Coping Strategies for Crowded Environments: Case of Public Transport Systems in Delhi

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ABSTRACT

Based on Edward Hall's theory of proxemics, this study delves into the interdisciplinary sciences that link architecture with human psychology and urban design to look at how human behaviour, spatial configurations and prevalent urban condition of crowding affect each other. Recognizing the western base of the literature in hand, the present study appropriates Hall's theory to suit the present day context of Delhi. Taking transit systems of Delhi as a case in point to investigate how people respond to crowding and how crowds hold the potential to be a bane or a boon for the city, the study brings forward certain aspects of design often overlooked while designing urban public spaces. It challenges certain notions about the design of public spaces and throws a new light.

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The authors of this paper are young architects based in the city of Delhi. They completed their degree of Bachelors in Architecture from the School of Planning and Architecture, New Delhi. A sensitisation towards the issues of the urban environment over the course of their education, coupled with their collective experiences as residents of this bustling city, prompted them to initiate research in this field. It is their mutual aspiration to contribute towards the creation of better user-centric urban environments in the country through continued research and design activities.

Figure 1: Crowding as an urban reality (Source: Authors)

Introduction

"All architecture is shelter but all great architecture is the design of space that contains, cuddles, exalts, or stimulates the persons in space", thus said Philip Johnson. As recognised by him and many architects and theoreticians, architecture must serve the purpose of benefiting the physical and mental being of the humans who occupy it.

With a user-centric approach in mind, this paper explores the built environment through the lens of behavioural science. An understanding of user behaviour can give an indication of the essential needs of the users which are commonly overlooked during design, thus revealing useful learnings for designers. The designers need to be more informed and sensitive – not only to buildings and infrastructure but also to the people who use them. A variety of behaviour can be observed in urban situations a person encounters daily. The present study focuses on the relationship between behaviour & spatial configuration under the condition of urban crowding, specifically in public transport systems in Delhi as they are an integral part of the everyday lives of the majority of citizens.

A validation of theoretical knowledge is sought by way of a case study of Delhi Metro and the DTC buses in Delhi conducted in 2015 by the authors. These transport systems are a melting pot of the diversity that exists in the city, where people from all walks of life co-exist in close proximity because of the highly dense situations.

This exploratory research is structured in an incremental manner to discuss via literature, concepts of behavioural science and its application to built environment. The first section deals with proxemics, the relation between space and human behaviour. The second section discusses the perception of crowding and its impact on user groups, leading to the subsequent sections on physical and behavioural responses of users to cope with crowding. The paper also draws observations from situations of "happy crowds" and concludes with a discussion on the intent of design with respect to crowded situations.

Space & Human Behaviour

Architecture, above all arts, is a culmination of artistic expression, technology, and very importantly, the fulfilment of human needs (Moore, 1979). For this reason, the study of user behaviour becomes an indispensable part of the spatial design process. The direct link between architecture and the brain has been a subject of study for decades. A seminal paper by Epstein et al. (1999) traced the perception of built environment to a place in the brain called
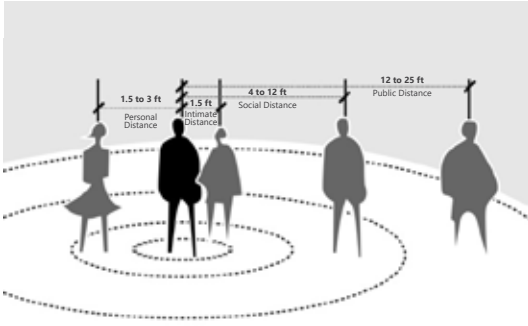
Figure 2: Proxemics based on Edward Hall (1969), drawn by Authors

the para-hippocampal place area, which is the area that responds significantly more when viewing complex scenes such as furniture, landscapes, and city streets, rather than just faces or objects. Another component of the brain - mirror neurons, has been described by Mallgrave (2013) as causal in the behavioural reactions of humans. Mirror neurons allow a

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person to feel empathy towards animate as well as inanimate objects – in our case, built space; by mirroring their physical nature. Neuroscience thus supports the mental objectives of design according to Pallasma (2013), which have so far been considered purely subjective. Behavioural neuroscience, the study of brain mechanisms underlying behaviour, explains human behaviour as a response to the surrounding environment.

Proxemics

Man has an immediate sense of personal space whenever he shares space with another being, which is based on the idea of territoriality inherent to every animal and is perceived through various sensory mechanisms in the body. Edward Hall (1969) coined the term 'proxemics' to study the way humans unconsciously use space and inter-personal space as an elaboration of culture. This takes into account non-verbal behaviour and interaction between occupants of the same space. Hall has described human sense of territoriality in terms of radial distances and can be categorized as intimate distance, personal distance, social distance and public distance.

