local: people who spent more than half of their life in Montréal

Various researchers such as Eroglu and Machleit (1990) have tried to avoid selection of an identifiable group. But Stamps (1999a) showed that in the study of people's preferences for the visual aspects of environment, the degree of consensus between students and non-students is high (r=0.83). Therefore, using students as subjects does not have a big difference in the results. Their answers were then inserted into an Excel spreadsheet after each experiment, and were monitored while the trials continued.

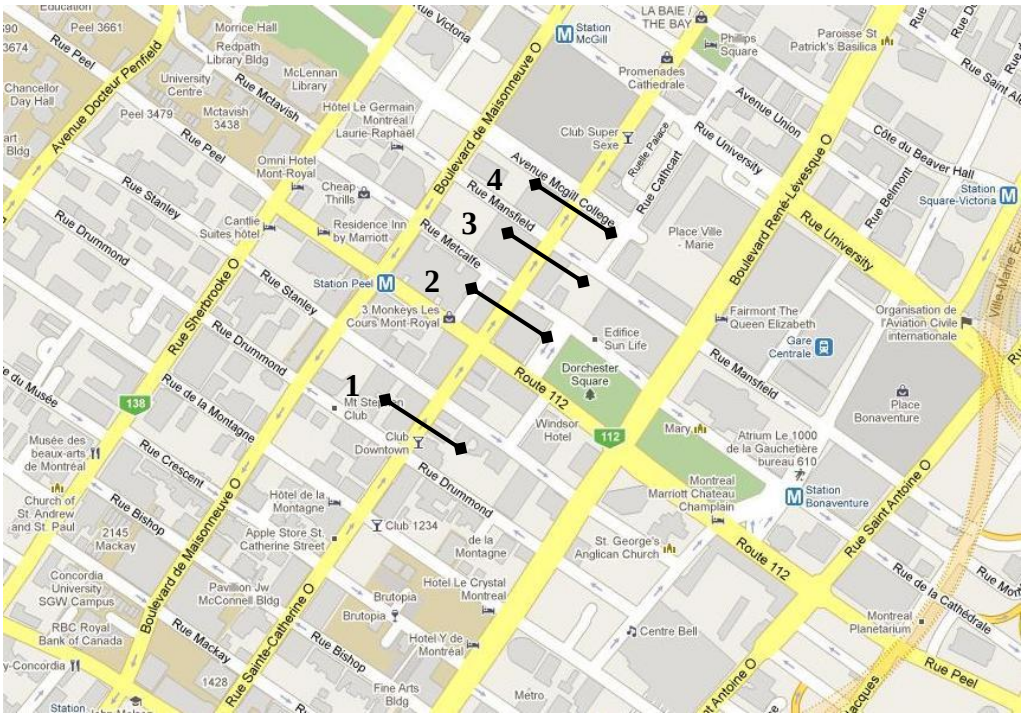
The number of the sample were then determined depending on the distribution of the results. That is when the results did not changed significantly by doing a few more trial.

4-5- Location of study

The case-study area of this research is rue Sainte-Catherine Ouest, in Montréal, Québec. Four different sections were chosen to see if specific location can influence respondents' preference. These sections defined by the intersecting streets are as follows:

1) Drummond – Stanley
2) Peel – Metcalfe
3) Metcalfe – Mansfield
4) Mansfield – McGill College

Figure 4-1: Location of street sections



Source: Google map (2011)

4-6- Procedure

After a brief explanation about the survey by the researcher, participants were shown one sample of a moderate level of density to get acquainted with the experiment, and then they heard the role-playing scenario while the picture was displayed on the computer screen. Then they were told to go on and read the instruction to fill in the scales. Finally, the researcher asked participants to go back and re-read the scenario one more time.

The colour slides were then shown one-by-one on a 21" monitor using Microsoft Power Point 2007. The order of the slides was determined randomly in the presentation, but the same order was used for all the respondents. Subjects viewed each picture and evaluated the desirability. In the case of any distraction, the researcher emphasized and reinforced the situation. The second part was followed after the first part with the same procedure but different experimental method. The videos were 10 seconds in length and also randomly ordered. At the end some open questions were asked and then the subjects were dismissed.

In the open question it was asked which method they prefer and which one could simulate the environment better. Furthermore, it was asked whether they have answered according to crowd level or not. If the crowd level was not the main factor their questionnaire were not involved in the analysis.

The total number of slides was 16 and videos were also 16 and the duration of the whole experiment took about 20 minutes.

Table 4-2: Categorization of videos

	Location 1	Location 2	Location 3	Location 4
Density 1	5	3	2	10
Density 2	13	4	11	16
Density 3	15	9	7	6
Density 4	1	12	14	8

Table 4-3: Order of pictures

	Location 1	Location 2	Location 3	Location 4
Density 1	12	14	15	7
Density 2	4	13	6	1
Density 3	2	8	10	11
Density 4	16	5	3	9

In the tables 5-2 and 5-3 the order in which the videos and pictures were displayed to the participants are shown. See the appendix for the scenario and the detailed survey instrument.

5- Results

There are five independent variables in this study:

1- Gender.

2- Culture (if the respondent is Montréaler or not) of the respondents.

3- Location.

4- Pedestrian density.

5- Experimental method.

Each of these variable's results will be discussed separately.

As it has been explained before there are four different locations and for each location there are four different levels of density, the four locations are called as L1, L2, L3 and L4, furthermore the four densities are called as D1, D2, D3 and D4. Since each movie or picture demonstrates a certain location with a certain density the name relevant to each of them is the mix of the two letters. Table 6-1 helps understanding the initials that will be used for explanation of the analysis. All the analysis is done by using PSAW Statistics (18).

Densities 1, 2, 3 and 4 respectively refer to 0 (without people in background), 0 (a few people in the background), 13 and 27 persons per minute.

Variables are non-parametric due to their characteristics which are ordinal data.

Table 5-1: Explanation of initials

	Location 1	Location 2	Location 3	Location 4
Density 1	D1L1	D1L2	D1L3	D1L4
Density 2	D2L1	D2L2	D2L3	D2L4
Density 3	D3L1	D3L2	D3L3	D3L4
Density 4	D4L1	D4L2	D4L3	D4L4

5-1- Gender

According to the hypothesis it has been assumed that there is a difference between male and female in their density preference. Since the analysis is non parametric, for testing the hypothesis Mann-Whitney U-test has been used. As the result (table 6-2, 6-3, 6-4 and 6-5), no significant difference between these two groups was found (significance values are more than .05) for both local and non-local respondents and their preference in pictures and videos. Although in one of the 56 situation a significant difference can be seen, but it is ignorable because the sample is small and the probability of its happening by chance is high. Therefore, the hypothesis has been rejected and this variable will not be considered in further analysis.

