

# FORAGING STRATEGIES OF HOMO CRIMINALIS: LESSONS FROM BEHAVIORAL ECOLOGY\*

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Many theories attempt to address who commits criminal behavior. Few theories attempt to address how they do it, why a particular place, why a particular time, and why a certain target. This article explores whether these questions can be answered with the help of optimal foraging theory. The theory is used in behavioural ecology to explain how animals search, choose, and process food. This article utilizes the theory to derive hypotheses concerning offence specialization, the use of time and space by property offenders, and the influence of the presence of police on behavior.

Etiological questions in criminology have typically addressed the inclination toward criminal (or delinquent, antisocial, deviant) behavior, distinguished perpetrators of criminal acts from those who are not perpetrators, and examined conditions that lead to criminal conduct from conditions that impede it. The majority of criminological theories are oriented toward answering questions on sources of motivation for the commission of crime or lack of motivation to withstand the seductions of crime. Accordingly, offenders are the locus of most theories of crime. This is reflected in the amount of space reserved for them, and for etiological theory, in most textbooks on criminology (for instance Vold, Bernard, and Snipes 2002). There are also questions regularly asked in criminology that focus on the acts performed by criminals. These questions are formulated primarily in a branch called environmental criminology (for an overview see Bottoms 2007; Bottoms and Wiles 2002; and Brantingham and Brantingham 1981). They are not primarily concerned with who commits crimes and why, but focus on the manner in which the crimes are committed and the circumstances surrounding the acts: where, when, how, and against what targets. These are the questions of environmental criminology, in which the willingness to transgress rules is accepted as a given so the focus turns to the way in which criminal conduct is enacted.

## Posing the Question

Environmental questions on how crime is enacted are perhaps regularly asked in criminology, but elaborated theories that explain behavioral variations are rare. Sometimes,

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routine activities theory (Cohen and Felson 1979) is used to answer such questions. According to this theory, crime arises from patterns of ordinary legal activities. When these patterns lead to motivated perpetrators and unprotected targets being present in the same place at the same time, the necessary and sufficient conditions for criminality are fulfilled, and crimes will occur. By this theory, crime is thus a question of “systematic coincidence.” An objection to this approach is that it does not take the goal-oriented behavior of many perpetrators sufficiently into account. For many of them, committing crimes is an everyday routine. Moreover, many criminals do not merely encounter unprotected targets by accident but consciously go in search of them, as is shown by the findings of many ethnographic studies (e.g., Wright and Decker 1997, 1994). Rational choice theory (Cornish and Clarke 1986) is also frequently used to answer environmental questions on crime. This theory is not concerned with criminal motivation either, but in this case because it assumes that every person is in principle prepared to commit crime. Rational choice theory regards every form of behavior as a goal-oriented choice directed toward accomplishing objectives. The point of departure is that, after weighing the advantages and disadvantages of various alternatives, a choice is made which is optimal given the aim (benefit maximization). Rational choice theory itself is abstract and requires supplementary empirical content through specification of the relevant aims and choice situations. To be able to apply rational choice theory to questions of how crime is enacted, a supplemental theory is therefore often necessary with respect to the choice situations with which individuals are confronted as they make decisions about when, where, how and against what target an offense will be committed.

In the present paper, I investigate to what extent optimal foraging theory (OFT) can be applied in formulating and answering environmental questions in criminology. OFT is a theory in behavioral ecology that seeks to explain the manner in which animals meet their need for food. The most important reason for investigating the applicability of this theory is the nature of the questions that OFT is intended to answer: what the animals eat (why this and not that?), where they seek food (why here and not there?), when they seek food and for how long (why now and not then?), and how they eat (why in this way and not differently?). These questions display many similarities with the descriptive and explanatory environmental questions in criminology listed above (for this, see Felson 2006). They deal with the way in which behavior is enacted—where, when, how, with whom—and not with the question of whether the behavior will occur in the first place. If questions in behavioral ecology show such similarities to environmental questions in criminology, then we can perhaps learn something from the answers behavioral ecology gives to these questions. This article continues with a general sketch of OFT, summarizing the assumptions that underlie the theory. The sections that follow include a discussion of how OFT can be used in explaining specialization, spatial localization of targets and the use of time in criminal behavior. The overall goal of the discussion is to address the question of what criminology can learn from OFT.

