Crime Journeys

Patterns of Offender Mobility

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Abstract

Crime requires the simultaneous presence of offenders and targets. This essay reviews what is known about how offenders come to intersect in time and space with their targets. It addresses their motivations, destinations, routes, distances, directions, modes of transportation, and travel companions, if any. Rational choice theory has been applied widely to organize and interpret empirical observations. Space-time geography and crime pattern theory emphasize the role of habitual behavior and routine activities. Previous research used police records and offender interviews, mainly to assess how far from home offenders committed crimes. Contemporary research utilizes time-use diaries and geographic tracking devices to measure multiple aspects of crime journeys. Future studies will profit from the advance of smartphones and similar devices.

Keywords: crime journey, rational choice theory, space-time geography, crime pattern theory, time-use diaries, geographic tracking, smartphones

1 Overview

Most crime requires that offenders and targets physically converge in time and space. Insofar as targets are static or predictably located away from an offender, convergences require the offender to move. This essay is about the journeys that offenders make before, during, and after

committing a crime. The five sections that follow address concepts, theories, methods, findings, and future directions, respectively.

The second section defines journeys and crime journeys, and it describes their aspects. These aspects include motivations (why they travel), origins (where they start), destinations (where they intend to arrive), crime locations (where they commit crime), routes (which way they take), times (when they travel), durations (how long they travel), distances (how far they travel), angles (in which directions they travel), travel modes (how they travel), and co-travelers (with whom they travel).

The third section discusses three theoretical perspectives that help organize and explain empirical observations of crime journeys. Two of these perspectives, rational choice and space-time geography, are general theories of human behavior. The third perspective, crime pattern theory, has been specifically developed to explain aspects of criminal behavior.

The fourth section describes the methods that are used to obtain empirical evidence on crime journeys. Police records and offender interviews have traditionally been the main sources of information. Space-time monitoring devices and space-time budget surveys are new methods that are currently being developed to add detail and improve the validity of the traditional measures. Smartphones and similar portable electronic devices will probably become important tools in data collection.

The fifth section reviews empirical evidence on relevant aspects of crime journeys. Most empirical research focuses on distance, some on direction. Information on other aspects of crime journeys is scarce.

The concluding sixth section identifies limitations of the literature and discusses future directions in which the field is likely to move forward.

2 Crime Journeys

Most crime requires the coincidental or planned convergence in time and place of motivated offenders and suitable targets. The convergence often entails mobility on the part of the offender. In the literature, this mobility is referred to as the "journey to crime." In this essay, the term "crime journey" is used instead. There are three reasons to diverge from the customary usage. First, the term "journey to crime" suggests that committing the crime is the purpose of the journey. This would be an unproductive restriction, and it does not apply to the materials presented, which include crimes that were not premeditated. Second, the travel behavior of offenders is interesting not only leading up to the crime incident but also during the crime and in its aftermath. The crime journey incorporates the journey before crime, the journey during crime, and the journey after crime. The third reason is tactical. The phrase "journey to crime" is associated with a comprehensive body of research that explores correlates of the distance between crime and the home of the offender committing it. While this distance is obviously an important aspect of a crime journey, the use of a different term emphasizes that this essay is not a review of the journey-to-crime literature.

A crime journey is an essential aspect of criminal behavior. It not only affects whether a crime is perpetrated or not but also where, when, how, and against whom it is perpetrated. Knowledge of crime journeys may inform crime prevention by suggesting ways to reduce accessibility of potential targets and to increase supervision, and it may help crime detection by informing investigative strategies regarding the whereabouts of offenders.

To understand crime journeys, it is useful to deemphasize the crime and focus on the journey. This focus requires us to review how human movement is analyzed in transportation

science. Transportation science applies concepts and theories from physics, technology, and the behavioral and social sciences (psychology, economics, geography, sociology) to the study of human travel behavior.

2.1 Definition of a Journey

In transportation science, a journey is much more precisely defined than in colloquial language. It is built up from smaller elements as follows (see Schönfelder and Axhausen, 2010, 19). A stage is a continuous movement by one mode or transport of one vehicle, including any pure waiting (idle) time immediately before or during that movement. A trip is a continuous sequence of stages between two activities. In turn, a tour is a sequence of trips starting and ending at the same location. Finally, a journey is a tour starting and ending at the relevant reference location of the traveller. This definition of a journey further requires a definition of the "relevant reference location." The relevant reference location is normally defined as the (main) home of the individual or any other the location from which the individual regularly departs and returns to on a daily basis. A crime journey thus contains the complete whereabouts of the individual between leaving home and returning, provided a crime was committed during the journey.

Journeys have many aspects, including motivations (why subjects travel), origins (where they start), destinations (where they intend to arrive), routes (which way they take), times (when they travel), durations (how long they travel), distances (how far they travel), angles (directions in which they travel), travel modes (how they travel), and co-travelers (with whom they travel). In addition, crime journeys have crime locations (where a crime was committed).

2.2 Aspects of (Crime) Journeys

Motivation is an important aspect of a journey. It refers to the activity that inspired the individual to start traveling. The activity-based approach in transportation science assumes that people do

not normally derive intrinsic pleasure from travel (Bhat and Koppelman, 1999). Admittedly, this assumption is occasionally violated by hikers, bikers, and others who move for pleasure or exercise and by people for whom travel is work. Bus drivers and truck drivers do not travel because they are interested in arriving at the destination but because it is their job to transport other people or items. However, in general it is a useful assumption to treat human demand for transportation as a derived demand. This means that travel is something that people do because it allows them to do something else, something more basic, namely to pursue activities (e.g., do legal work, sleep, visit a friend, watch a movie, or perpetrate a crime) that are distributed in space. A single journey can have multiple purposes. For example, buying gasoline, picking up a friend, buying clothes, and lunching in a restaurant can be combined in a single journey.