Table 5-2: The significance value of Mann-Whitney U test between non local males and females for videos

	Location 1	Location 2	Location 3	Location 4
Density 1	.591	.751	.942	.232
Density 2	.756	.664	.825	.768
Density 3	.472	.828	.198	.470
Density 4	.756	.181	.270	.162

Table 5-3: The significance value Mann-Whitney U test between local males and females for videos

	Location 1	Location 2	Location 3	Location 4
Density 1	.837	.766	.681	.837
Density 2	.771	.865	.734	.190
Density 3	.607	.199	.927	.797
Density 4	.740	.518	.746	.498

Table 5-4: The significance value Mann-Whitney U test between non-locals males and females for pictures

	Location 1	Location 2	Location 3	Location 4
Density 1	.449	.449	.449	.405
Density 2	.907	.780	.248	.601
Density 3	.155	.352	.729	.301
Density 4	.272	.647	.039	.338

Table 5-5: The significance value Mann-Whitney U test between locals males and females for pictures

	Location 1	Location 2	Location 3	Location 4
Density 1	.681	.681	.967	.745
Density 2	.840	.631	.496	.346
Density 3	.800	.629	.740	.183
Density 4	.472	.623	.336	.399

5-2- Culture

Another variable that was hypothesized to have effect on respondents' preference was culture, which in this study was divided to two group of local and non-local. Locals are the people who lived in Montréal most of their lives and others are non locals. Statistical testing for non-parametric independent variables (Mann-Whitney U test) revealed that in contrary to the assumption, there is also no significant difference in the answers given by these two using two different methodologies (table 6-6 and 6-7). Therefore the second hypothesis has been disproved, and the variable of culture will not be involved in the process of further data analysis.

Table 5-6: The significance value Mann-Whitney U test for videos

	Location 1	Location 2	Location 3	Location 4
Density 1	.193	.210	.396	.377
Density 2	.086	.441	.374	.445
Density 3	.683	.842	.676	.838
Density 4	.386	.070	.216	.561

Table 5-7: The significance value Mann-Whitney U test for pictures

	Location 1	Location 2	Location 3	Location 4
Density 1	.657	.657	.497	.167
Density 2	.558	.580	.065	.769
Density 3	.552	.900	.475	.964
Density 4	.156	.108	.072	.349

5-3- Location

Regarding the use of different locations in this study, it was hypothesized that different locations will not have significant effect on respondents' preference with density as the main determinant. Friedman ANOVA has been used for testing the hypothesis. As the result, different locations were not significantly different in preference on the desired level of density. Therefore, the hypothesis has been approved and the effect of location will be ignored in the further hypothesis in both videos and pictures.

For testing if there is any difference between the answers regarding different locations a Friedman ANOVA test was run as can be seen in table 6-8.

Table 5-8: Significance value of Friedman ANOVA for different locations

	Video	Picture
Density 1	.277	.779
Density 2	.216	.883
Density 3	.271	.369
Density 4	.108	.115

At the end, it is possible to take an average of desirability levels for different locations and go on to the next step of analysis which is comparing different desirability levels according to density.

5-4- Density

As explained in the previous section there is no significant difference between locations. The next step is to find if there is significant difference among densities, which if true, would mean that respondents based their answer on the density level. For testing the hypothesis Wilcoxon T-test was used. The analysis revealed that there is a significant difference between the average desirability of each density level and the close density level (table 6-9). All the density levels were not compared to all the others because according to the hypothesis there is an inverted-U relation between desirability and density level. The Wilcoxon T-test revealed that there are highly significant differences between pairs. It is also found that there is a significant difference between two zero density level; one with some people in the background and the other without people in the background. However, although the difference is significant, the effect size is small ($d<0.3$) and it will not be evaluated as a separate level.

Table 5-9: Significance value of Wilcoxon test and Cohen d's effect size comparing different densities

Density	Videos		Pictures	
	Wilcoxon test	Effect size	Wilcoxon test	Effect size
1-2	.008	0.19	.001	0.23
2-3	.000	1.77	.000	1.47
3-4	.000	1.06	.000	1.29

Therefore, the hypothesis is confirmed. Furthermore, it was proposed that the relationship between density and desirability is an invert-U shape function. Calculating the average desirability of each level of density as we can see in the following charts the hypothesis is confirmed for both pictures and videos.