### **General Sketch of OFT**

All living things require food. Many species of animals have a daily routine by which they meet this need. Foraging behavior includes searching for, selecting, obtaining, and consuming of food. OFT explains and predicts how animals go about this. Three important choices to be explained are the choice of diet (what they eat), the selection of a foraging territory (where they obtain it) and the length of time spent in the foraging territory (how long they stay

there) (Pyke, Pulliam, and Charnov 1977; Pyke 1984; Schoener 1971, 1987; Stephens and Krebs 1986). In criminology, these three questions can be translated into the questions of target selection and behaviors concerning space and time in offenses involving property.

OFT is a component of behavioral ecology, a branch of biology that studies the ecological and evolutionary basis for behavioral patterns (Krebs and Davies 1993). OFT arose 40 years ago when models were developed in which an animal's choice of food was considered as an optimization of energy intake per time unit, determined as a result of natural selection (Emlen 1966; MacArthur and Pianka 1966). OFT proposed that within the restrictions imposed by their environment and under the pressure of natural selection, various animal species developed foraging strategies that maximize the number of calories ingested per minute. The explanatory mechanism of OFT thus rests on two principles: optimization and natural selection. Thus, OFT explains how ecological restrictions influence foraging strategies.

In the first formulations of the theory, it was primarily the availability and spatial distribution of alternative sources of food that functioned as ecological restrictions. In revisions of the theory, a third factor was added – the presence of natural enemies and the accompanying risk of predation. More recently, a fourth factor, competition for food with both other species and with congeners, was proposed.

The central core of OFT, like that of rational choice theory, is derived from the neo-classical micro-economics concept of goal-oriented behavior. According to OFT, the purposefulness of the behavior is a result of the mechanism of natural selection: optimizing foraging strategies consists of making choices that increase the chance of offspring. As a consequence, less than optimal foraging behavior disappears from the species repertoire.

### **Application Of OFT to Crimes Against Property**

To successfully employ OFT in criminology, it is necessary to translate the key concepts, and determine the extent to which the theory can be applied to the study of criminal behavior. In the next sections of the article, I indicate how a number of questions in environmental criminology can be approached with the aid of OFT. The discussion is limited to property crimes because all cases this large group of crimes have one common element that can be specified beforehand – the value of the illegally obtained property. In the application of OFT to crimes involving property, the monetary value of the property to be acquired per unit of time functions as the monetary unit that permits the results of alternatives to be weighed against one another. The assumption that, in crimes involving property with all other factors being equal, every offender will prefer a more valuable take over a less valuable one. This is plausible enough for further exploration, but also leaves room for other possibilities, such as experiencing the pleasure of a crime or the exertion of violence.

### **Choice of Target and Specialization in Offenses Involving Property**

Almost since its beginnings, there has been an ongoing debate in criminology about criminal specialization. It involves such questions as to what degree offenders specialize in certain types of crime (Wolfgang, Figlio, and Sellin 1972), and which offenders are specialists and which are generalists (Mazerolle et al. 2000). Although there has been progress in this field methodologically, there is no theory at present that explains why certain patterns of specialization occur and others do not. To answer questions about how animals select their food,

optimal diet models (sometimes called prey models) have been formulated (Stephens and Krebs 1986). These models suppose optimization of energy intake per time unit, and proceed from the assumption that eating and seeking food are competing activities. Three testable hypotheses follow from the basic model (Pyke 1984; Stephens and Krebs 1986):

*The 0-1 Rule.* If a certain type of food is encountered, either every specimen encountered or none of the specimens encountered will be selected. If a type of food is in the optimal diet, it will always be selected; if it is not in the diet, never.

*Ordering by profitability.* Types of food are ranked according to profitability (i.e., the ratio of calorific value and necessary ingestion time). As the availability of more profitable types of food, or of all types of food increases, less profitable types of food disappear from the diet. As less profitable types of food become available in larger quantities, the diet does not change.