A journey has one or more *destinations*, which are the locations where the individual interrupts travel to perform an activity, such as working, eating, or socializing. Typically, the destination is known when the journey is started, but this is not strictly required. If, for example, the purpose of the journey is finding and buying a new item of furniture, the journey may include extensive spatial search before the destination is found. The same may be true for the crime journey of a thief who must search for hours before finding a suitable target. Furthermore, the location of a crime is not necessarily a destination of the crime journey during which it took place: the provocations or opportunities that induce criminal behavior may present themselves unexpectedly at any time during journeys with noncriminal purposes.

The *route* of a journey is the total sequence of points that the traveler followed between the moment of leaving the relevant reference location (usually home) and the moment of arriving back at the same location. A route need not be a straight line and can include turns, returns and loops. There are often a number of routes that can be followed between consecutive destinations,

and they can involve multiple travel modes (e.g., train, car, walking). Routes are often habitual and shaped by repeated travel between the same locations.

Distances and directions are part of the route of a journey because they form the relation between the individual locations that together constitute the route. In the empirical journey-to-crime literature, distances and directions apply to the distance and the angle between the offender's home and the location of a crime. In other words, in this literature the location of the crime is assumed to be the destination of the journey (for an exception focusing on the journey after crime, see Lu, 2003).

Time is an important aspect in the analysis of travel behavior. The departure time starts the journey; the arrival time ends it. The period between departure and arrival is its duration, and divided by the length of the route it becomes the average speed of the journey. In crime journeys, the time of the crime is obviously also an important defining aspect. It forms the natural break between the period before crime and the period after crime.

Travel mode is the mode of transportation used by the traveler along the route taken. Walking, biking, or taking a scooter, car, train, bus, taxi, or boat are common modes of transport. A single journey can contain multiple trips, multiple stages, and thus multiple travel modes. The travel mode has important repercussions for the other aspects of crime journeys, such as possible routes, travel speed, and company.

People can travel alone, with others they know, such as family, friends, colleagues, or schoolmates, or (usually in public transport) in the *company* of anonymous others. The social aspect of a journey consists of the sequence and timing of any company that an individual traveler has during the journey. For example, an individual can walk alone to the train station, ride in the train with anonymous others to work, work there with colleagues, and make a walking

tour with a friend during the lunch break. A single journey may involve various types of company. In crime journeys, it may be important to distinguish carefully between the company before, during, and after the criminal event.

3 Theoretical Perspectives on Crime Journeys

Theoretical perspectives help us understand empirical phenomena by organizing the way we think about them. To understand the plethora of facts that can be collected about crime journeys, three theoretical perspectives are particularly relevant and have attracted most interest. The first two—rational choice theory and space-time geography—are generic theories of action. They have not specifically been developed to explain aspects of criminal behavior. The other—crime pattern theory (which includes the concepts and mechanisms of routine activity theory)—is a criminological theory; that is, it was developed specifically to deal with criminal behavior.

3.1 Rational Choice Theory

Rational choice theory is a general theory of action. It can be used to describe aspects of journeys and to explain the choices that people make before and during these journeys. This applies without modification to offenders and to crime journeys. Rational choice theory is at the heart of microeconomics. It is also routinely applied in the social and behavioral sciences, and in ecology it is used to explain animal behavior (e.g., Krebs and Davies, 1993). The theory asserts that when confronted with choices, individuals strive to achieve their goals in the most cost-effective way. The goals or "preferences" themselves are viewed as given, as are the biological, physical, social, logistic, and other constraints that limit the alternatives of the individual. The theory does not make assumptions on the nature of the goals themselves, but it does assume that they are stable over time. According to the subjective expected utility theory (Savage, 1954), any choice

involves a set of alternatives, and individuals select those alternatives that they expect to provide them most utility, that is, the particular combination of benefits ("goods") and costs ("bads") that they prefer over the benefits and costs they expect to obtain from any of the other alternatives.

Because transportation research is strongly rooted in economics, except for motivation all other aspects of journeys have been described and analyzed with the concepts of rational choice theory. For example, where an individual goes on holiday can be viewed as a choice between a limited number of alternative holiday destinations, each of which is rated according to given preferences regarding climate, culture, comfort, expenditures, status, or risk. Similar arguments are used to analyze the route, the travel modes, and the timing of journeys: if the origin and the destination of a journey are known, the optimal route, timing, and travel mode are a function of the importance of time, money, comfort, and possibly other criteria for the individual. According to revealed preference theory (Samuelson, 1938), the relative importance of these characteristics can be derived from the choices they make.

Rational choice theory is not very useful for understanding motivation itself. This is because goals or preferences are part of a motivational hierarchy that lies outside the scope of rational choice theory. The rational choice perspective generally claims that "all else being equal," people prefer more goods over fewer goods. But what a "good" is and why it is a good and not a "bad" remains undefined. A sunny climate may be a good for some but a bad for others, and even a taste for variety is sometimes required to explain observed erratic choice behavior.

The most influential articulation of the rational choice framework to crime is the work of Becker (1968). Becker and most of those who applied rational choice theory to criminal decision making (e.g., Cornish and Clarke, 1986), have focused on the choice between obeying and

breaking the law. Both options are associated with uncertain benefits and costs. The benefits of crime vary widely and include both material benefits (e.g., stolen property) and symbolic rewards (e.g., status and prestige among peers). Criminal behavioral options differ from noncriminal options because they are associated with the risk of apprehension and conviction and their associated costs, which depend on the likelihood, severity, and swiftness of punishment.

Given that a person is motivated to commit a crime —the expected benefit/cost ratio apparently outweighs the benefit/cost ratio of not committing it— he or she faces additional decisions, including the choice of a day and a time, co-offenders, a target, a location, a route, and mode of transport. Rational choice theory can also be applied to these "second-order" aspects of criminal decision making. For example, the fact that the frequency of offending decreases quickly with the distance from the offender's home is generally viewed as indicating that offenders prefer to minimize costs and risks associated with travel. In accordance with rational choice theory, the finding that large criminal benefits are associated with longer journeys (Morselli and Royer, 2008; Snook, 2004; Van Koppen and Jansen, 1998) has been interpreted in terms of a tradeoff: if offenders are indeed weighing the expected profits and costs, then higher expected rewards justify incurring more costs to reach the location of the rewarding target.