Figure 5-1: Mean desirability of different crowd level for videos

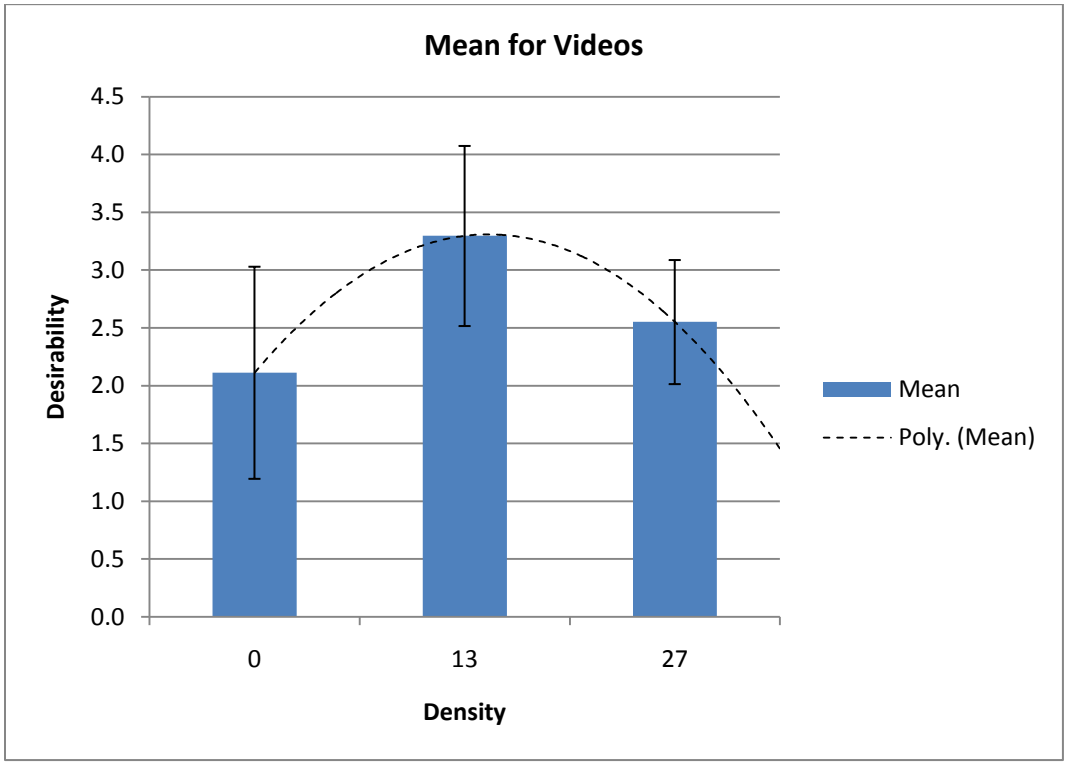
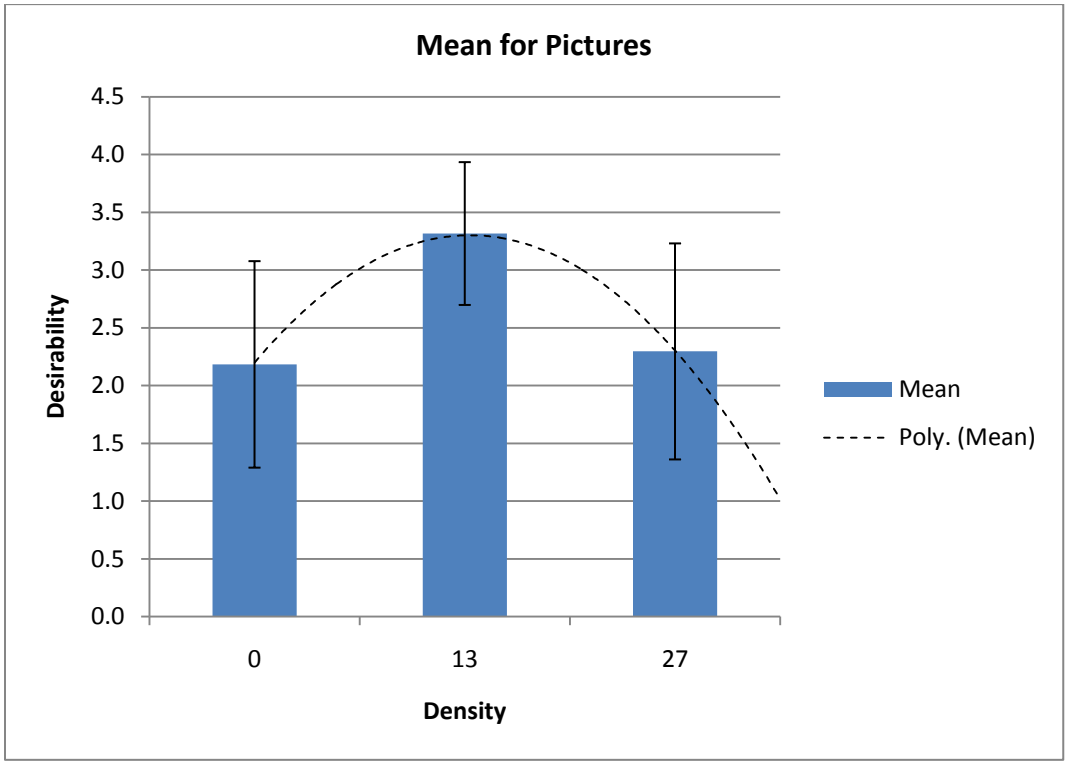


Figure 5-2: Mean desirability of different crowd level for pictures



5-5- Experimental method

Comparing two different methods used for this study, it has been revealed that there is not a significant difference between them except for the density level 4 which is the highest density. The first column of the following table demonstrates the result of Wilcoxon T-test it explains that there is not significant differences between pictures and Movies for the first three densities.

However a quick look at the average density levels between them show that for the low and medium density respondents showed a higher desirability for the pictures compared to videos.

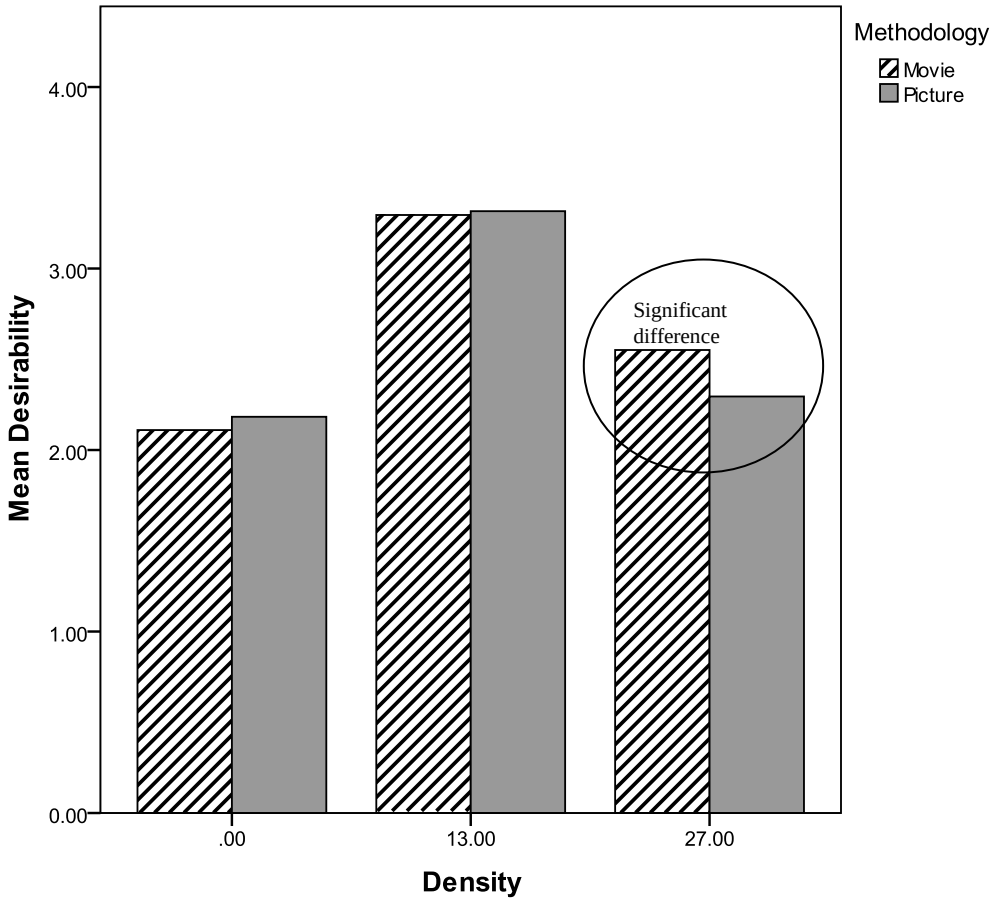
Moreover, it has been explained before that people might perceive more individuals in picture compared to video as they felt excluded because they are not participating in the crowd. Comparing the two methods in density 2 and 3 the respondents found a picture more desirable. It is perceived to be more crowded. In addition to the comparison of average and literature review some of the subjects mentioned that they found pictures more crowded.