Intimate Distance - The distance into which close family and friends are comfortably allowed is up to 1.5 feet from the individual. People other than these within your intimate space would lead to a feeling of hostility and aggression.

Personal Distance - The normal spacing between non-contact species ranges from 1.5 feet to 3 feet. The distance here is enough that visual distortion of features is no longer apparent while facial features are discernible.

Social Distance - The distance maintained between two people during an impersonal interaction, varying from 4 to 12 feet depending on the degree of involvement.

Public Distance - Well outside the circle of personal involvement at a distance of 12 to 25 feet, it is characterised by an exaggerated or amplified voice. Gestures and body stance play a major role here.

Proxemics Across Cultures

The thumb rules of these distances vary based on cultural factors according to Hall. He describes sensory variables such as body posture, gender identity, physical contact, visual code, voice loudness, body heat and olfaction as extension of proxemics. M.S. Thirumalai (1987) suggests that the differentiation of these distances - from the

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public space into the social, personal and intimate, is perceived based on important sensory shifts that occur in the transition from one space to another. Proxemics is inherently a part of culture and gets shaped by social norms and expectations. It brings forward the need to further expand this theory to incorporate cultural variations for the determination of personal space.

One of the most significant things overlooked by Hall is the existence of two kinds of distances – physical distance and perceived distance. While the first depends on physical position associated to each person, the latter depends on proxemic behaviour based on culture and social rules (Manenti et al., 2011). Around the world, this perceived distance causes the existence of 'contact' and 'non-contact' cultures, depending on the general inter-personal distance maintained and frequency of physical contact during interaction (Martin and Nakamaya, 2010). While South America, Middle East and

Southern Europe are examples of contact cultures, Great Britain, the Far East and the United States are non-contact cultures.

By this definition, India is a non-contact culture with further variations in sub-culture proxemics. Various forms of greetings, like folding hands into a Namaste, handshakes and hugs are acceptable to different degrees in differing cultural circumstances. Caste and gender roles as cultural variables have a strong influence on proxemics (Thirumalai, 1987), especially within the rural context of India which are in stark contrast with its urban situation. Anonymity, which allows for such culturally ingrained social norms to be shed, is considered a defining attribute of urban living (Garber, 2000) and provides liberation to whoever wishes to exercise it. This phenomenon has a direct impact on the study of proxemics because of the cultural shift while moving from a rural to urban area. Differences because of gender cannot simply cease to exist but those based on profession, economic background and caste get dissolved to a degree.

However, there is a breaking point at which all cultural or societal rules about contact break down. Scenes from mass rapid transit systems across the world look almost identical, regardless of their cultural attitudes. For example, Japan is considered as a typically non-contact culture, but has 'pushers' that help pack commuters in their mass transit system during peak hours. In such situations, urgency associated with the journey gets a priority.

Crowding

In his essay, 'What is a City?'(1991), Spiro Kostof states the primary condition for a

place to qualify as a city. He says, "Cities are places where a certain energized crowding of

> **Occupants in every environment have goals they wish to accomplish. These goals may be unique for every individual, and even clash with those of other occupants of the space. Potential conflicts will be higher with more number of people occupying a space.**

people takes place." Not the total population or size of the city, Kostof gives priority to density. However, this density, which has been romanticised about in literature, is an everyday reality of urban living. A high density mix of heterogeneous populations is directly conducive to the situation of crowding, a situation prominent in Delhi.

Crowding as a Group Phenomenon

Crowding is necessarily a group phenomenon, with spatial restriction being a very significant component and other occupants being the key causes of problems. Epstein (1981), while discussing crowding, highlights the role of group orientation and the concept of perceived control as a person-level concept. He also speculates that since crowding is a social phenomenon, its consequences would also be social. For example, people who are a cause of another's frustration would also become objects of his/her response to the frustration, unlike other environmental stressors such as heat, noise, and air pollution.

The Perception of Crowding

Freedman (1975) measures crowding in physical terms. He defines crowding as "….the amount of space per person". However, the study of individual behaviours requires a more comprehensive approach to crowding and density.

Density must account for how space itself is to be measured, since a person's perception of density characteristics depends on factors like environmental conditions, previous experience and social organization. Density should relate not only to the number of people in a given space but also an individual's awareness of those people. Hence, the perception of crowding is as much psychological as it is spatial.

Being a psycho-spatial phenomena, there are two components to perceived density: physical and social. Therefore the extent of crowding should be determined by the examination of this perceived density against certain standards, such as desired levels of social interaction (Freedman, 1975). For crowding to be experienced, a shared environment must exist. A person cannot feel "crowded" being the only individual in the space, no matter how small the space may be. They would feel "cramped" instead (Epstein, 1981).

