Patterns of Perception: Forecasting the perception of crime

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Abstract

This paper provides a visual interpretation of the perception of crime. A literature review did not reveal a comprehensive visual analysis of this spatial phenomenon. This paper borrows concepts from different fields of study to build a theoretical framework for the perception of crime. This theoretical model suggests this phenomenon is spatially predictable. Perceptual maps from four community surveys in the City of Vancouver, British Columbia are used to develop and explore a forecasting methodology. The results show that certain crime types influence the perception of crime. These results are discussed in relation to current research on disorder, incivilities and the macro movement of humans in the urban domain.

Theoretical review: Building a pattern of perception

Although significant research on the perception of crime has been conducted on the macro, meso and micro levels, an environmental theory which explains this spatial behaviour appears to be lacking in the field of criminology. This perspective concerns itself with the everyday effect that the urban environment has on the people who populate it, and therefore pays specific attention to the physical structure of the urban environment.

Perception of crime can be predicted using the principles which are applied to criminal activity. The following environmental theories are reviewed and then applied to the perception of crime:

- Routine Activity Theory
- Rational Choice Theory
- Geometry of Crime
- Pattern Theory

1- Routine Activity Theory – Cohen and Felson (1979)

The first environmental theory applied to the perception of crime is the Routine Activity Theory developed by Cohen and Felson (1979). This theory proposes that individuals commit crime during their daily routines when they are presented with a suitable target and non-capable guardian (Cohen and Felson, 1979). Both motivated and unmotivated individuals may commit crimes depending on the situation.

The main focus of this theory can be flipped to the victim’s perspective: individuals conduct their daily routines and during these activities, they are presented with situations where there is a motivated offender and a lack of capable guardianship. The interaction of the three elements that form the Routine Activity Theory (victim – offender
location) can trigger a crime occurrence, but also create a fearful situation or one where perception of crime is high.

From this perspective, perception of crime at the aggregate level will occur where there is an intersection between generalized urban movement, reduced guardianship and increased public display of criminality. This is both location and time specific as the Routine Activity Theory includes the time dimension as the intersection of the three elements must occur in both a geographical place, and in a temporal space (Felson and Cohen, 1979).

2- Rational Choice Theory – Cornish and Clarke (1986)

Cornish and Clarke (1986) developed the Rational Choice Theory which assumes that individuals are rational and a decision-making process occurs prior to the commission of an offence. When individuals find themselves in a position to commit a crime, they will weigh the situation, considering both the potential risks associated with the act and the benefits resulting from the act (Cornish and Clarke, 1986).

This theory can be reversed and applied to people operating in the urban domain and who are making choices about activities and the potential victimization related to these choices. When presented with situations, the person in the victim position relies upon rational choice. For example, when someone is walking home and has the choice of going down a lit street where there appear to be many capable guardians versus a shorter route down a dark alley populated by suspicious individuals, the decision to go the presumably safer route is a rational choice.

There is a choice impasse when people are locked into a route and cannot make a rational decision to practice avoidant behaviour. These would be situations where the person engaged in the activity, is aware of the potential ramifications of his or her actions, but has few choices in relation the chosen activity. The individual in fact, is locked into a choice where crime avoidance is not possible and where victimization is probable.

3- Geometry of Crime Theory – Brantingham and Brantingham (1981)

In Notes on the geometry of crime, Brantingham and Brantingham (1981) described the various search patterns of criminals. This theory is based on human geography where decision-making about criminal offending is related to the urban spatial dimension (Andresen, 2010). Within this theoretical model, the offender’s motivation is not of primary concern, but rather this theory focuses on the manner in which perceived opportunities are formulated (Brantingham and Brantingham, 1981; and Andresen, 2010).

The environment produces cues which offenders pick up on and translate into perceived opportunities (Brantingham and Brantingham, 1981, 1978). Furthermore, the patterns of offender movement do not differ from the movement of the non-criminal population. At
the aggregate level, crime will be concentrated in locations where there is a convergence of environmental factors that relate to the general movement of offenders with the availability of suitable targets (Brantingham and Brantingham, 1993b).