In contrast to the afore-mentioned explanations for the 4th density, which is the highest level of density, the desirability is higher in videos compared to the pictures. Although it is contrary to the rest of analysis, it still can be explained. As mentioned before by passing the tolerance level the desirability tends to decrease with increasing density. Therefore, respondents expressed the higher desirability level for movies and less for the pictures.

Table 5-10: Methodology comparison

Density (Person/m*min)	Picture vs. Movies Mann-Whitney significance value	Average desirability using Pictures	Average desirability using Movies
0	.461	2.18	2.11
13	.668	3.32	3.30
27	.000	2.30	2.55

Figure 5-3: Methodology comparison



6- Conclusion

The first major finding of this study was that the inverted U-shaped relationship between density and desirability was approved. Although the complete curvilinear function was not achieved, since it is not possible to make distinction between small portions of changes in density, but the trend was achieved. The U-shaped relation has been discussed before in the aesthetic analysis (Berlyne, 1971, 1974) of the environment which is approved in this study which is on crowding that is a dynamic factor.

Furthermore, in the proxemic studies (Hall, 1968) it is mentioned that there is difference among different culture or between men and women but in contrast to our first assumptions other variables namely gender and culture did not influence the result significantly. This means that there were no significant difference between the preference of men and women or locals and non locals.

Moreover, comparing the two methodologies used in this study it has been found that the subjects' desirability level did not vary significantly by the methodology except for the fourth density which is the highest. Searching for the probable reasons it has been mentioned by the respondents that they prefer movies over picture since they can see pedestrians' movement and speed which is not recognizable in pictures. Therefore, by looking at the pictures they feel trapped behind the crowd which might not be true by watching its video. This fact becomes more influential in high density, therefore, it can be explained that the preference level for movie got significantly higher since the respondents do not feel being blocked and they can have their free movement.

Additionally, it has been mentioned in the literature that people feel more crowded by looking at the crowd from out and when they are involved in the crowd themselves the perceive lesser density. Moreover, respondents have mentioned that the videos looked more real and they felt more involved. Concluding, since pictures demonstrate the crowd from the outside viewpoint and it can result in more perceived crowd and the desirability decreases by the increase in density, therefore, the desirability level in pictures can drop abruptly comparing to the comparable movies.

To summarize, the desirability of the environment increases by the increase in number of people available until it reaches a maxima. Afterward, by continuing to increase the number of people the preference starts to diminish which was not significantly different among different culture or gender. This trend is true for both methods which are pictures and videos. Also in high density the respondents significantly preferred videos over pictures.

7- Discussion

The finding of this research can explain the importance of considering crowd level in planning for public space. Past research in crowding and behavior study focused on aggressive behavior in extremely high density. Furthermore, they were mainly conducted indoors. Therefore, this study mainly focuses on the outdoor public space and also considers the effect of very low density.

Limitation of this study was I did not have access to my ideal capturing equipment which was a professional camera and sky cam equipment which could make me able to capture while walking that could definitely give a more real impression.

It is assumed that in a different environment like residential neighborhoods the results may change drastically future study can be conducted in diverse environment to compare the difference between the desirable crowd levels. Also, using a pedestrianized street as case study may influence the results as well.

Regarding the implications of the result of this study, public space planners should consider that people do not like isolated places as much as they do not like overcrowded places therefore their design should encourage a moderate level of crowd by applying this idea in landuse planning and public space design. This study can also be interesting for psychologists who mainly focus on the environmental behavior.

More importantly the study of personal space exclusively is done in static subject and the proxemic behavior of walking people is unstudied. Therefore, as far as I know

this study represents new finding in this realm and explains that the variables which are influential in static subject may not be of importance in moving subjects.

For the future research the following topics are suggested:

- personal space concerning the walking subjects
- developing determining factors in outdoor spaces
- the effect of crowding in different environments such as residential neighborhoods

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9- Appendix

9-1- Role playing scenario

In the next page a situation will be explained, read it carefully and put yourself in the described situation. Internalization of the situation is very important. After reading the situation go on the next page and read the instruction about how to fill in the questionnaire and asked any question if you have. Then, go on the next page, I will re-read the situation. Then you can start answering the questions.

Imagine a nice summer day. You come to downtown to walk on street. You are very relaxed and have plenty of free time. There are various shops around you. You face different levels of crowd. Sometimes it is very crowded and sometime there is no one around you. You want to kill time and enjoy spending time walking and observing.

16 different slides will be shown and while imagining that you are walking in those environments mark how much you like walking in the shown level of crowd.

9-2- Questionnaire

Section 1

How much do you like to walk in the shown level of crowd?

	Dislike very much ⟷ Like very much			
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				

Section 2

How much do you like to walk in the shown level of crowd?

	Dislike very much ⟷ Like very much			
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				
16				

1) What were your reasons for choosing different answers?

2) Which section could simulate the different levels of crowd the best?

3) Which section did you prefer? Why?

Personal questions: Gender?

Have you spent most of your life in Montreal?