Occupants in every environment have goals they wish to accomplish. These goals may be unique for every individual, and even clash with those of other occupants of the space. Potential conflicts will be higher with more number of people occupying a space. This would present problems in coordination of the goals and even make it impossible for some to attain theirs. Reasons for these conflicts could be scarcity of resources, activities of one person becoming an interference for another, thus making unwanted interpersonal interaction unavoidable (Epstein, 1981). Eroglu and Harrell (1986) have described crowding as an environment which is dense to the extent of being dysfunctional. This suggests that a space may be dense in terms of number of people per unit space but still may not feel crowded till people are able to perform efficiently in that space.

Crowding could be understood as an individual's perception of space which varies depending on expectations, one's tolerance level, time, pressure and activity being performed. Jain (cited in Ambe, 2014) notes that these factors influence stress components associated with a feeling of reduced physical or psychological space, discomfort, negative perception of space, boredom, etc. Inside an overcrowded train coach, commuters end up encroaching each other's intimate space (Ambe, 2014). They may be in close physical proximity, but being strangers, they are still psychologically or emotionally far away from each other. Travelling in this high density space becomes stressful due to this divergent physical and psychological proximity.

Environmental factors and the duration of travel often determine the behavioural response of people to their crowded surroundings. This was observed in an experiment by Lundberg (1976) where he studied adrenaline levels amongst commuters on a 72-minute train journey and found commuters that joined the train later to have higher levels of adrenaline. The study suggests that those who joined the train at the start had a greater choice of place to sit that increased their sense of control. Those who joined the train later had relatively higher stress levels as they were forced to stand or sit wherever they found space.

Impact of Crowding on Social Groups

Freedman (1975) suggests that crowding could intensify whatever social orientation exists amongst groups. This social orientation could depend on, among other factors, the compatibility of the group members. In a group of incompatible occupants, social interaction would further reduce in the situation of

crowding. The converse is true for people with compatible personalities, where social interaction would indeed increase in high-density situations (Epstein, 1981).

Some of the negative effects of crowding are diffusion of responsibility leading to a decline in altruistic behaviour (Latane and Darley, 1968), poor psychological development, stress due to social overload (Baum and Valin, 1977) and detrimental effects on the physical health of an individual such as increased blood pressure & increased secretion of stress hormones. This collapse in social behavioural has been termed as the Behavioural Sink by ethnologist John B. Calhoun (1966). It can thus be inferred that overcrowding, while not pathologically harmful per se, was found to lead to disorder in the normal functioning of society.

Occupants living in crowded situations could also demonstrate positive qualities. Hall (1969) has noted that stress caused by social overload has been instrumental in evolution of species as it employs forces of intra-species competition rather than inter-species competition.

Spatial Appropriation in Crowded Spaces

The proxemics theory is based on man's sense of territoriality, a psycho-spatial phenomenon. The patterns of grouping and space usage bring groups of similar activity closer and isolate them from others (Thirumalai, 1987). When sharing space with other people, the categories of interpersonal distances as described by Hall (1969) come into play and the space gets subdivided into a number of typologies of usable zones, according to the appropriation of that space undertaken by various user groups or individuals occupying it. This is further

elaborated in the concepts of spatial enclaves and sub-zones.

These typologies of **spatial enclaves** have been defined by Toni Sachs Pfeiffer (1980) based on spatial grouping, communicative subsystems and the nature of use which dominates these groupings.

1. **Protective Corners** - Sought out the most by individuals, they offer maximum spatial protection, tending to cover not only the back but to a certain extent the sides as well.
2. **Spheres of influence** around protective corners – 5 to 10 feet from the corner, when the protective corner has been claimed by other people. In this case these zones provide the same kind of protection that the corner provided.
3. **Retreat / Withdrawal zones, Coves** - These are normally niches or recesses that have a direct relationship to traffic lanes or spheres of activity with which the user is trying to maintain visual contact.
4. **Supportive Points** - Elements such as pillars, posts, signs etc. which offer protection similar to that of the protective corner when the latter is not available.
5. **Waiting Pools** - Not necessarily defined by an architectural framework, these spaces are characterised by light/shadow, lack of wind etc. For example, the shadow cast by a tree might serve a comfortable waiting pool.

Spatial enclaves are identifiable zones formed in a large shared space, where the spatial configuration results in its appropriation in a particular manner by individuals or groups of people. The general characteristics of spatial enclaves are overall visual control, protection

from behind, separation from traffic flow, easy access to the traffic flow and are often connected with the possibility of sitting, leaning etc. When spatial enclaves are not inherent in the architectural space, they are often 'improvised' as shown in the case study of coaches in Delhi's public transport system.