This theory can be applied to the perception of crime. Individuals in society have activities which bring them from one location to another. Individuals travel to work, entertainment areas, shopping districts, and bring their children to school. As they go through these daily routines they develop an activity space which is related to an awareness space. However, rather than concentrating on perceived opportunities for the commission of a crime, they will develop an awareness around perceived opportunities for victimization. At the aggregate level, cues that generate the perception of crime may emanate more strongly in specific areas and be linked to very specific displays of criminality and disorder. The human behaviour patterns in these areas may in fact be very specific and predictable.

4- Pattern Theory – Brantingham and Brantingham (1993a)

In the Notes on the geometry of crime, Brantingham and Brantingham (1981) describe how offenders form an awareness space. This is a geographical area surrounding travel paths that go between places such as a home, work or entertainment locations (Brantingham and Brantingham, 1981). This awareness space is fluid and grows as the offender travels to various places and accesses different forms of transportation. As the offender travels from place to place, they receive cues from the environment which assists them in identifying suitable targets (Brantingham and Brantingham, 1993a). Offenders build an offending template which takes into account these factors and eventually, this template stabilizes and becomes fixed, therefore leading to the predictability of offending patterns (Brantingham and Brantingham, 1993a).

This theory can be inversed and applied to the perception of crime and rather than developing crime templates, individuals who act in a protective manner develop safety templates. Individuals in urban places travel from one location to the next in their daily routines and create awareness spaces around these travel paths. They will read cues in the environment and develop cognitive maps that include the information emitted from the environment. Feelings of safety will vary throughout the course of their travels depending on the cues they receive and how these relate to the locations they are attending. Over time, these cues will form fixed safety template with some predictable cues and others linked to specific places. The choice regarding these places is either to avoid or cope with the environment through a heightened sense of vigilance.

Certain places or contexts when combined with specific cues may trigger higher feelings of fear and the perception of crime. The reason for this may depend on the relative emotional feeling linked to that place, or the manner in which this place can be negotiated, and also the particular situational dynamics occurring in that location.

It is also important to consider that perception of crime may be greater in situations where people are obliged to take a defined route and where cues that trigger perception
of crime are strong. For instance, many people have to take public transportation and cannot avoid mass-transit stations as they have to use them to get where they need to go (Yavuz and Welch, 2010; and Walsh, 1999). They are in fact locked into a definite path and are exposed to specific cues for two main reasons: first they have to go there and second these are typically places that attract people who are motivated offenders. The level of fear will likely be greater in these situations as they cannot practice alternate route planning; a natural reaction to fear is to avoid the situation.

Exploring the spatial distribution of the perception of crime in the urban domain

In the Image of the City, Lynch (1960) describes the way in which cognitive images of the city are created and related to way-finding. This is an interactive process between the individual and the environment (Lynch, 1960). Therefore these images of the city are individual, but can resemble the image of other people who may share similar experiences of the environment (Lynch, 1960). The city is structured through major or minor elements which are paths, edges, nodes, districts and landmarks (Lynch, 1960). These elements are described as follows:

- Paths: These channels designed for movement such as streets, sidewalks, bike paths, or transit lines. Major paths would carry large numbers of people whereas minor ones have lower flow on them (Lynch, 1960).

- Edges: These are barriers between two places which vary in how penetrable they are. For instance, a river is very impenetrable whereas a change in land-use is less of a physical barrier (Lynch, 1960).

- Nodes: These are geographic points which generate concentrated activity. Nodes can be the crossing of two paths which create a condensation of retail stores where many people go to shop. Nodes are connected to paths in that these are high activity spaces. Nodes are generally predominant features in perceptual images of the city (Lynch, 1960).

- Districts: These are sections of the city and each one has its own identifying character. Cities are structured by districts and while these districts hold similar geographical definitions from a general perspective, each individual person will place these in a different hierarchical order depending on their own personal experience (Lynch, 1960).