*Independence from availability.* Whether a type of food is eaten does not depend on its availability, but exclusively on the absolute availability of more profitable types of food.

This basic model of OFT offers possibilities for application to offenses involving property, in which the monetary value of the takings can be regarded as analogous to caloric nutritional value. Thus, we assume that perpetrators involved in property offenses are out to maximize their “criminal hourly wage.” A further point to be specified is which types of targets should be distinguished for an application of the model to property crimes. If the purpose of the theory is to understand the degree of specialization of offenders involved in crimes against property, then we should distinguish basic types of crime by targets (shoplifting, burglary, auto theft, purse snatching, pick pocketing, armed robbery, etc.). Three verifiable hypotheses, applied to shoplifting and burglary on the supposition that the latter is a more profitable type of crime than the former, are therefore:

*The 0-1 rule.* If an opportunity for successfully committing a burglary presents itself to a person, he or she will always take this opportunity or never take it, but not sometimes do so and sometimes not.

*Ordering by profitability.* Perpetrators of offenses against property rank types of crime according to their profitability (monetary value/time required). As the availability of profitable types (for example, burglary) increase, for instance through the increase of portable electronic apparatus in homes, or if the availability of all types of crime increase because of a decline in police surveillance, then they will commit fewer less profitable types of crimes (for example shoplifting). Thus specialization will occur.

*Independence from availability.* Whether someone seizes the opportunity to commit a certain type of crime, such as shoplifting, is not dependent on the availability of the opportunities for shoplifting, but exclusively on the availability of more profitable types of crime.

If the purpose of the theory is to investigate the specificity of the selection of targets for a specific type of crime, then it is obvious to distinguish targets as categories of objects (victims or items). A theory of optimal shoplifting then will distinguish categories of items (from candy bars and lipstick to power drills and fur coats), a theory of optimal auto theft will distinguish various types or brands of autos, and a theory of optimal burglary will distinguish various types of dwellings (student dormitories, flats and apartments, row houses, freestanding villas).

## **Length of Stay and Use of Time in Property Crimes**

Food is generally not equally distributed, but is concentrated in particular “patches.” For example, some species of plants only grow near water in the shade, birds find concentrations of shellfish around specific rock formations, and squirrels find acorns only under oak trees. For many animals, the distribution of food in patches and the fact that a patch may be exhausted by continued foraging, produces foraging strategies with the following steps: searching for a suitable patch, foraging there until it is no longer profitable, and then searching for the next patch. One model for the optimal investment of time in patches is the marginal value theorem (Charnov 1976), otherwise called the patch model (Stephens and Krebs 1986). According to this model, animals continue foraging in a patch until the marginal energy intake per unit of time falls to the average long term food intake in the animal’s habitat. This model implies that animals spend less time in patches that yield less nutritional value than they do in patches that yield more. It also implies that the length of stay in a given patch will be longer if the average availability of profitable patches in the environment decreases, or if the distances between patches increase.

This model for the use of time can be applied to property crimes in various ways, for which the choice of the criminological equivalent of a patch is a variable. For pickpockets the patch can be a train station, shopping mall or other place where people congregate. For burglary a dwelling can be regarded as a patch. The phenomenon to be explained is then the time spent in the dwelling; and one hypothesis is that the greater the amount of portable goods available in the dwelling, the longer the burglar will remain. Another hypothesis, which in this case follows from the application of OFT model, is that to the extent that there are fewer similar dwellings (that is to say, alternate patches) available in a neighborhood, the time spent in the dwelling will be greater. It can also be expected that the length of time spent in the dwelling will increase in proportion to the time that is needed to obtain entry to dwellings.

In the case of burglary, a street or a neighborhood can also be regarded as a patch of homes suitable for burgling. Here, the phenomenon to be explained is how long a burglar continues to commit burglaries in one night, week, or month in a particular street or neighborhood. Spatial-temporal patterns of burglary suggest that burglars or groups of burglars often commit multiple burglaries immediately or shortly after one another in the same vicinity, sometimes within the same 24-hour period (Bernasco 2007). A theoretical and practical question that remains is what causes them to stop with burglaries in a particular neighborhood at a certain point. According to OFT, the answer is connected to the increasing difficulty in finding suitable targets and the decreasing amount of goods to be obtained. That means, for instance, that the chance that a burglar or group of burglars will continue with a series of burglaries in the same street or neighborhood decreases as the average take from the burglaries decreases. Among other things, the percentage of unsuccessful burglary attempts (in which effort is expended without any return) will contribute to the cessation.