Public Transport System of Delhi: A Case Study

Spatial Enclaves

The formation of spatial enclaves was studied in the case of the Delhi Metro coaches (**Figure 3** and **Table 1)** and DTC buses (**Figure 4** and **Table 2**). The five kinds of spatial enclaves were clearly identified in each space and observations were made for the parameters regarding the physical nature of the space as well as its use by occupants. The following inferences were drawn from the observations:

- Instinctive occupation of space by users gives clues for design.
- There is a difference in order of occupancy of the spatial enclaves between the bus and metro because of factors such as cleanliness, ventilation, perceived safety, etc.
- Body posture indicated the level of comfort in that particular space – however a defensive posture was not dependent only on spatial configuration but also social influences.

Sub-Zones

Sub-zones are perceivable, contained spaces that need not necessarily be physically defined but are perceived and dealt with as separate entities. Each sub-zone seems to have its own personal communication subsystem for the regulation of behaviour.
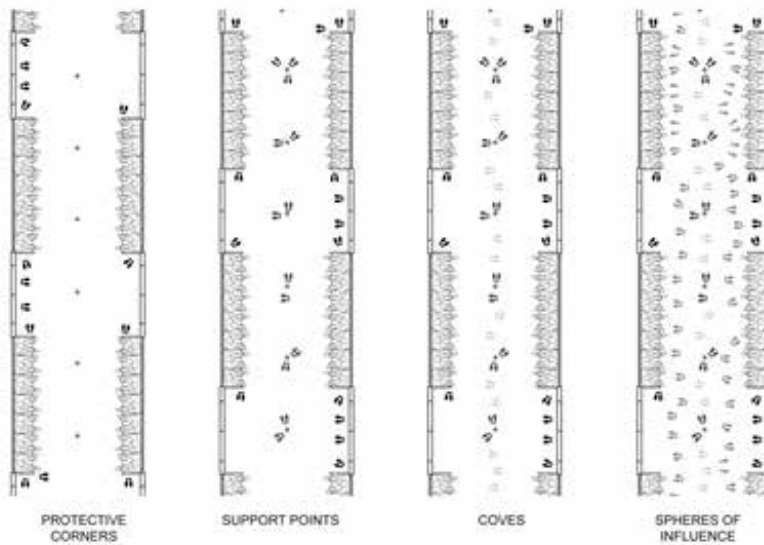
Figure 3: *Spatial Enclaves in Delhi Metro coach (Source: Authors)*

	Protective Corners	Spheres of influence	Withdrawal Zones- Coves	Support Points	Waiting Pools
Location	Niche next to the door At junction of coaches	Around the protective corner	Central Aisle between the seats	Near glass partitions Around support poles	Around door opening mark on platform seats on platform
Physical Feature	Supportive Elements	Loosely defined space for movement	Spatial elements are either focal or supportive	Supportive Elements	Protection from sun, or other natural elements
Sequence of Occupancy	First	Fourth	Third	Second	Varying Occupancy
Usage Character	Socio-fugal	Socio-fugal	Socio-petal	Socio-petal	Socio-fugal
Commonly Observed Activities	• Listening to music • Reading a book • Looking out of the window • Talking				
Body Postures	Defensive or curled up posture	Defensive and goal-oriented postures	Defensive postures	Supported using spatial elements, either by leaning or holding on.	Varies

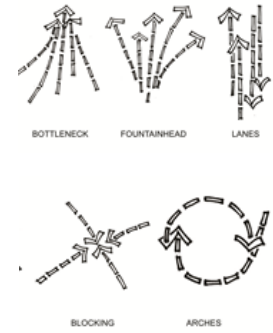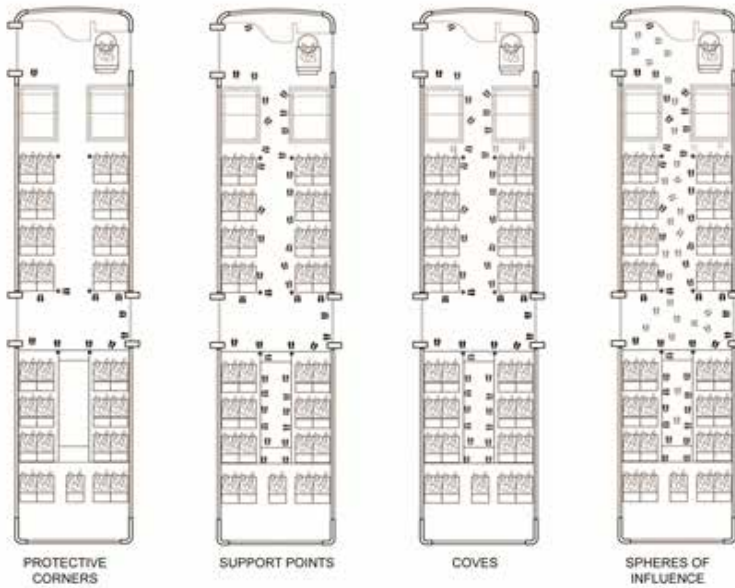*Table 1:* *Observations of spatial enclaves in a Metro coach (Source: Authors)*