- Landmarks: These are reference points which are physical objects in the environment. These can be well-known landmarks which can symbolize a direction (Lynch, 1960).

Couclelis, Golledge, Gale and Tobler (1987), build on these concepts to formulate an anchor-point theory which uses the elements established by Lynch (1960) to show how space becomes conceptually clustered, and affects judgement about this space. Where landmarks are both individually and collectively experienced, anchor-points are only
found in individual cognitive maps. These are places like home or work which are unrelated to the collective because these would be specific to the person forming the cognitive map (Couclelis, Golledge, Gale and Tobler, 1987).

Brantingham and Brantingham (1993b) apply these geographical concepts of nodes, edges, paths and anchor-points to the field of Criminology. Space is then structured in such a way that crime can be analyzed and predicted both at the individual and aggregate level. While the purpose of this work in Criminology has focused on both the occurrence of crime and the commission of crimes, these concepts can be applied to the perception of crime.

Locating perception of crime in blocks, neighbourhoods and cities

Spatially locating perception of crime within the urban domain can be done using a mapping technique in which individuals who are familiar with an area are presented with a map, and then asked to indicate the area on the map where they perceive there is higher level of crime. The level of precision depends on multiple factors including the size of the study area and the individual's relative knowledge of problems in the area.

For instance, if residents of a particular city block are presented with their block and asked to mark a place where there is the highest crime in the block, they would likely select the residence which generates the most disturbances, a place where the police regularly attend, where there are numerous domestic disputes, or a premises which may seem particularly unkempt and abandoned. The place selected would generally not comply with the social norms present on that block. This experiment could also be duplicated on a commercial block and store owners asked to select the place where there is the most crime.

Again, respondents would choose a place which generates the most physical and visual disturbance to the norm of the area. This location could be a bar where patrons spill out onto the street and get into fights, or a pawn shop which attracts suspicious individuals trying to sell presumably stolen property. In both these examples, the majority of respondents would select the most obvious location which could be located through physical descriptors or police calls for service, with a few selecting locations which would “fly under the radar”. The respondents who select the locations which are not the norm may have some inside information about these places, for instance they may know that a particular business is into money laundering, something which may not be common knowledge to the rest of the block. Figure 1 shows what this map would look like if this exercise was completed at the block level.
A similar exercise could be conducted at a neighbourhood level and respondents asked to circle the area on a map where they feel there is the highest level of crime. Again the variation in selection could be explained through the relative experience of the respondent. This experience could be impacted by daily routines, by length of time living or attending the area, by the relationship to the area, and by usual markers which have been shown to explain variation in the perception of crime (age, gender and age). Regardless, general patterns would emerge with certain focal point emerging. Figure 2 shows the Grandview-Woodland neighbourhood in Vancouver and respondents were asked to circle the area on the map where they felt there was the highest crime. This experiment was conducted in 1997 and respondents drew polygons on a map. The drawn polygons were digitized using ArcGIS.

Figure 1: Example of a block level perception of crime map
A similar experiment could be conducted at the city level and respondents presented with a map of the city, and then asked to circle the area on the map where there is the most crime. Certain areas would consistently emerge and likely these would be commonly known as high crime areas. These locations would possess the markers associated with fear and the perception of crime such as higher levels of social and physical disorder, but would also be labelled by police and government officials as high crime areas.

**Developing a perceptual mapping technique**

A review of the criminological literature does not reveal studies that explore the mapping of perception of crime. Geographic information systems (GIS) are an effective method of visualizing a particular problem (Satur and Liu, 1999). From a theoretical perspective, this aspect of problem exploration can lead to a better comprehension of the core elements that formulate a particular situation. However, it is important to realize that there are limitations to these techniques, and that results may often only lead to further exploration as opposed to concrete conclusions (Satur and Liu, 1999). Hotspot mapping has been used extensively in the policing world, yet this technique has almost uniquely been applied to reported crime data (Chainey, Tompson and Uhlig, 2008). On the other hand, the mapping of crime perception is very rarely explored or analyzed. The
research on visualization of crime perception is very sparse and therefore visualization techniques for this phenomenon are yet to be fully developed.