Figure 9-1: Density 1, Location 1

Figure 9-2: Density1, Location2

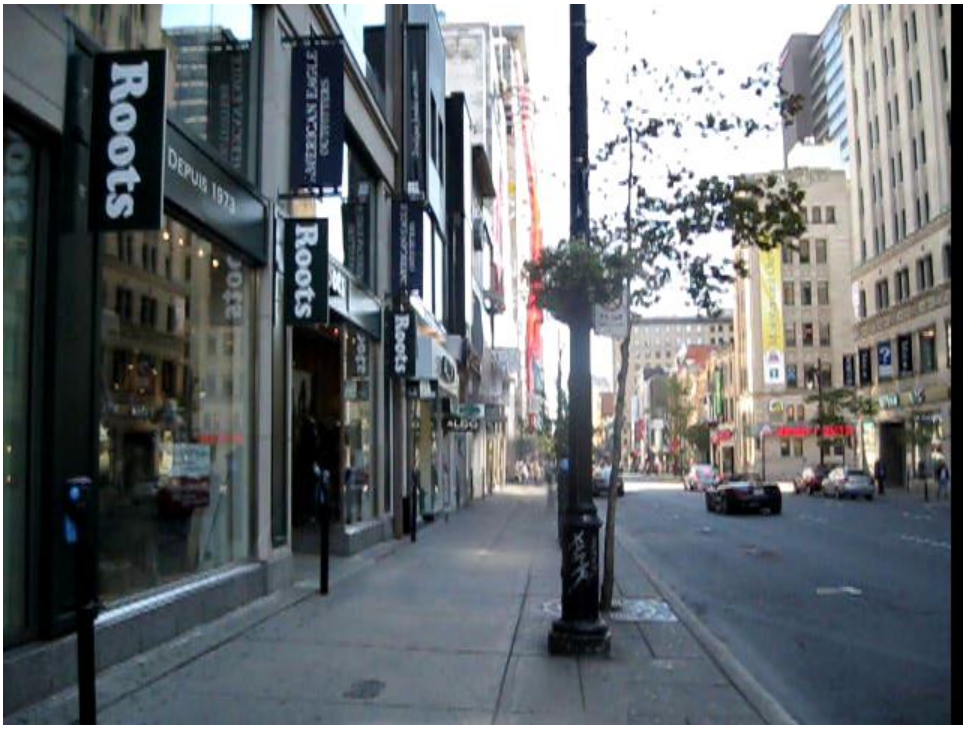

Figure 9-3: Density1, Location3

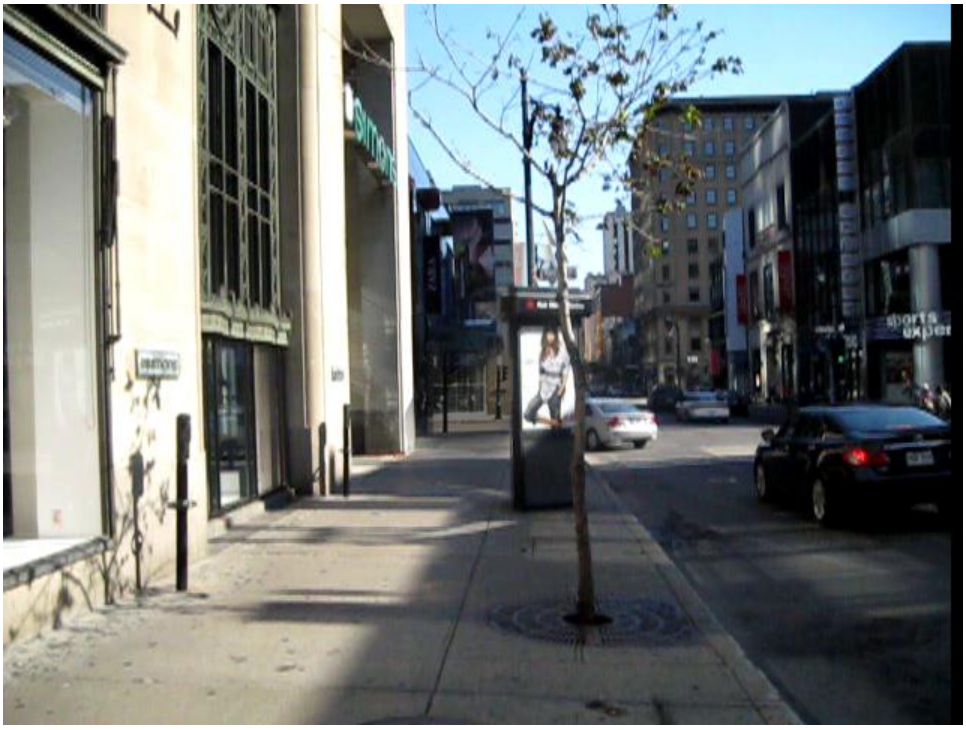

Figure 9-4: Density1, Location 4

Figure 9-5: Density2, Location1

Figure 9-6: Density2, Location2

Figure 9-7: Density2, Location3

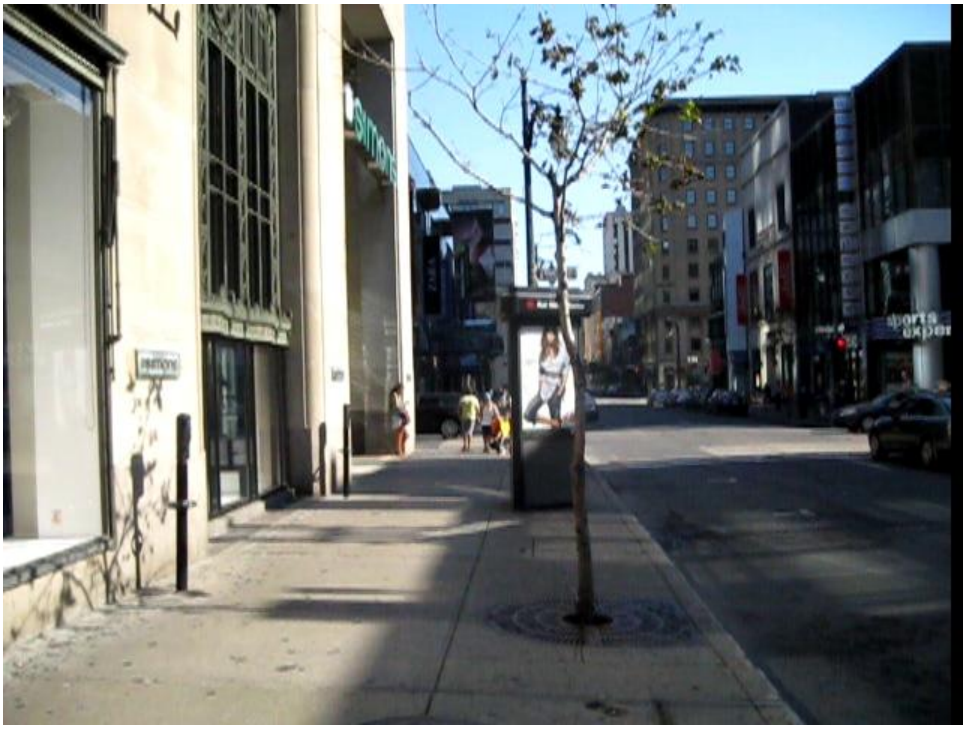

Figure 9-8: Density2, Location4

Figure 9-9: Density3, Location1

Figure 9-10: Density3, Location2

Figure 9-11: Density3, Location3

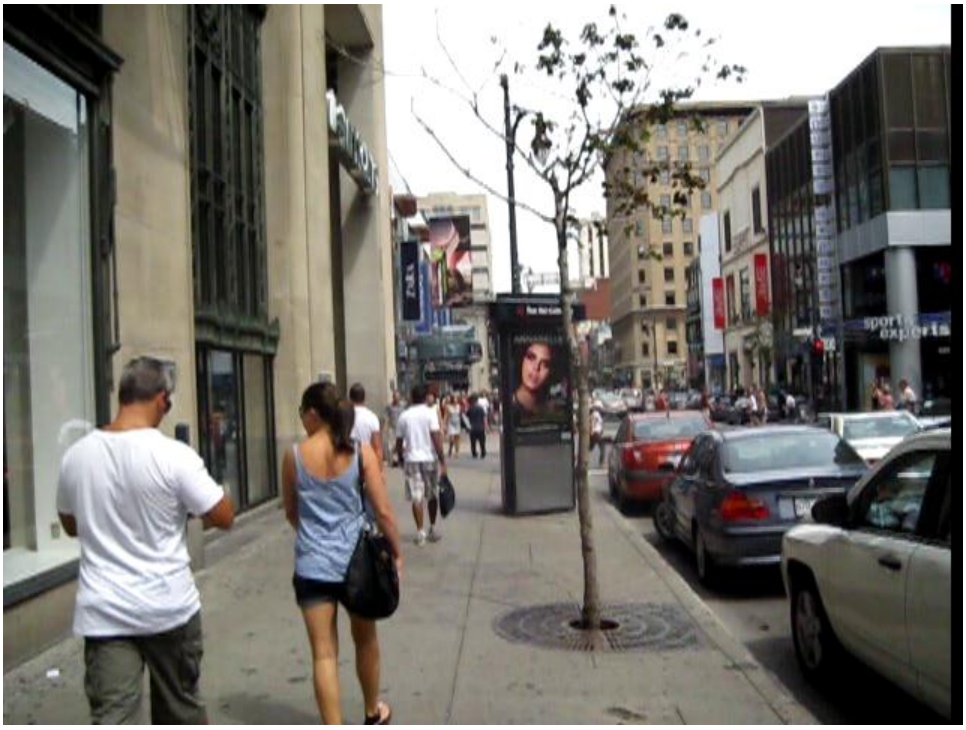

Figure 9-12: Density3, Location4

Figure 9-13:Density4, Location1

Figure 9-14: Density4, Location2

Figure 9-15: Density4, Location3

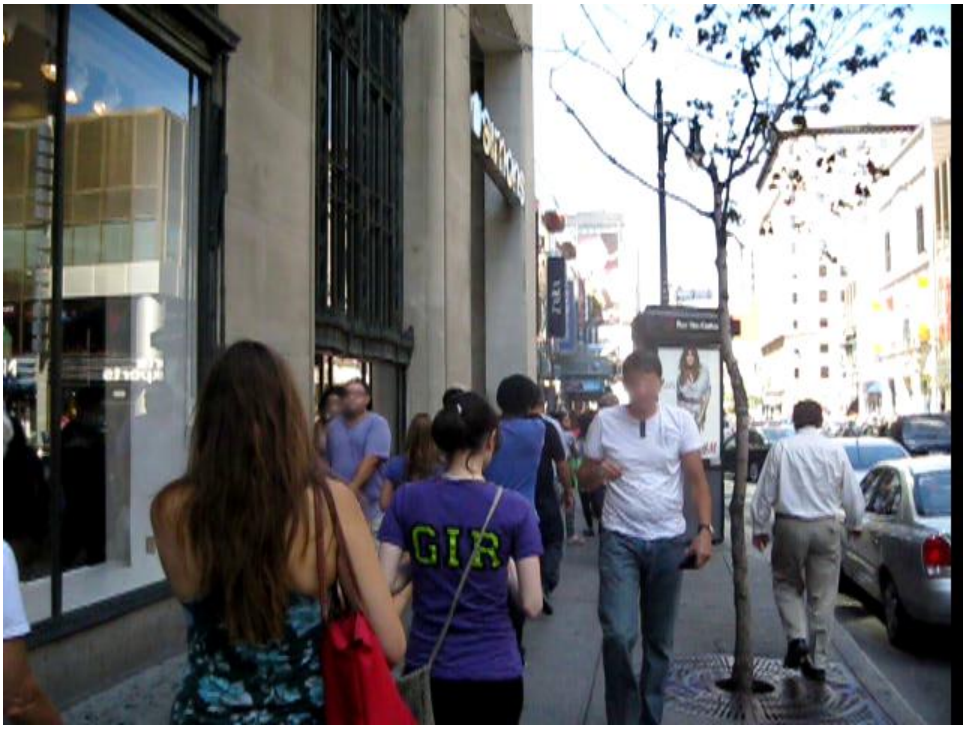

Figure 9-16: Density4, Location4

Table 9-1: Mann-Whitney U test comparing non-local males and females for videos

Descriptive Statistics[a]

	N	Mean	Std. Deviation	Minimum	Maximum
D1L1	29	1.76	.912	1	4
D1L2	29	1.90	.900	1	4
D1L3	29	1.86	.915	1	4
D1L4	29	1.86	.953	1	4
D2L1	29	2.00	.802	1	4
D2L2	29	2.07	.704	1	4
D2L3	29	1.93	.753	1	4
D2L4	29	1.97	.823	1	4
D3L1	29	3.38	.622	2	4
D3L2	29	3.34	.721	2	4