Figure 5: Permanent subzone types (Drawn by Authors)

Figure 4: Spatial Enclaves in DTC Bus (Source: Authors)

	Protective Corners	Spheres of influence	Withdrawal Zones- Coves	Support Points	Waiting Pools
Location	Corners (near the recess of the closed door)	• Central aisle • Around protective corners	• Space near front wheels • Facing occupied seats	Around poles	• At front door • Shaded areas on either side of the bus
Physical Feature	Supportive Elements	Loosely defined space for movement	Spatial elements are either focal or supportive	Supportive Elements	Protection from sun, or other natural elements
Sequence of Occupancy	First	Fourth	Third	Second	Varying Occupancy
Usage Character	Socio-fugal	Socio-fugal	Socio-petal	Socio-petal	Socio-fugal
Commonly Observed Activities	• Listening to music • Reading a book • Looking out of the window • Talking				
Body Postures	Defensive or curled up posture	Defensive postures	Defensive postures	Supported using spatial elements, either by leaning or holding on.	Varies

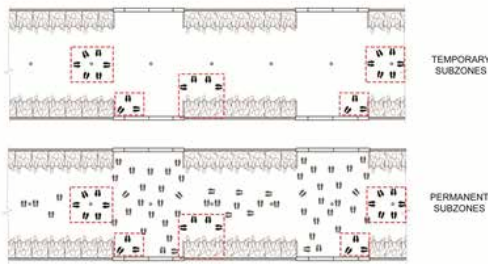*Table 2: Observations of spatial enclaves in a DTC bus (Source: Authors)*

Figure 6: Subzones in Delhi Metro coach (Source: Authors)

Figure 7: Subzones in DTC bus (Source: Authors)

	Permanent Subzones	Temporary Subzones
Location	- Bottlenecks upon entry into coach - Fountainhead while exiting the coach - Lanes in the central aisle - Blocking at the gates at time of entry & exit	- Near glass partitions - Around support poles - At junction of coaches - Facing occupied seats
Physical Feature	Loosely defined space for movement	Spatial elements are either focal or supportive
Nature of Occupancy	Transient occupancy	Varying occupancy
Usage Character	Used for movement	Random grouping of people – Socio-petal
Commonly Observed Activities	Movement	Voluntary social interaction amongst groups
Body Postures	Defensive and goal-oriented postures	Supported using spatial elements, either by leaning or holding on.

Table 3: Observations of subzones in a Metro coach (Source: Authors)

1. **Permanent sub-zones** - Traffic lanes, buffer zones and transitional areas fall under the category of permanent sub-zone. Solmaz, Moore & Shah (2012) have described five identifiable movement patterns in crowds, namely bottlenecks, fountainheads, lanes, blocking and arches **(Figure 5)**. These facilitated the study of sub-zone formation in the primary case study.

2. **Temporary sub-zones -** these are formed between architectural elements due to the nature of the space that allows random grouping behaviour to occur. For example, crowding of people around street performers.

The formation of subzones was studied in the case of the Delhi Metro coaches (**Figure 6** and **Table 3**) and DTC buses (**Figure 7** and **Table 4**). Observations were made relating

to the parameters which define the space physically as well as its usage by occupants of the space. Activity-based observations were conducive to defining the micro-zones within the Metro coach and bus and locations were diagrammed.

The following inferences were drawn from the observations of sub-zones:

• Due to varying density across the length of the coach or bus, permanent subzones of different kinds formed at entrances or along aisles. The space required for standing or sitting varies across the coach because of these subzones.

• Space can be better articulated (like the existing floor stickers on metro platforms) to guide movement without any physical barriers to avoid blocking conditions.

Perceived Usage Zones

Perceived usage zones are entirely created through the general architectural framework of each particular space. The spatial perception of these encourages as well as hinders all forms of activity in that space. These zones are different for every space we use. The presence of perceived usage zones accounts for the fact that patterns of transitional activities such as 'through traffic', 'waiting', 'watching' etc. when diagrammed according to actual usage, have an activity-oriented territorial aspect which is fundamental to the usage of each space in itself.