Although the kernel density function that was used in this study does not create a predictable space, it is found to be a good way to visualize perception of crime. Indeed, this function smooths the area around a point and therefore diffuses the strength and locality of that point to a wider area (Chainey and Ratcliffe, 2005). This is a limitation to this technique when applied to crime data because crime is discrete, point data (Chairney and Ratcliffe, 2005). However, perception is a diffused expression of human cognition, so varying techniques need to be developed in order to capture this aspect of cognition (Satur and Liu, 1999). While the kernel density function may not be the perfect way to predict perception the technique presented here builds on this function to intensify the peaks of perception into a more condensed area.

Mapping the perception of crime would prove to be significant for practitioners involved in the field of crime prevention as this could potentially identify the activities and locations most likely to trigger fear and the perception of crime. This knowledge in turn could assist in further targeting police and civic resources to areas considered focal nodes in the community where perception is high and where these nodes are necessary to the vitality of the city.

The exploration of perceptual mapping presented here is based on four community surveys conducted in three separate neighbourhoods in Vancouver, British Columbia. The first community survey was conducted in 1997 in the Grandview-Woodland community in Vancouver. This survey contained 30 questions on conditions and problems in the neighbourhood. The survey was also designed to obtain demographic information in order to determine the reason the respondents were in the area (visitor, resident, employee, or business owner in the area), to elicit further responses through a comment section and to determine perception of crime using a map of the area. Respondents were asked to circle the area on the map where they felt there was the highest level of crime. This survey was then replicated ten years later using the exact same questions. Two similar surveys were conducted in 2008 in two other Vancouver neighbourhoods, Renfrew- Collingwood and Mount Pleasant. Table 1 outlines the map data available in the four community surveys.

<table>
<thead>
<tr>
<th>Year</th>
<th>Name</th>
<th>Number of Maps</th>
</tr>
</thead>
<tbody>
<tr>
<td>1997</td>
<td>Commercial Drive Community Survey</td>
<td>430</td>
</tr>
<tr>
<td>2007</td>
<td>Commercial Drive Community Survey</td>
<td>458</td>
</tr>
<tr>
<td>2008</td>
<td>Collingwood Renfrew Community Survey</td>
<td>173</td>
</tr>
<tr>
<td>2008</td>
<td>Mount Pleasant Community Survey</td>
<td>117</td>
</tr>
</tbody>
</table>

Table 1: Overview of Survey Map Data
Method development: Centroid technique versus random points

Figure 3 shows the map that was included at the end of the 1997 and the 2007 Commercial Drive Community Surveys and respondents were asked to circle the area on the map where they thought there was the highest level of crime.

Some respondents drew several circles on their maps indicating that these respondents viewed several areas as containing the highest level of crime. Any marks such as an x was transcribed as a very small circle around the area marked by the x. There were a few configurations that could be described as concave shaped (less than 5%). The following maps were completed:

1997: 430 maps were completed
2007: 458 maps were completed

The maps were then manually digitized using ArcGIS and each polygon that was entered into ArcGIS assigned a number which corresponds back to the originally survey. The original perceptual maps were created using a centroid technique. In a first instance the layer of polygons was intersected with itself. A centroid was then assigned to each polygon. In the case of an intersection between two or more polygons, centroids were weighted to represent the number of intersections. Figure 4 shows how centroids were assigned. For instance, when two centroids intersect, the assigned value to represent this intersection is 2.
The centroid points were then collected and any point that was overlapped was weighted accordingly to reflect the number of points overlapping (e.g.: if one point overlapped four others it was assigned a weight of 5). Then a Kernel density function with a bandwidth of 100 was applied to these points and their weights to create the perception maps.