Recent studies explicitly utilized rational choice theory to investigate which factors have an effect on where burglars, robbers, and other offenders commit crimes (Baudains, Braithwaite, and Johnson, 2013; Bernasco, Block, and Ruiter, 2013; Bernasco and Nieuwbeerta, 2005; Clare, Fernandez, and Morgan, 2009). To explain the destinations of crime journeys, they applied the random utility maximization choice model (McFadden, 2001) assuming that the individuals are motivated to commit crime before they start a crime journey, that they are aware of all relevant

characteristics of all alternative potential target locations, and that they weigh the expected benefits and costs in order to maximize their expected outcomes. While this model may apply to planned offenses (including some but not all robberies and burglaries), it may not apply to all offending, and it may not even apply to the majority of crimes. For example, many violent offenses are unplanned and impulsive rather than premeditated (Barratt et al., 1999; Stanford, Houston, and Baldridge, 2008). It would severely underrate human agency to suggest that crimes "happen to people," but in terms of planning and preparation a purely rational choice model may overestimate the amount of premeditation involved in most offending (Jacobs, 2010), in particular cognition that takes place in advance of the crime journey.

Other aspects of crime journeys, such as route or travel mode, have thus far not been explicitly theorized in a rational choice framework, which is logical given a lack of empirical data and research on these phenomena (see the following).

3.2 Space-Time Geography

Space-time geography (Hägerstrand, 1970) is a theoretical perspective on human spatial behavior. It emphasizes that human spatial behavior is restricted because of capability, coupling, and authority constraints. Capability constraints are physical limitations to movement. They include biological constraints but also technological constraints such as a lack of transportation tools. For example, young people are not allowed to drive a car or motorbike. Some lack financial resources for public transport. Coupling constraints force the individual to specific locations at specific times because of the social roles they fulfill. Individuals have fixed school hours or work schedules and many other obligations at fixed times that restrict their freedom of movement. Authority constraints are limits to the accessibility of locations because the owners

do not allow access. The freedom of individuals to be where and when they wish is restricted by these three types of constraint, some of which are obviously more fundamental than others.

Space-time geography contains a number of concepts that describe the actual and possible whereabouts of individuals and groups of individuals in time and space. The elementary concept is the *space-time path*, which describes the whereabouts of an individual over the life course, that is, the location in terms of longitude, latitude, altitude, and time. Ignoring altitude, the space-time path is typically visualized by plotting location and time in a *space-time aquarium* (also called *space-time cube*), in which time is added as a third (perpendicular) dimension to a two-dimensional map. The *space-time prism* describes the possible whereabouts of an individual as limited by the three types of constraints listed previously. For example, if the individual is required to be at location X_1 until T_1 and to arrive no later than T_2 at location X_2, the set of possible space-time paths of the individual during the discretionary interval T_1–T_2 are contained in the space-time prism. The space-time prism derives its name from its typical geometric shape when visualized in a space-time aquarium. A *bundle* is the convergence in space and time of two or more space-time paths for some shared activity. For example, many individuals share space-time paths in schools, workplaces, trains, retails shops, and concert halls.

Inspired in part by the increasing availability of large volumes of detailed space-time data from location aware devices, Miller (2005) developed a measurement theory for the conceptual framework of time geography. It consists of rigorous mathematical formulations for basic elements and relations in time geography, including the three concepts mentioned earlier. The formalization should be helpful not only in the measurement of spatial behavior but also in the formulation of theory-driven hypotheses.

Time geography has not been widely applied in the study of crime. Most applications emphasize mainly its potential for visualizing crime journeys. Morgan and Steinberg (2013) explored the utility of time geography visualization for practitioners and researchers in the field of crime and criminal justice. Another study (Rossmo, Lu, and Fang, 2012), which is addressed in more detail later, measured the space-time paths of parolees who carried location-tracking devices. The fact that some parolees committed crimes allowed the authors to visualize their crime journeys in space-time cubes.

Ratcliffe (2006) used space-time geography to develop the hypothesis that temporal constraints, in combination with the locations of offender nodes, are a major determinant of spatiotemporal patterns of property crime. The argument is based on the assumption that many crimes are not planned but are generated by temptations and opportunities that people encounter during daily routines. This assumption is combined with the observation that most discretionary time is spent on the routes between activity nodes (such as home, school, work, gym, and shopping center). As a result, the hypothesis is that crime concentrates in the space-time prism that is bounded by their velocity (and thus travel mode) and the fixed times at which they are allowed to leave from and required to arrive at their activity nodes.

3.3 Crime Pattern Theory

Crime pattern theory (P. J. Brantingham and P. L. Brantingham, 2008; P. L. Brantingham and P. J. Brantingham, 1991) is a perspective rooted in environmental psychology, behavioral geography, and urban planning. It asserts that offenders, like other people, learn about their environment during legitimate everyday activities.

Two important elements of spatial knowledge are *activity nodes* and *paths* (Lynch, 1960). An activity node is a place where an individual regularly performs activities for more than a

trivial amount of time. Examples are home, workplace, shopping center, and homes of family and friends. Paths are the routes that people take when they travel between nodes. Nodes and paths together form an individual's *activity space*. Spatial knowledge is generated by repeated exposure, and empirical evidence shows that spatial behavior is highly repetitive and predictable (Song et al., 2010). Many people travel the same routes from the same origins to the same destinations on the same weekdays around the same time of day using the same mode of travel.

Crime pattern theory asserts that crime takes place where and when the awareness space of an individual intersects with criminal opportunities. In other words, for a crime to be committed at a certain location at a certain time, the location must not only provide criminal opportunities; the offender must also be aware of its existence and of the criminal opportunity it provides.