The character of perceived usage zones was studied in the case of the Delhi Metro platforms (**Figure 8 and Table 5**) and DTC bus stops **(Table 6)**. For easy comprehensibility, the platform was divided into fringes (where the train arrives), core (where elements of vertical circulation such

as staircases, elevators and escalators exist) and shadow areas (under the staircase where seating is created for passengers waiting). The space of bus stop was similarly defined. The following inferences were drawn from the observations:

• Perceived usage zones are temporal in nature. Based on the arrival of the metro/bus and the waiting time these perceived usage zones get formed. The duration varies between the two modes of transport because, unlike the Metro, people end up waiting for longer periods for buses.

• The activity-oriented territorial aspect gets defined in the form of invisible corridors of movements, often influenced by external focal points like the entries or vehicle location.

• Less number of seats were provided as the duration of occupancy for each user is extremely small. The nature of this seating is not socially-interactive, as users are expected to vacate after quick intervals.

• Goal oriented behavior can be observed in the users as most are waiting anxiously for the metro/bus to arrive. People waiting at bus stops are more relaxed as the distractions provided by external stimuli are more abundant, such as vendors, traffic noise and other on-going activities.

Behavioural Response to Crowding

In the case of transit systems in Delhi, one finds that there are periods prone to extremely high density of crowds where, from 'sharing space', one is faced with the situation of his/her 'territory' getting violated. The behavioural responses to these situations are quite different from simply sharing space where evasion of contact is not that difficult and/or social
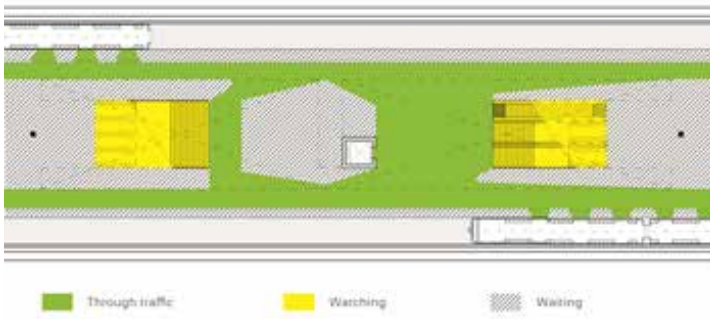
Figure 8: Perceived usage zones on Metro platform (Source: Authors)

	Traffic Thoroughfare		Watching/Waiting Area
	Metro at platform	**Yet to arrive**	
Location	Near doors of the metro; extended to exit routes such as staircases, escalators, elevators or the other platform.	Depending on waiting time, staircase, escalator, elevator to platform or waiting zones	Shadow areas; Staircase edges, sides of escalators used for seating,
Physical Feature	Space free of hindrances for easy movement of traffic		Places where people can sit, or stand
Sequence of Occupancy	-NA-	-NA-	Seating areas, then walls to lean on
Usage Character	Socio-fugal ; Bottlenecks created near doors, quick exchange of traffic facilitated	Socio-fugal	Free for appropriation
Commonly Observed Activities	Brisk walking towards metro or towards exit points (core)	Walking towards platform or waiting areas	Sitting, standing with their backs on the walls or columns, indulging in external media while waiting.
Body Postures	Defensive and urgent, with shoulders, arms, bags used to shield and make way through extreme crowding	Relaxed behaviour, with more time to mentally prepare for the crowding one has to face when metro arrives.	

Table 5: Observations of perceived usage zones on Delhi Metro Platform (Source: Authors)

	Traffic Thoroughfare	Watching/Waiting Area
Location	Platform fringe	Entire platform
Physical Feature	Loosely defined space for movement	Benches
Sequence of Occupancy		Benches , followed by poles (back, side support), then surrounding spaces.
Usage Character	Socio-fugal	Free for appropriation
Commonly Observed Activities	Walking through or exchange of traffic between bus and platform	Waiting for bus
Body Postures	Defensive and urgent, with shoulders, arms, bags used to shield and make way through extreme crowding.	Relaxed - sitting, standing or leaning on columns, indulging in external media, talking to people, watching traffic go by etc.

Table 6: Observations of perceived usage zones on DTC bus stop (Source: Authors)

interaction might be a welcome change. In any transit system, people are either moving to reach their platform, or are stationary while waiting or in transit. The communication between people, if any, is mostly non-verbal.

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Sommer (1969) describes the concept of personal space from the perspective of protective behaviour, suggesting it is the personal "bubble" that surrounds a person, into which others may not intrude. When individuals are not constrained, they may 'flee' or maintain larger interpersonal distances (IPDs) to mitigate this discomfort (Felipe & Sommer, 1966). During rush hours in crowded public spaces, the notion of personal space and territory often gets relinquished. While during interpersonal

communication, one has the freedom and control to break off the exchange, in a crowded public space, one is forced into a continued exchange where one have no control over interpersonal distance. The concept of overload from systems theory by Milgram (1973) and Harrell, Hutt & Anderson (1980) suggests that when the amount and rate of environmental input exceed the capacity to cope, an individual must enact behavioural adaptation strategies in order to function effectively in the environment.