This technique was intuitively chosen because there was no pre-determined method documented in criminological research that used perception of crime data that was captured in the form of polygons. As well, the Raster methodology was attempted, but given the number of polygons, there was insufficient computing power to run this query in ArcGIS. Furthermore, 95% of the polygons were regularly shaped in a convex form.

The red spaces on the maps represent in figure 5 and 6 are the area where 50% of the perception of crime is concentrated. These areas were cross-referenced to the respective police calls for service collected through the Vancouver Police Department (1997 and 2007). For this study, the calls for service are address specific with 97% of the locations geocoded. This data was then visualized in the aggregate.
The top ten crimes falling in the higher perception area were compared to the rest of the study area to assess the relative distribution of reported crime where perceived crime was high. Table 2 and 3 compare reported crime in the perception hotspots relative to the rest of the study area.
The classification for police calls for service has changed several times from 1997 to 2007 and comparison between 1997 and 2007 can only be exploratory. However, certain call types do stand out. For instance in 1997, 21% of person annoying calls fell within the perception areas. This result is confirmed in 2007 with 28% of the annoying person calls falling within this area. As well, theft reports are high in these areas both in 1997 and 2007. It should be noted that there is an interesting change in 2007 due to the creation of a new call type called drugs, and 38% of these calls fall in the perception area.

These ten crime types were mapped out using the kernel density function and the distribution of these crimes did not match the perception maps at all. In fact, these ten crime types produced a much more diffused image with the behaviours happening more consistently throughout the entire study area. As well, the annoying person call type
was mapped on its own as this can be attributed to the visible display of multiple behaviours linked to disorder (e.g. panhandler, sex trade worker, or drug trafficker). This also produced a diffused map that did not resemble the perception maps.

Prior to further developing a forecasting method, the perceptual mapping technique was explored and the data from the Mount Pleasant Community Survey 2008 was used to compare the random point technique to the centroid technique. Perceptual maps were created by assigning a random sample of points to each polygon. This technique accounted for irregularly shaped polygons. The points were randomly generated in each polygon with these points covering one tenth of the space in each polygon. Then a Kernel density function was run on these points with the bandwidth set at 100. Figure 7 compares the centroid to the random point technique.

![Figure 7: Centroid versus Random Mapping Technique](image)

The results from the random method generated a diffused image of perception. It does not lend itself as well to forecasting because this method produces a larger area from which to select police calls for service. This creates a vaguer area of perception and a more undefined pattern.
Intersecting perception of crime with police calls for service

Since the centroid technique concentrates perception, this method was selected to create outlines which were then interfaced with the calls for police service. A perceptual template was created for the Commercial Drive Community Survey 2007, the Mount Pleasant Community Survey 2008, and the Collingwood Renfrew Community Survey 2008.

In a first instance, The Mount Pleasant Community Survey 2008 perceptual map was compared to police calls for service data from 2007\(^1\) and the area where 50% of the perception fell was further analyzed to determine the crime types most likely to be associated with perception of crime. In the total study area, there were 120 different call types accounting for 7030 calls whereas there were 81 call types accounting for 716 in the heightened perception area.

This perception area was further analyzed in relation to police calls for service. Then any call type that contained more than 10 calls in the perception area was compared to the rest of the area to determine the calls that were more likely to occur in the perception area. The following table illustrates these results for the top ten calls.

<table>
<thead>
<tr>
<th>Perception Area</th>
<th>Study Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Incident</td>
<td>Count</td>
</tr>
<tr>
<td>Arrest</td>
<td>21</td>
</tr>
<tr>
<td>Drugs</td>
<td>17</td>
</tr>
<tr>
<td>Breach</td>
<td>22</td>
</tr>
<tr>
<td>Warrant</td>
<td>43</td>
</tr>
<tr>
<td>Mischief</td>
<td>12</td>
</tr>
<tr>
<td>Annoy</td>
<td>80</td>
</tr>
<tr>
<td>Assault 1</td>
<td>15</td>
</tr>
<tr>
<td>Intell</td>
<td>23</td>
</tr>
<tr>
<td>Weapon</td>
<td>11</td>
</tr>
<tr>
<td>SIPP</td>
<td>10</td>
</tr>
</tbody>
</table>