In contrast to routine activity theory, crime pattern theory does not explicitly assert that crimes take place *during* habitual daily routines. It merely claims that offenders learn about their environment during these routines. Thus the theory allows for unplanned crimes committed during routine activities as well as for premeditated crimes not committed during routine activities but using information gathered during routine activities. In the former case, crime journeys must closely match offenders' routine daily journeys, as it is during these same journeys that unplanned crimes are committed. In the latter case, it is likely that some aspects of the crime journey resemble offenders' routine daily journeys (e.g., the route they take or the mode of transport) but that other aspects (e.g., the time of the day or the people with whom they travel) are different.

4 Methods of Investigating Crime Journeys

Various methods have been used to collect information about crime journeys. Most of what is currently known about crime journeys originates from police records. Many scholars have interviewed offenders to learn about their lives and their crimes, but even among those who were specifically interested in the practical and tangible aspects of criminal acts, very few discuss crime journeys (exceptions are Polišenská, 2008; Summers, Johnson, and Rengert, 2010). A study in Florida (Rossmo et al., 2012) used very detailed geographic data on the movements of parolees who were enrolled in an electronic monitoring community corrections program. Some parolees committed crimes while under supervision, and the monitoring system recorded their crime journeys. Recently, space-time budget instruments have been used in England and the Netherlands to record the whereabouts and activities of young persons, including incidents of offending and of victimization. In the near future, the technological development and increasing popularity of smartphones and similar devices are likely to become very useful in adding not only efficiency to time-use measurement but also unprecedented spatial and temporal detail.

4.1 Police Records

Responding to crime and identifying and apprehending offenders is one of the core businesses of the police. As a consequence, the police have access to more information about crime and about offenders than any other organization. A common way for scholars to obtain information on crime journeys is to gain access to police records of detected crimes, that is, crimes for which the police have identified the offender (or the suspect). Typically, the minimal facts that are routinely recorded include the nature, location, date, and time of the incident that required police action, and the addresses of the apprehended persons. Police records may also include information on other aspects of crime journeys, such as routes taken and modes of travel, but

these have not been used systematically in the scholarly literature, and it is doubtful that such details of crime journeys have been systematically collected by police agencies.

During the last decades, police agencies in the United States and elsewhere have increasingly adopted computerized crime-mapping methods and techniques (Weisburd and Lum, 2005). Crime mapping is the visualization of the spatial distribution of crime with the use of digital maps and is used by police departments to assist in the allocation of resources to areas. Increasingly, the maps are also used published on the Internet to inform the public (Ratcliffe, 2002). Crime-mapping methods include automated geocoding tools that are able to assign correct geographical coordinates to alphanumeric and nonstandardized address descriptions (e.g., "17 Thompson Ave.") and resolve minor spelling issues. The geographical coordinates can be used to create maps and to calculate distances, travel times, and other geographic measures.

Whereas a few decades ago studies describing the distances between offender residences and crime locations required large amounts of time in every step of the process from coding police records from paper and resolving and geocoding addresses, a contemporary researcher who has obtained access to police records can do the same thing today merely by pressing a button. Illustrative of the sheer volume of data that contemporary analysts have access to are a study that examined 97,429 crime journeys in 2006 by 56,368 arrested offenders in Manchester, England (Levine and Lee, 2013) and another study (Guo and Wu, 2013) that analyzed no fewer than 169,829 crime incidents from January 2007 to June 2011 in Philadelphia, Pennsylvania.

While geocoding accuracy of police-recorded crime has received considerable attention (Ratcliffe and McCullagh, 1998, 1999), few scholars have collected more spatial information about crimes than the coordinates of the crime scenes and of the offenders' residences. A few studies on predatory sexual offending and on homicide have collected somewhat more data on

aspects of offender spatial behavior before, during, and after the crime. For example, Beauregard and Busina (2013) studied offender mobility during sexual assaults. Based on a combination of police records and interviews with the offenders, they distinguished four different stages in the act of sexual assault (encounter, attack, crime, and victim release) and examined whether offenders changed location between these stages. Studies of homicide based on police records have sometimes also distinguished multiple locations visited during the commission of the act. They usually include only the location where the offender encountered the victim and the location where the victim's body was discovered, as these two locations are most likely to be disclosed in police reports.

4.2 Offender Interviews

To obtain information on crime journeys straight from the horse's mouth, offenders can be asked about their crime journeys. If they can be contacted and interviewed, if their recollection of the events is accurate, and if they are willing to share details about their crime journeys, this information may be richer than records in police files. It may not only be richer because offenders know about more crimes than the police because only a minority of all offenders are apprehended (and those who are apprehended are not always charged for all crimes they committed) but also because the police may not always be interested in and record details of crime journeys. Offender interviews are probably the only method to obtain accounts of intentions and cognitions during crime journeys, although their reliability may be low when questions are asked retrospectively.

Offenders may not recollect every detail of a crime journey, but they will usually be able to provide information on their route, travel mode, and company. While there are many studies that have used offender accounts to learn more about crime events, few have explicitly focused

on transportation. For example, Rengert and Wasilchick (1985) asked their respondents explicitly about how they learned about the suburban burglary targets they selected, and about their legal travel routines, but they report limited systematic information on travel before and after the burglaries. While they might have found it obvious that most burglars traveled by car to the crime target, route, stops, activities, and company during these crime journeys are not obvious and were apparently not asked. The same holds true for most other offender-based research (Bennett and Wright, 1984; Wright and Decker, 1997).

An ethnographic study (Cromwell, Olson, and Avary, 1991) used a method labeled "staged activity analysis," in which the researchers joined the offenders in visiting their prior burglary targets. In addition to participation in an extensive interview, the offenders were asked to direct the interviewer to the site of a recent burglary, using the method of travel and route taken at the time of the actual burglary. They were also asked about the route and method of escape. Unfortunately, the authors did not systematically report any findings about the crime journeys that they reconstructed this way.

In an ethnographic study in the Czech Republic (Polišenská, 2008), burglars were interviewed about their targets and distances between their targets and their homes were recorded. Although some exceptional findings were established regarding the (large) distances traveled, the routes, travel modes, and other details of the crime journeys were not reported.