Defensive Strategies
Gaining a sense of greater control over their surroundings, people perform better under such situations. These behavioural adaptation techniques include defensive strategies and interactive strategies to overcome interpersonal discomfort.

Defensive strategies against inter-personal discomfort have been observed to be of two types - physical defence and mental defence. Physical defence is to remove oneself from the crowd and form spatial enclaves as a response to crowding. As indicated in the various spatial

Figure 9: Shrinking of personal space as a part of accepted levels of 'adjustments'. (Source: Authors)
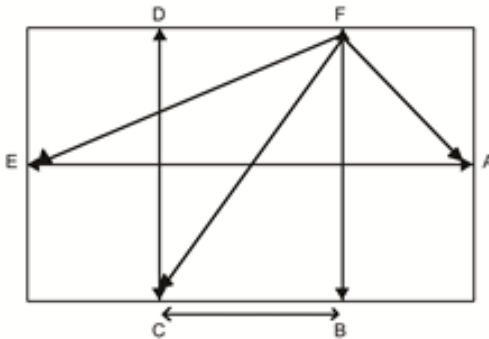

Figure 10: Osmond Study (Source: Osmond, 1959)

typologies by Pfeiffer (1980), in such cases people tend to group, stand or sit in certain places that make them feel a certain degree of control over their surroundings and reduce their perception of crowding.

When physical distancing is not possible, as is most of the time in public transport, individuals create a mental buffer as a means of defence against inter-personal discomfort. Non-verbal cues such as body positioning or gaze have been identified as tactics adopted by individuals in a crowded environment to attain a certain level of personal space mentally, if not physically. The digital world offers relief in such situations, as suggested by Haddon and Green (2009) and observations by the authors of the present study. Common activities are playing games on the phone,

texting people (or pretending to do so!) and listening to music using earphones, besides reading books or newspapers.

Interactive Strategies

There are many cases of interactive strategies being used by commuters to decrease the discomfort of a perennial crowded situation such as adapting the notions of interpersonal

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distance (Haddon & Green, 2009). The idea of "adjusting" is very commonly observed here. A common sight in the DTC bus is one or two women standing in the "excess" legroom in the first row designated as the women's seats (**Figure 9**). This is not observed on the other side of the aisle where such excess space is missing. Even in the Metro, seats are shared as a part of common 'adjustments'.

The seating layout in a coach or a compartment also impacts interactions. Osmond (1959) study examines interaction levels between subjects located at varying proximities and orientations with relation to one another (**Figure 10**). It shows that socio-fugal spaces which are grid like tend to keep people apart and suppress communication while socio-petal spaces which are radial does just the opposite. It showed that perpendicular edges are most interactive – whether it is interaction with a fellow commuter or with the outside environment that

we seek. Seating that presents a good balance of both kinds of spaces is in the opinion of the authors, is a preferable layout design.

The Mumbai Local presents classic examples of interactive adaptation techniques where passengers have developed interesting ways of coping with the stress due to crowding. They

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socialise and interact with fellow passengers. After having befriended one another, the sense of crowd reduces as personal space becomes a part of social space. In the Mumbai Local as noted in Ambe's study (2014), people interacted by forming local train friend circle, *bhajanmandali*, shared food and celebrations. A crowded public space often becomes a social space, helping in neutralising stress.

Learning from "Happy Crowds"

Crowds are not always a 'problem' in cities. Numerous situations exist where discomfort is absent, despite the same levels of personal space violation and density as public transport, if not more. From religious pilgrimages to large gatherings at concerts and melas, no observed discomfort is present even in the most congested situations with almost the same diversity of population as is observed in public transport. The apparent reason for this seems to be the general ambience of the place created by the larger purpose of the journey or the space. These responses to crowding must not be

dismissed prematurely as instances that have no significance in day-to-day city living. An analysis of them can provide crucial learnings applicable to urban public spaces in general. The key quality common to such situations, apart from a festive atmosphere, is that of a common spectacle and the interpersonal community relations that get forged amongst the strangers who experience it together. An overall emotion of the space or process makes people behave in ways different from usual. It is this feeling that our public transit systems, and urban public spaces, seem to lack. In the absence of any feeling, emotion or overall experience, people have nothing to focus on other than the large heterogeneous mass of strangers that they are a part of and the resulting discomfort being caused to them.