Table 4: Mount Pleasant comparisons

These top ten calls were then used in an attempt to forecast perception of crime in the Grandview-Woodland area. However, once these calls were extracted in this forecasted area and the Kernel density run on these points, perception appeared to be diffused throughout the entire area. A second test was conducted using only the top three calls: arrest, breach and drugs. These crime points were then used to conduct the Kernel density map. This result was much closer to the actual perceptual map drawn by the respondents in the Commercial Drive Community Survey 2007. Figure 9 contrasts the forecasted map with the actual perception map.

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\(^1\) Vancouver Police Department 2007 police calls for service was used in this study because it contained a complete year of data. The 2008 data was not available at the time of this study.
Figure 8: Forecasted Map and Actual Perceptual Map Commercial Drive

This was then applied to the Renfrew Collingwood area and produced similar results. The forecasted map was similar to the one generated from the results of the Collingwood Renfrew Community Survey 2008. Figure 10 contrasts the forecasted map with the actual perception map.
It should be noted on the Renfrew Collingwood maps, that the two main hotspots are inverted. In the forecasted map, which contains the three calls for service (arrest, breach and drugs), the denser hotspot is located at the intersection of Kingsway Avenue and Joyce Street and the secondary hotspot at Vanness and Joyce where the Skytrain is located. In the perception map, the denser hotspot is at the intersection where the Skytrain is located. This confirms the principles where people experience heightened perception of crime where they are locked into a specific route choice (public transportation) and where certain crime types are present; especially those which relate to social disorder which are more likely than physical disorder to result in arrests in the first instance, breach arrests or drug crime reports.
Discussion: Exploring disorder, perception of crime, and drug crimes

Perception hotspots are specifically centered on nodes and along major pathways which follows the Pattern Theory principles for crime. As well, perception peak in area where aggregate routine activities converge such as a major transit stop. These perceptual maps reveal that reported drug crimes, arrests and breaches are likely linked to perception of crime. This is most probably due to the visual manifestation of these police calls for service and the central location where they occur. These reported crimes often include drug dealing, use of drugs, but also arrests or breaches linked to a number of different street activities.

In order to further verify this link between drug crimes and the perception of crime, perception of crime would need to be tested in various community contexts as there may be a unique relationship between these factors in the City of Vancouver. However, it is important to note that most studies which look at the relationship between disorder, fear and the perception of crime involve some measures regarding either drug use or drug dealing.

Drug crimes as they relate to the perception of crime would be acts visibly carried out at the street level. Unlike many other forms of criminal activity, these are repetitive crimes. For example, drug dealing on the street involves a single person, or group of people loitering in the same place, with customers coming to and from this dealer or group. Drug dealing at the street level therefore involves the appropriation of public space for the purpose of committing multiple, successive crimes. Other crimes such as assault or robbery occur usually very quickly and are not generally repeated in a short period of time therefore individuals who use the public space where these types of crimes occur are not likely to see these crimes as they are occurring, and if they do this would not be a daily occurrence.

Street level drug trafficking on the other hand can become a permanent activity with certain dealers appropriating specific areas who will be there regularly to conduct their business. As people in the community conduct their routine activities they come to notice these individuals and their permanence which signals a lack of capable guardianship over the area where these dealers are operating. Therefore the perception of crime become elevated in areas where these activities are occurring. Controlling the locations where these activities take place is important in the maintenance of community vitality. As social retreat is a potential reaction to fear and the perception of crime, it is important to ensure that such activities do not take over the activity nodes or pathway connections that ensure the movement of people through cities.

Future directions: Human movement, disorder and the perception of crime

A review of the literature reveals that although numerous studies associate disorder to the perception of crime, a single disorder matrix which can be transferred from one study to the next does not appear to exist. Furthermore, disorder tends to be described in fixed terms, referring more to a stable state, as opposed to a problem containing both a temporal and spatial dimension. Within the urban space, disorder can be interpreted
both spatially and temporally, and from this perspective linked to the movement of people through space.