D3L3	29	3.17	.805	1	4
D3L4	29	3.41	.628	2	4
D4L1	29	2.48	.785	1	4
D4L2	29	2.28	.960	1	4
D4L3	29	2.55	.870	1	4
D4L4	29	2.38	.942	1	4
Gender of the subjects	29	.41	.501	0	1

a. Culture = Non local

	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)	Exact Sig. [2*(1-tailed Sig.)]	Exact Sig. (2-tailed)	Exact Sig. (1-tailed)	Point Probability
D1L1	91.00	244.00	-0.54	0.59	0.65	0.60	0.35	0.10
D1L2	95.50	173.50	-0.32	0.75	0.78	0.74	0.38	0.04
D1L3	100.50	178.50	-0.07	0.94	0.95	0.98	0.49	0.05
D1L4	77.00	230.00	-1.20	0.23	0.28	0.24	0.12	0.01
D2L1	95.50	248.50	-0.31	0.76	0.78	0.78	0.38	0.05
D2L2	93.50	246.50	-0.43	0.66	0.71	0.65	0.36	0.10
D2L3	97.50	250.50	-0.22	0.82	0.84	0.84	0.40	0.05
D2L4	96.00	249.00	-0.30	0.77	0.81	0.81	0.36	0.03
D3L1	87.50	165.50	-0.72	0.47	0.53	0.55	0.26	0.05
D3L2	102.00	180.00	0.00	1.00	1.00	1.00	0.56	0.11
D3L3	79.00	157.00	-1.14	0.25	0.32	0.30	0.13	0.03
D3L4	76.50	154.50	-1.26	0.21	0.26	0.23	0.14	0.07
D4L1	95.50	173.50	-0.31	0.76	0.78	0.79	0.42	0.05
D4L2	73.50	151.50	-1.34	0.18	0.21	0.22	0.11	0.04
D4L3	78.50	156.50	-1.10	0.27	0.30	0.31	0.16	0.04
D4L4	72.00	150.00	-1.40	0.16	0.19	0.18	0.09	0.01