Offender interviews are not only potentially useful for obtaining details about crime journeys that are not present in police files. They can also be utilized to gain insight into the spatial knowledge of offenders in their habitual legal travel patterns and activity spaces. Even the most prolific offenders spend very little time offending, and their knowledge of the world around them is gathered during legal activities. Using a semantic differential methodology, Carter and

Hill (1978) studied criminals' and noncriminals' perceptions of variation in crime incidence, police protection. Polišenská (2010) and Summers et al. (2010) attempted to learn about the spatial knowledge of offenders by asking them to draw maps that summarized their knowledge of certain areas where they had committed offenses. Summers et al. report considerable practical difficulties in getting offenders to draw maps. Asking respondents to indicate familiar areas and locations of previously committed crimes on a topographic map proved to be a more successful method of gathering information about offenders' spatial knowledge.

4.3 Tracking Devices

Only a single study (Rossmo et al., 2012) has thus far used data from geographic tracking devices to analyze crime journeys. The authors obtained their data from the electronic offender monitoring program of the Florida Department of Corrections. To monitor parolees and offenders on bail under community supervision, the department applies an electronic monitoring system that uses the Global Position System (GPS) to monitor the whereabouts of the offenders in real time. Although the program aims to increase compliance with the terms of the offenders' release into the community, and to reduce recidivism, some of the parolees committed new offenses while being monitored. Combing police records of these offenses with the geographical movement data of the offenders on the day of the offense, Rossmo and colleagues were the first to reconstruct crime journeys at this level of precision. Moreover, the available data also allow comparisons of crime journeys with noncrime journeys made on previous days by the same person. These comparisons can help identify aspects that distinguish crime journeys from other journeys.

To visualize the recorded crime journeys, the authors used geographic information systems and a software tool (GeoTime) that plots a space-time path in the space-time cube, that

is, in the three dimensions of longitude, latitude, and time. Projected on two-dimensional space (printed on screen or on paper), these figures are not unambiguous enough to accurately describe crime journeys in three dimensions. However, the space-time data on which they are based are available for other visual methods, such as animations, as well as for statistical analysis.

The main limitation of data collected with GPS tracking devices is that they contain *only* the individual's space-time path and nothing else. They lack information about the functions of the places visited, the nature of the activities pursued, the modes of travel, or the presence of other people. Such contextual information about the situations to which respondents are exposed to during the journey is collected in space-time budget interviews. Currently these latter instruments provide little spatial and temporal detail.

4.4 Space-Time Budget Interviews

Although time-use research is a well-developed and thriving area of scientific research (Harvey and Pentland, 2002), it has only recently been introduced in research on offending. Wikström and colleagues (2010, 2012) introduced the space-time budget interview to criminological research, where it has also been used by others (Bernasco et al., 2013). The space-time budget interview is a structured interview in which detailed hour-by-hour information is collected about the activities of the respondents over the course of four complete days during the week before the interview. For each hour, the space-time budget records the main activity that the respondent had been involved in for most of the hour. In addition to recording activities, the space-time budget also records what other people were present, the function of the location where the activity was performed, and the geographic location of the activity.

The measurement of activities at a temporal resolution of one hour precludes the reliable measurement of brief activities, including most crimes. Crimes are a typically a matter of

seconds or minutes rather than hours. To prevent offending and victimization not being measured, Wikström's space-time budget interview includes specific questions about the respondents' involvement in offending and criminal victimization, including the nature of the event and the time at took place.

Obviously, then, this instrument allows the researcher to measure some aspects of the geographical mobility of the respondent not only during regular days but also during some specific days in which he or she perpetrated a crime. The latter cases include crime journeys, that is, the whereabouts of the offender before during and after the crime committed on a recent day covered in the space-time budget interview, including the nature of activities performed and the company present in the setting.

A limitation of the space-time budget interview for recording travel behavior is that activity coding is per hour, while many habitual trips tend to be short. As the space-time budget does not include any specific questions about the trips that respondents made, and because so many trips are short, the instrument may not accurately measure mobility at small, temporal scales. It is, nevertheless, a giant leap ahead in comparison to just recording crime and offender home coordinates.

4.5 Smartphones

The space-time instrument requires respondents to recollect their activities, and without doubt it generates inaccuracies and missing information because respondents fail to remember some aspects of their activities and whereabouts. It also requires that time be partitioned into units that match the memories of respondents and that are tractable in terms of the time available for interviewing them. Units of one hour seem acceptable on both grounds, but it is unlikely that

smaller units of time, for example 10-minute intervals, are feasible. This implies that episodes in which many displacements or other events take place are imprecisely measured.

To overcome these and related challenges of retrospective surveys, the experience sampling method was introduced a few decades ago (Csikszentmihalyi, Larson, and Prescott, 1977; Larson and Csikszentmihalyi, 1983). Samples of respondents were given pagers that gave an audible signal a few times per day, probing the respondent to answer a small set of questions that related to the situation they were in when being probed (e.g., about the activities they were currently performing or about their current mood). Today, the pager function is better performed by (smart)phones, and some studies have started to apply smartphones for time-use research, using customized "apps" to have respondents report their activities up to a few times per hour (Raento, Oulasvirta, and Eagle, 2009).

Indeed, smartphones offer even more opportunities for learning about the respondent's life. An important feature of smartphone technology is that it can collect the geographical coordinates of respondents easily and unobtrusively by either the onboard GPS system (i.e., geographically very precise but only works outside buildings) or location information of the GSM mobile phone network (geographically less precise but also functional indoors). Thus smartphone technology is potentially able to combine experience sampling with an automated geographic tracking function. An important feature of smartphones is their popularity. Increasing numbers of people own a smartphone, carry it with them all day, and use it routinely during most of their daily activities.

Smartphones have not yet been used in the study of crime. Because offending, victimization, and observing crime impinge on everyone involved, and prompt strong emotions, it is an open question whether respondents will be able to reliably report such events in real time.

Queries about these experiences are probably better asked in sets of questions that are posed retrospectively at the end of the day.

Future data collection may combine the strengths of the space-time budget methodology with its broad focus with the precision that can be achieved with the help of modern information and communication technology, allowing respondents also to report details of their activities online and possibly add other content such as sound, photo, or movie data, their use of Internet and their social network data.