Architect Archana Khanna, elucidates this point in an interview conducted by the authors. She talks about how a large chunk of the population is engaged in mundane, unexciting jobs throughout the day and how a stimulus as small as the laughter of a toddler catches their attention. This provides them with a distraction and for some time everyone forgets about their discomfort while smiling and acknowledging the child.

It is interesting to note that dynamic settings in the urban environment cater to those who seek simulation to break the monotony of daily life as well as those who find solace in watching the action from afar. The amphitheatre in the New York Highline, meant as a window to the urban environment, and the example of the train-watching platforms in Tokyo's transport hub Shinjuku District demonstrate how a dynamic surrounding can form the backdrop for social

interaction as well as a moment of solitude. Buchholz (1997) clarifies that solitude does not

> **An overall emotion of the space or process makes people behave in ways different from usual. It is this feeling that our public transit systems, and urban public spaces, seem to lack.**

require one to be in a quiet meditative state but can actually be found in the company of other people, in a crowd, in sleep or in chosen isolation. It is not uncommon to notice individuals on the Metro reading a book or listening to music not as a mere tool to avoid social interaction, but perhaps to find this moment of solitude of themselves within the realm of their everyday lives. It is in this sea of people that people can simply tune out. They can fade into the background and gain the anonymity they need to find solitude (Ganz, 2005).

This is indicative of the fact that the much needed stimulus in the environment need not come from grand festivities, but from many possible diverse instances of dynamism. Music playing in the background, a visually active scene outside the window, passing traffic and elements of interest in the built environment are all examples of dynamism which draw one's focus away from the crowding.

Conclusion:

It is crucial to accept that the prevalent urban condition of crowding is a ceaseless one with both benefits as well as disadvantages to society. While on one hand it causes a negative behavioural sink amongst the members of the crowd, the density also has a potential for an energised form of crowding that is essential for cities to thrive. Along with crowding, issues of resource scarcity and interpersonal discomfort amongst citizens is also here to stay. Thus, design of public spaces in the city needs to acknowledge these factors and occur and take a user centric approach. The role of design in public space should be to reduce discomfort caused by crowding so that the users cope with it, and even appreciate it, the way many great public places are considered successful for the very reason of being "crowded", and thus lively, at all times.

The crucial learnings that emerge from the literature and observations from the study of Delhi's public transport system reinforce the role of design in influencing user experience. In conditions where physical space is a limited resource, critical design moves can help users gain a perception of control over their surroundings and feel more at ease within the same limited about of space. The learnings are summarised here:

1. Negation of the rules of proxemics: The rules for proxemics vary across cultures, but get completely negated in case of the high densities that were studied. Behavioural adaptations and coping mechanisms come into play when the urgency of travel takes priority over comfort.

2. Urban solitude & social interaction: The ability to generate social interaction amongst strangers has been considered a measure of the success of a public space (Hall, 1969). However, an important observation of this study is that seeking and achieving of solitude is as important for urban citizens as healthy social interaction. Designers must aim to create

a balance of socio-petal and socio-fugal zones in the same environment to cater to the needs of all users.

3. Spatial layouts in public spaces: In continuation to the previous observation, appropriate spatial layouts need to be created for different kinds of spaces. Varying configurations for seating can be developed using the Osmond study as a starting point, whereas the space for standing and thoroughfare need to be defined using physical elements at a much smaller scale.

4. Design of environmental conditions: Though influenced by several other factors such as cost and technical feasibility, the quality of the environmental conditions are within the control of the designer to a certain extent. Conditions of natural and artificial lighting, amount of ventilation, ambient temperature and auditory conditions can induce specific behavioural patterns amongst people which vary from calm patience to extreme aggression in the same set of users.

5. Design cues from user instinct: Appropriation of space by users, such as the creation of spatial enclaves, can guide designers towards incorporation of the specific enabling physical qualities of that space into their design. The study reveals how certain surfaces and focal elements in an otherwise undefined space start shaping the way it is used by people. Consideration of usage patterns that develop organically can contribute to a better-articulated spatial design.

6. Dynamism and engagement: The instinctive human reaction to be drawn to dynamic surroundings should be incorporated into the design of public spaces. This intangible quality of an engaging environment can reduce the stress that arises of crowding by directing the attention of users away from the awareness of the density that surrounds them. A common, engaging focal point for a large number of users can reduce the number of potentially conflicting goals.

A notable paucity of literature in the Indian context presents an imminent need for future research in the field of behavioural sciences, including anthropology, psychology and sociology. This would be of great value not just to designers of spaces but others involved with the study of human behaviour. A thorough multidisciplinary approach to design would lead to production of more meaningful and humane spaces. These would then cater to the prime purpose of architecture, as expressed by Philip Johnson, to design space that contains, cuddles, exalts, or stimulates the persons in space. ∎

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