Table 9-2: Mann-Whitney U test comparing local males and females for videos

Descriptive Statistics[a]					
	N	Mean	Std. Deviation	Minimum	Maximum
D1L1	20	2.10	1.021	1	4
D1L2	20	2.20	.951	1	4
D1L3	20	2.10	1.021	1	4
D1L4	20	2.10	1.021	1	4
D2L1	20	2.45	.887	1	4
D2L2	20	2.30	.923	1	4
D2L3	20	2.20	.951	1	4
D2L4	20	2.20	1.005	1	4
D3L1	20	3.30	.657	2	4
D3L2	20	3.30	.657	2	4
D3L3	20	3.20	.523	2	4
D3L4	20	3.45	.686	2	4
D4L1	20	2.70	.801	1	4
D4L2	20	2.85	1.137	1	4
D4L3	20	2.85	1.040	1	4
D4L4	20	2.55	1.146	1	4
Gender of the subjects	20	.40	.503	0	1
a. Culture = Local					

	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)	Exact Sig. [2*(1-tailed Sig.)]	Exact Sig. (2-tailed)	Exact Sig. (1-tailed)	Point Probability
D1L1	45.50	123.50	-0.21	0.84	0.85	0.96	0.48	0.09
D1L2	44.50	80.50	-0.30	0.77	0.79	0.85	0.42	0.09
D1L3	43.00	79.00	-0.41	0.68	0.73	0.73	0.38	0.08
D1L4	45.50	123.50	-0.21	0.84	0.85	0.96	0.48	0.09
D2L1	44.50	80.50	-0.29	0.77	0.79	0.83	0.44	0.10
D2L2	46.00	82.00	-0.17	0.87	0.91	0.93	0.51	0.14
D2L3	44.00	122.00	-0.34	0.73	0.79	0.76	0.43	0.09
D2L4	32.00	110.00	-1.31	0.19	0.24	0.23	0.11	0.02
D3L1	42.00	120.00	-0.51	0.61	0.68	0.68	0.36	0.13
D3L2	33.00	111.00	-1.28	0.20	0.27	0.21	0.11	0.04
D3L3	45.00	123.00	-0.29	0.77	0.85	1.00	0.53	0.24
D3L4	43.50	121.50	-0.39	0.70	0.73	0.88	0.44	0.15
D4L1	44.00	122.00	-0.33	0.74	0.79	0.79	0.39	0.06
D4L2	40.00	76.00	-0.65	0.52	0.57	0.56	0.30	0.05
D4L3	44.00	122.00	-0.32	0.75	0.79	0.78	0.39	0.03
D4L4	39.50	117.50	-0.68	0.50	0.52	0.49	0.26	0.05

Table 9-3: Mann-Whitney U test comparing non-local males and females for pictures

Descriptive Statistics[a]					
	N	Mean	Std. Deviation	Minimum	Maximum
D1L1	29	1.86	.953	1	4
D1L2	29	1.86	.953	1	4
D1L3	29	1.86	.953	1	4
D1L4	29	1.76	.988	1	4
D2L1	29	2.10	.976	1	4
D2L2	29	2.17	1.002	1	4
D2L3	29	1.93	.842	1	4
D2L4	29	2.10	.860	1	4
D3L1	29	3.21	.819	1	4
D3L2	29	3.31	.660	2	4
D3L3	29	3.38	.728	1	4
D3L4	29	3.48	.634	2	4
D4L1	29	2.00	1.035	1	4
D4L2	29	2.07	.842	1	4
D4L3	29	2.10	.939	1	4
D4L4	29	2.28	.922	1	4
Gender of the subjects	29	.41	.501	0	1
a. Culture = Non local					

	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)	Exact Sig. [2*(1-tailed Sig.)]	Exact Sig. (2-tailed)	Exact Sig. (1-tailed)	Point Probability
D1L1	86.00	239.00	-0.76	0.45	0.50	0.50	0.25	0.02
D1L2	86.00	239.00	-0.76	0.45	0.50	0.50	0.25	0.02
D1L3	86.00	239.00	-0.76	0.45	0.50	0.50	0.25	0.02
D1L4	85.00	238.00	-0.83	0.41	0.47	0.44	0.22	0.02
D2L1	99.50	177.50	-0.12	0.91	0.91	0.91	0.44	0.00
D2L2	96.00	249.00	-0.28	0.78	0.81	0.81	0.40	0.00
D2L3	77.50	230.50	-1.16	0.25	0.28	0.27	0.14	0.04
D2L4	91.00	244.00	-0.52	0.60	0.65	0.60	0.30	0.01
D3L1	81.50	159.50	-0.98	0.33	0.37	0.37	0.19	0.05
D3L2	83.00	161.00	-0.93	0.35	0.42	0.40	0.23	0.09
D3L3	101.00	254.00	-0.05	0.96	0.98	1.00	0.55	0.07
D3L4	92.50	170.50	-0.48	0.63	0.68	0.75	0.39	0.14
D4L1	78.50	156.50	-1.10	0.27	0.30	0.29	0.15	0.02
D4L2	92.50	170.50	-0.46	0.65	0.68	0.73	0.38	0.04
D4L3	57.50	135.50	-2.07	0.04	0.05	0.04	0.03	0.00
D4L4	81.50	159.50	-0.96	0.34	0.37	0.37	0.19	0.02

Table 9-4: Mann-Whitney U test comparing local males and females for pictures

Descriptive Statistics[a]					
	N	Mean	Std. Deviation	Minimum	Maximum
D1L1	20	2.10	1.252	1	4
D1L2	20	2.10	1.252	1	4
D1L3	20	2.15	1.226	1	4
D1L4	20	2.20	1.196	1	4
D2L1	20	2.30	1.081	1	4
D2L2	20	2.35	1.089	1	4
D2L3	20	2.45	.945	1	4
D2L4	20	2.25	1.070	1	4
D3L1	20	3.15	.671	2	4
D3L2	20	3.35	.587	2	4
D3L3	20	3.15	.745	2	4
D3L4	20	3.45	.686	2	4
D4L1	20	2.50	1.235	1	4
D4L2	20	2.50	1.051	1	4
D4L3	20	2.65	1.089	1	4
D4L4	20	2.60	1.273	1	4
Gender of the subjects	20	.40	.503	0	1
a. Culture = Local					