Public urban space is shared by many people who often do not know each other (Valentine, 2008). As such, social protocols allowing for the proper use of this space are referred to as civility and breaches of these protocols result in what can be referred to as incivility (Valentine, 2008). Smith, Phillips and King (2010) explore incivility within the context of everyday living and find that generally speaking the research in this area needs to be re-directed away from what they describe a geostatic spaces (e.g.: neighbourhoods) towards a spatial movement theory which accounts for urban spatial dynamics.

From this theoretical perspective, incivility is an everyday experience linked to human movement through the urban space (Smith, Phillips and King, 2010). Phillip and Smith (2006) introduce their research project entitled the Everyday Life Incivilities Study – ELIAS. This is a study based on cross-sectional data where respondents engaged in their routines activities were asked questions pertaining to their interaction with incivility by strangers (Phillip and Smith, 2006). In this study, several new incivility measures are identified including those which can be linked to human movement in urban space:

- “bumped into me”
- “blocked my way”
- “pushed in front of me (cut me off)”
- “tailed”
- “stopped abruptly in front of me”
- “Took up too much personal space (seating)”
- “invaded my personal space”
- “swerved in front of me (child)”
- “sat or stood in front of me (cinema)” (Phillip and Smith, 2006).

Although there are several other measures revealed in this study, the researchers find that the above mentioned behaviours related to movement were most often cited. More specifically, being “pushed in front of” or “cut off” were cited 25.3 % of the time which was the most often cited behaviour (Phillips and Smith, 2006: 890).

Although it is not the purpose here to fully explore social and physical disorder within the context of movement in the urban space, some examples are presented here to illustrate this important dimension in the study of disorder as it relates to the perception of crime. The following example illustrates how street level drug trafficking can interfere with the aggregate movement of human within the urban space. In this diagram, the blue dot represents a static drug trafficker awaiting clients. The red dots represent potential clients travelling from different directions to access the trafficker. The red arrows display their movement patterns. The large blue arrow represents the aggregate movement of people who are for instance walking on a sidewalk to and from a transit station. This diagram shows how the movement of the clients consistently bisects the
aggregate movement pattern thus raising the potential of people being bumped, pushed or cut off. As such, this type of street activity may elucidate a higher perception of crime because physical movement is interrupted. Figure 11 illustrates this repetitive interruption of human movement.

Figure 11: Street-level drug trafficking scenario

Applying the dimension of human movement to the study of the perception of crime would greatly expand the field as the preliminary research presented here shows an aggregation of perception near major transit stops and central neighbourhood intersections. These are typically considered high activity nodes and as such high attractors of human movement through the urban space (Brantingham and Brantingham, 1993b).

Further research in this area should account for the aggregate movement of people throughout the urban environment including pedestrian and vehicular flow through major pathways. The intersection of these major pathways, for example at highly attractive path intersections, with certain crime types which could be categorized as street level crimes which interrupt generalized human movement, could be considered highly focused areas for fear and the perception of crime.

In the 2007 Commercial Drive Community Survey, the 2008 Mount Pleasant Community Survey, and the 2008 Collingwood Renfrew Community Survey intersections were identified as places where there was heightened perception of crime. In two of these surveys, a Skytrain station was identified as a major focus. These types of places are critical to the sustenance of healthy urban living because intersections are the crossing of pathways and mass transit systems are funnels for the macro movement of humans in the urban domain. The danger occurs when these places become overrun by activities which negatively impact this movement and create fear then potentially avoidance.

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The results presented in this paper focus specifically on the perception maps that were included in the community surveys. Although there are limitations to the visualization of this phenomenon, this technique can assist in further understanding the physical dynamics of a place that generates perception hotspots. In future research, a number of other variables could be introduced into this analysis as this method allows for the layering of numerous data sets including land use, traffic flows, pedestrian flow, and transit stops.
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