5 Empirical Facts about Crime Journeys

Although crime journeys are among the most tangible aspects of criminal activity, systematic empirical evidence on crime journeys is surprisingly scarce. In the following we summarize what is known about crime journeys.

5.1 Motivation

Crime journeys embarked upon with legal intentions can be distinguished from crime journeys embarked upon with criminal intentions. The former are initiated to perform a legal activity elsewhere (or are pursued for legal fun or work); the latter are initiated to commit a crime.

Crime journeys embarked upon with legal intentions are initially not different from normal travel. They are work commutes or trips to schools, shopping centers, entertainment facilities, or the homes of relatives. The journeys are motivated by the desire to reach the destination for legal purposes: people travel to get to their workplace, to learn at school, to shop, to be entertained, or to socialize with their relatives. What makes them different is that for some reason during the journey the individual becomes involved in criminal acts, either along the way at the destination of the journey, or on the way back. It is the crime that transforms the regular

journey into a crime journey. The criminal acts need not be completely unforeseen or impulsive, but they were not premeditated when the individual started the journey.

When the journey is motivated by criminal intention, committing the crime is the purpose of the journey. In some journeys with criminal intention, the destination of the journey is selected in advance. It is the location of the target of the crime. A planned bank robbery is a good example. In other journeys motivated by criminal intention, the destination is not selected in advance, but the motivated offender moves around while actively searching for attractive targets. Examples are motivated prospective burglars, rapists, or shoplifters that wander around in hopes of finding an attractive opportunity to commit the crime.

Some offenders are not actively searching but wait for serendipity (Jacobs, 2010) to expose them to good criminal opportunities. In terms of the strength of the criminal motivation, these crime journeys are intermediate between the two types discussed previously.

To learn about the motivations for crime journeys, we must know what the reasons were for the offender to be present at the crime scene. What is particularly interesting is not only how many crime journeys are started with and without criminal intentions but also what the motivations were for the journeys that started without criminal intentions. What activities were the offenders pursuing when they became involved in crime? Empirical evidence on this issue is scarce, scattered, and mostly anecdotal. Studies based on police records and other criminal justice sources typically do not systematically collect information that helps answer the question, and offender-based researchers do not always cover the topic systematically either.

Some offender-based studies on modus operandi and crime planning are helpful because they provide details on the original, noncriminal motivation of crime journeys. For example, when reporting on an offender-based study on 113 Californian robbers, Feeney (1986) noted that

of the 30 percent of robbers who committed a robbery in a town other than were they lived, half had gone there for the purpose of committing a robbery. The others were there to visit friends or relatives or were just passing by (Feeney does not discuss where they were headed). Other research on robbery also suggests that a considerable percentage of robberies feature minimal planning (Wright, Brookman, and Bennett, 2006; Wright and Decker, 1997). In a sample of 243 incarcerated Australian burglars, when asked about the reason why they were in the area when they committed the burglary, only 47 percent answered they were there with the purpose of perpetrating a burglary. The others answered they were there to visit friends, to shop, by chance, or because the place was near their home (Fernandez, Clare, and Morgan, 2006). School or work were not mentioned, which may either imply that the respondents did not have much school or work commitments (not discussed in the report) or that burglaries were never committed during their school or work commutes.

Given that burglary and robbery are usually considered to involve more deliberation and planning than many other types of crime (e.g., Rhodes and Conly, 1981, 178), it seems reasonable to conclude that the majority of crime journeys are initiated with a noncriminal intention. This does not imply that most crime journeys proceed in the same way as regular journeys. Some aspects may differentiate crime journeys from other journeys, for example alcohol use or the company of peers. In addition, the fact that a crime was perpetrated at some point in time may alter the subsequent journey in important ways.

5.2 Route

Systematic empirical information on the routes of crime journeys is almost completely lacking from the literature. A very informative exception is the study of 16 parolees' crime journeys that were recorded with GPS tracking technology (Rossmo et al., 2012) that was already discussed.

While being monitored these parolees committed a variety of violent, sexual, property, and drug offenses. The data gathered in this study allowed the authors to reconstruct and visualize the routes of crime journeys with great temporal and spatial detail and compare them with regular noncrime journeys during the week preceding the crime.

By visual inspection they informally identified various patterns in the data. Some parolees had repetitive travel patterns in the days preceding the offense but diverged from their normal route on the day of the offense. Others visited the location that would become the crime site regularly during the days preceding the offense, which suggests that the location was part of their normal daily activity space.

One of the parolees displayed a pattern that according to the authors could indicate purposeful hunting behavior: he drove along the (future) crime site without stopping on one day, passed it again two days later making extra turns and stops before driving on, and displayed the same behavior on the next day, just before committing the offense. Interestingly, some offenders traveled on the day of the offense but ended up committing the offense in their own home.

5.3 Distance and Destination

Because a journey implies movement, distance is an essential aspect. The distance of a crime journey is the total distance that the offender covered before, during, and after committing the crime. This would normally cover the time period between leaving an anchor point or reference location and returning to it after having committed the crime. Occasionally, the endpoint could be another anchor point, for example by someone leaving home in the morning, committing a crime, and checking into a hotel afterward.

Distance is the only aspect of crime journeys that has been studied extensively; the first systematic study was conducted by White (1932). Studies documenting the distance of crime

journeys are referred to as "journey-to-crime studies," and many dozens of them have appeared during the past decades. Reviews of this literature include Wiles and Costello (2000) on property crime and Beauregard, Proulx, and Rossmo (2005) on sexual offending.

Except for Pettiway (1995), who collected crime journey information of crack users through personal interviews, the studies have been based on police-recorded data of detected crimes. The distance is usually defined as the Euclidian (crow's flight) or Manhattan (city block) distance between the offender's residence (as recorded by the police) and the location of the crime (as recorded by the police). Occasionally distances are measured in terms of the estimated average time required to travel from the offender's home to the crime site. In situations where the offense itself included movement (e.g., when a person was kidnapped and taken to another place), multiple places may have been recorded, but such studies are extremely rare (e.g., Beauregard and Busina, 2013).