	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)	Exact Sig. [2*(1-tailed Sig.)]	Exact Sig. (2-tailed)	Exact Sig. (1-tailed)	Point Probability
D1L1	43.00	79.00	-0.41	0.68	0.73	0.68	0.32	0.01
D1L2	43.00	79.00	-0.41	0.68	0.73	0.68	0.32	0.01
D1L3	47.50	83.50	-0.04	0.97	0.97	0.91	0.47	0.03
D1L4	44.00	122.00	-0.33	0.75	0.79	0.78	0.43	0.12
D2L1	45.50	123.50	-0.20	0.84	0.85	0.89	0.46	0.08
D2L2	42.00	120.00	-0.48	0.63	0.68	0.66	0.36	0.06
D2L3	40.00	118.00	-0.68	0.50	0.57	0.59	0.31	0.07
D2L4	36.50	114.50	-0.94	0.35	0.38	0.37	0.21	0.06
D3L1	41.50	119.50	-0.56	0.58	0.62	0.68	0.37	0.16
D3L2	42.50	78.50	-0.48	0.63	0.68	0.70	0.41	0.15
D3L3	47.00	83.00	-0.08	0.93	0.97	0.99	0.56	0.14
D3L4	34.50	70.50	-1.17	0.24	0.31	0.33	0.18	0.09
D4L1	39.00	75.00	-0.72	0.47	0.52	0.58	0.29	0.08
D4L2	42.00	78.00	-0.49	0.62	0.68	0.71	0.36	0.09
D4L3	36.00	72.00	-0.96	0.34	0.38	0.36	0.19	0.05
D4L4	37.50	115.50	-0.84	0.40	0.43	0.43	0.22	0.05

Table 9-5: Mann-Whitney U test comparing locals and non-locals for videos

Descriptive Statistics					
	N	Mean	Std. Deviation	Minimum	Maximum
D1L1	49	1.90	.963	1	4
D1L2	49	2.02	.924	1	4
D1L3	49	1.96	.957	1	4
D1L4	49	1.96	.978	1	4
D2L1	49	2.18	.858	1	4
D2L2	49	2.16	.800	1	4
D2L3	49	2.04	.841	1	4
D2L4	49	2.06	.899	1	4
D3L1	49	3.35	.631	2	4
D3L2	49	3.33	.689	2	4
D3L3	49	3.18	.697	1	4
D3L4	49	3.43	.645	2	4
D4L1	49	2.57	.791	1	4
D4L2	49	2.51	1.063	1	4
D4L3	49	2.67	.944	1	4
D4L4	49	2.45	1.022	1	4
Culture	49	.41	.497	0	1

	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
D1L1	231.00	666.00	-1.30	0.19
D1L2	234.00	669.00	-1.25	0.21
D1L3	251.50	686.50	-0.85	0.40
D1L4	249.50	684.50	-0.88	0.38
D2L1	211.50	646.50	-1.72	0.09
D2L2	256.50	691.50	-0.77	0.44
D2L3	250.50	685.50	-0.89	0.37
D2L4	255.50	690.50	-0.76	0.45
D3L1	272.00	482.00	-0.41	0.68
D3L2	275.00	485.00	-0.34	0.74
D3L3	276.50	486.50	-0.32	0.75
D3L4	276.50	711.50	-0.31	0.76
D4L1	250.50	685.50	-0.87	0.39
D4L2	204.50	639.50	-1.81	0.07
D4L3	232.00	667.00	-1.24	0.22
D4L4	262.50	697.50	-0.58	0.56

Table 9-6: Mann-Whitney U test comparing locals and non-locals for pictures

Descriptive Statistics					
	N	Mean	Std. Deviation	Minimum	Maximum
D1L1	49	1.96	1.079	1	4
D1L2	49	1.96	1.079	1	4
D1L3	49	1.98	1.070	1	4
D1L4	49	1.94	1.088	1	4
D2L1	49	2.18	1.014	1	4
D2L2	49	2.24	1.031	1	4
D2L3	49	2.14	.913	1	4
D2L4	49	2.16	.943	1	4
D3L1	49	3.24	.778	1	4
D3L2	49	3.33	.625	2	4
D3L3	49	3.29	.736	1	4
D3L4	49	3.41	.705	2	4
D4L1	49	2.20	1.136	1	4
D4L2	49	2.24	.947	1	4
D4L3	49	2.33	1.029	1	4
D4L4	49	2.41	1.079	1	4
Culture	49	.41	.497	0	1

	Mann-Whitney U	Wilcoxon W	Z	Asymp. Sig. (2-tailed)
D1L1	269.50	704.50	-0.44	0.66
D1L2	269.50	704.50	-0.44	0.66
D1L3	258.50	693.50	-0.68	0.50
D1L4	226.50	661.50	-1.38	0.17
D2L1	262.50	697.50	-0.59	0.56
D2L2	264.00	699.00	-0.55	0.58
D2L3	205.00	640.00	-1.85	0.06
D2L4	276.50	711.50	-0.29	0.77
D3L1	263.00	473.00	-0.60	0.55
D3L2	284.50	719.50	-0.13	0.90
D3L3	258.00	468.00	-0.71	0.47
D3L4	288.00	723.00	-0.05	0.96
D4L1	223.00	658.00	-1.42	0.16
D4L2	214.50	649.50	-1.61	0.11
D4L3	205.00	640.00	-1.80	0.07
D4L4	245.50	680.50	-0.94	0.35

Table 9-7: Wilcoxon test comparing different densities for videos

Test Statistics[c]			
	Densit2M - Density1M	Densit3M - Densit2M	Density4M - Densit3M
Z	-2.644[a]	-5.209[a]	-4.502[b]
Asymp. Sig. (2-tailed)	.008	.000	.000
a. Based on negative ranks.			
b. Based on positive ranks.			
c. Wilcoxon Signed Ranks Test			

Table 9-8: Wilcoxon test comparing different densities for Pictures

Test Statistics[c]			
	Density2P - Density1P	Density3P - Density2P	Density4P - Density3P
Z	-3.399[a]	-4.898[a]	-4.838[b]
Asymp. Sig. (2-tailed)	.001	.000	.000
a. Based on negative ranks.			
b. Based on positive ranks.			
c. Wilcoxon Signed Ranks Test			