The literature on the distance-of-crime journeys has produced a number of stable findings. Many studies have demonstrated that most offenders commit crimes within a short distance from where they live and that offenders are less likely to commit crimes as the distance from their home increases. This pattern, which has been observed in many mobility-related phenomena such as work commutes, residential mobility, holiday trips, and international trade, is called "distance decay." The interpretation of the pattern is that distance represents friction, impedance, or a barrier between two places, because costs are involved in moving persons and objects from one place to the other. When selecting a place to pursue an activity, and having available two equally attractive alternatives, people would generally prefer the one that takes the least time and effort to reach. Because a considerable proportion of crime journeys are initiated with noncriminal intentions, the interpretation that "offenders prefer nearby targets over distant

targets" may not be entirely reflect the origin of the distance decay phenomenon. A more likely explanation is that to perform any given activity, people prefer nearby locations over distant ones. The distance decay pattern in crime journeys is merely the logical consequence of the presence of a distance decay pattern in all human activity. An activity-corrected *criminal* distance decay would exist if the distance to crime is smaller than the offenders' average distance to their homes (a hypothesis that could be tested with the space-time path data of offending parolees [Rossmo et al., 2012], discussed elsewhere in this essay).

The distance decay pattern in crime has been hypothesized to contain a "buffer zone," an area around the offender's residence in which offenders are less likely to commit crimes (Rossmo, 2000). There is however little empirical evidence to support that claim (Kent, Leitner, and Curtis, 2006; LeBeau, 1987).

Offender characteristics such as sex and age have been related to variability in distance, and the findings suggest that demographic groups with an lower access to motorized vehicles, such as women (Rengert, 1975) and adolescents (Canter and Larkin, 1993; Snook, 2004; Van Koppen and Jansen, 1998; Wiles and Costello, 2000) travel shorter distances, although a recent large-scale study established the relation between age and distance to be inversely U-shaped (Andresen, Frank, and Felson, 2014). Distances to property crimes are generally found to be larger than distances to violent crimes (Baldwin and Bottoms, 1976; Hesseling, 1992).

The limiting role of distance on crime is also explored in studies of criminal location choice (Baudains et al., 2013; Bernasco and Block, 2009; Bernasco et al., 2013; Clare et al., 2009), where distance is an independent variable and the destination of the crime journey is the dependent variable. Without exception these studies demonstrate that the probability of committing a crime at a certain location decreases with the distance of that location from the

offender's home. The effect has even been shown to apply to offenders' former homes (Bernasco, 2010), suggesting that the role of distance is not simply an issue of reducing time and effort but also an effect of familiarity: most people, including offenders, are more aware of and familiar with nearby locations than with distance locations.

5.4 Direction

All movement in space has direction. A handful of studies has addressed the direction of crime journeys. As has been the case in studies of distance, studies of direction have measured the direction of a crime journey as a vector from the offender's home to the location of the crime. No single work has hypothesized that absolute direction matters for crime journeys, that is, that something general can be learned about crime journeys by knowing whether it is headed north or west or in another direction. Studies of direction in crime journeys have instead been concerned with directional consistency. Except for one study (Costanzo, Halperin, and Gale, 1986), which demonstrated that offenders living near each other tend to travel in similar directions, all others address intraindividual directional consistency; that is, they assess whether serial offenders, when perpetrating crimes, tend to travel in approximately the same directions as they did on previous and subsequent crime journeys.

Offenders are directionally consistent if they repeatedly commit crimes at locations that are situated in the same direction from their main anchor point. This may occur if all habitual travelling occurs in the same direction from their home, for example if they live at the outskirts of a city and all professional and leisure activities require inbound travel. Alternatively, individuals may be directionally consistent if they habitually travel in several directions but only one single route offers them attractive criminal opportunities.

There is no consensus in the literature about the details of how directional consistency should be measured. Lundrigan and Canter (2001) and Goodwill and Alison (2005) use sequential angulation, in which only the angles between pairs of consecutive offenses are taken into account. In two other studies (Kocsis et al., 2002; Lundrigan and Czarnomski, 2006) directional consistency is calculated as the largest angle between any pair of crimes in the series. Frank, Andresen, and Brantingham (2012) propose using the smallest angle that encompasses a large percentage *p* of the crimes in the series, while Van Daele and Bernasco (2012) use the average angle of all pairs of crimes in the series irrespective of sequential order. Except for Lundrigan and Canter, all other studies established considerable directional consistency.

5.5 Travel Mode

Again, the research literature does not provide many details about the mode of travel in crime journeys. Two exceptions are from the Netherlands and Australia. They demonstrate that in commercial robbery and in burglary the car is the main transport mode but that, surprisingly, large percentages of robbers and burglars arrive by foot at the location of the crime.

In the Netherlands, Van Koppen and Jansen (1998), using court records to collect data on commercial robberies, found that commercial robbers used various modes of transport to robbery sites, including car (52 percent), walking (29 percent), bicycle (12 percent), motorcycle (4 percent), and public transport (4 percent).

An offender-based study of burglary (Fernandez, et al., 2006) reported that the majority of burglars arrived by car (45 percent) or walking (also 45 percent) in the target area, and 83 percent left the target site with the same mode of transportation.

5.6 Journeys During and From Crime

Some crimes involve movement, in particular abduction, car-jacking, smuggling, and sometimes sexual crime and homicide. In a rare study of the journey during crime (Beauregard and Busina, 2013), it was suggested that sexual offenders purposefully changed location during the crime (meaning in this case between encountering the victim and releasing the victim) in order to be able to complete the crime and avoid detection and arrest.

Where and how offenders move after committing crime may be as interesting as how and from where they came. For example, the police might be particularly interested in where burglars go to dispatch stolen items or where commercial robbers escape to after having committed a robbery. The only systematic study of the journey after crime (Lu, 2003) is a study on vehicle theft. It related the location where the vehicle was stolen to the location where it was recovered (and apparently left behind by the thief).

Given the mentioned lack of realistic crime-journey data, it is not surprising that little is known about what people do and where they go during and after committing a crime. The journey from crime is an ordeal for the minority of offenders who are caught in the act, arrested, and taken to the police office and trivial for the scholar studying it. But the journey from crime made by the large majority of offenders who manage to escape detection and arrest, is indeed a very interesting topic to explore.

6 Future Directions

Some crimes can be committed at a distance and do not require a crime journey. Two examples are stalking a victim over the telephone and breaking into a computer through an online connection. Although online crimes may proliferate as information and communication services continue to develop, most types of crime still require that offenders and targets physically

converge in time and space. As a result, crime journeys will continue to be relevant in the era of information and communication technology.

The mixture of planning and opportunism in the commission of crimes is an issue that touches on many topics in criminology, including crime journeys. Rational choice theory suggests that crimes are planned and that the required journey is part of the "master plan": crime journeys are undertaken with the sole intention to commit a crime, in some cases even against a predetermined target at a predetermined place. In contrast, crime pattern theory suggests that many journeys to crime are not undertaken with the intention to offend. Instead, they result from opportunities or provocations that offenders unexpectedly encounter at the places where their daily routines take them. Jacobs (2010) distinguishes a category that is situated between completely planned and completely haphazard offending, which he labels "manufactured serendipity." In manufactured serendipitous offending, individuals do not follow a preplanned crime script but nevertheless travel to places and enter settings where they are likely to encounter criminal opportunities.

A deeper understanding of crime journeys may lie in the proper distinction of these different types of crime journey. In the explanation of planned crimes, travel characteristics (time, destination, route, mode, company) are phenomena in need of an explanation. They are dependent variables, thus they are consequences. When, where, how, and with whom offenders travel can hopefully be explained by analyzing their purposes and their restrictions. However, in the case of haphazard crimes, these travel characteristics are not selected with criminal intentions, and therefore they are not in need of a criminological explanation. These characteristics potentially are, however, situational explanations of crime. They are independent variables; thus they are causes. For example, if an adolescent paints graffiti on a wall we may

relate the act to instantaneous situational features, including where he is, whether peers or adults are present, and whether or not he is intoxicated (see Bernasco et al., 2013). But the act of crime may also be related to characteristics of his journey, including where he came from and where he is heading, what the route and mode of travel were, and so on. In sum, the theoretical status of a crime journey depends on whether the crime is planned or haphazard.

Few studies have addressed the individual and social context of crime journeys. From a transportation science perspective this is remarkable, because transportation science emphasizes repetitive travel behavior and habitual travel patterns and also stresses the social embeddedness of transportation decisions. One example is the lack of attention to series of journeys and series of crimes committed by the same offender. In most studies, crime journeys are analyzed as if they were isolated observations. But the fact is that they are not: an offender's crime journey today must be affected by his or her previous crime journeys: Where and when were these crimes committed? Were they successful? What did the journey look like on that occasion? As an exception to the rule, some work has analyzed multiple offences committed by serial offenders in order to distinguish intraoffender and interoffender variations in home-crime distances (Smith, Bond, and Townsley, 2009; Townsley and Sidebottom, 2010).

Another example is co-offending. Co-offending is quite common, especially among adolescent offenders. However, in the study of crime journeys co-offending is typically ignored. Crimes jointly committed by two or more co-offenders are analyzed as if they are two or more independent observations (two exceptions are Bernasco, 2006, and Levine and Lee, 2013). This is disappointing, in particular because co-offending challenges theories. Who is, in terms of rational choice theory, the actor in the decision-making process? How do offenders reach agreements? In terms of space-time geography, co-offenders have to work under double

constraints: if one offender has discretionary time between 2 and 5 PM and the other between 4 and 7 PM, it leaves them only a single hour (4 to 5 PM) in which both have discretionary time.

In addition to smartphones and geographic tracking devices, other information and communication technology is also likely to be used in future research on crime journeys. In part, the rise in surveillance and monitoring technology will be responsible for recording much more information on our whereabouts, including the whereabouts of those who violate the law. Ubiquitous presence of CCTV in public and semipublic space is already used by the police to obtain information of offenders' journeys to crime and their journeys from crime (when they escape the crime scene). DNA collection at crime scenes as a quickly proliferating field and is now in many countries a standard procedure not only in case of murder, rape, and other very serious crimes but also in high-volume crimes. Linked DNA traces of identified and unidentified offenders can tell us something about the size of their action radius.

The collection of simple factual information on times, routes, and modes of crime journeys is currently the most pressing research need. We know a lot about how people get to school, work, or the grocery store but almost nothing about how they reach the location where they commit crime. The availability of valid, reliable, and detailed descriptive information is a prerequisite for starting to answer explanatory questions.

Such information is also a prerequisite for practical applications, such as the development of strategies to help solving crime. Geographic offender profiling (Rossmo, 2000) is a good example of an established technique. It is an investigative method for prioritizing geographic areas in the search for an unknown serial offender's home. The technique is based in the widely corroborated fact that the home–crime distance is subject to decay (frequency of crimes decreases with distance).

In the absence of a more comprehensive knowledge base about crime journeys, one can only speculate potential applications. Knowledge of the type of locations where offenders spend time before arriving at the crime scene might help solve cases. For example, if one were to find that the majority of offenders are home during the hour leading up to the offense, geographic profilers should focus on finding an offender's home address. If, however, one were to find that most offenders are at school or at work just before committing the crime, they should focus on finding their school or workplace.

Another potential use is found in knowledge about the journey after crime in case of overt crimes that involve offender–victim interactions (e.g., assaults, robberies). These crimes are most likely to be reported when the offenders are still escaping the crime site, and police strategies aimed at catching offenders red-handed may be informed by knowledge of various aspects of the journey after crime. For example, if one were to know that most urban robberies are committed by local residents who immediately return home by foot when leaving the crime site, it may not be advisable to post along main roads and highway exits. The reverse would be true if most robberies are committed by commuting offenders trying the leaving the crime site and the city by motorized vehicle.

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