## **Committing Crimes from a Fixed Base of Operation**

The relation between the places where perpetrators live and where they commit their crimes is a key theme in environmental criminology. The two questions here involve the 1) the distance between the location where the perpetrator lives and the location where the offense is committed, and 2) to what extent this distance differs among types of perpetrators and types of offenses. These questions would seem to lend themselves well to OFT models for the choices

made by animals that return to a home base or anchor point with their food during foraging. This foraging pattern is called central place foraging (Kacelnik 1984; Orians and Pearson 1979; Pyke 1984; Stephens and Krebs 1986). An advantage of this type of foraging is that the food can be consumed in a safe environment. Species of animals that collect stores of food, such as squirrels, and species in which the parents forage for their immature young, such as most birds, also follow this foraging pattern. Central place foraging is also typical of human hunter-gatherer societies (Gurven, Hill, and Jakugi 2004; Smith 1983), and has been studied extensively in anthropological and archaeological research. The principles of optimization also apply to central place foraging, but the travel and extra effort connected with the return trip have different or additional implications. There are diverse models for central place foraging that all differ somewhat from one another with regard to assumptions about circumstances and limits. Some models are based on the assumption that the supply of food in a patch is not used up or reduced during the foraging, while other models make that assumption. The following general hypotheses can be derived from most of the variants:

- The minimal acceptable nutritional value of a chosen type of food increases with the distance to the home base; thus the further away from the home base, the more selective the choice of food (i.e. specialization).
- The greater the distance between the location where food is found and the home base, the longer the time that is spent in the patch.

Orians and Pearson (1979) distinguish between species of animals that can only carry one item of food (single-prey loaders) and species of animals that can carry several items (multiple-prey loaders). The most important difference between the two behavioral models is the more complicated choice that the multiple-prey loaders have to make: with each new item of food acquired, they must constantly decide if it is time to return or to continue searching. As they make this decision, they are always taking into account the weight of the items already collected. To keep the distance that the heaviest load has to be carried as short as possible, it is also best to keep the distance between the home base and the location where the last item of food is obtained as short as possible.

The models developed for central place foraging in OFT would appear to be applicable to the movement habits and selection of targets by perpetrators in property offenses. As a rule, such offenders also operate from a fixed home base and return there daily, or even more often, even if this base of operations is temporary or of a provisional nature. If we assume a methodical or planned mode of target selection (Bennett and Wright 1984; Elffers 2004), the above hypotheses can also be translated into hypotheses about the movement and target selection of perpetrators of offenses against property. The first hypothesis then becomes:

- The minimal acceptable value for goods increases with the distance to the base of operations. The further away from the home base, the more selective the perpetrator of property crimes will be in the choice of targets (i.e., specialization, a positive relation between the distance between the location where the crime is committed and the home base, and the value of the take).

Although it is outside the purpose of this paper, it is interesting to note that, in environmental criminology, there is support for this finding coming from studies of robbers (Capone and

Nichols 1975; Van Koppen and Jansen 1998) and burglars (Snook 2004). Explicitly citing a foraging hypothesis formulated by Felson (2006) with regard to offenders in general, Morselli and Royer (2008) found that greater distances traveled for crime are associated with higher criminal earnings.

A second hypothesis, which has never been the subject of investigation, reads:

- The greater the distance between the home base and the target location, the more time (exclusive of travel time) will be spent at the target location.

A limitation on the applicability of OFT models for central place foraging is that, as a rule, they assume that the size and weight of an item of food is proportional to its energy value. That may be the case in nature, but is far from always being true for property crimes. For example, cash, jewelry, and portable electronic apparatus are both valuable and highly portable. In criminology, the implications that apply to single-prey loaders and multiple-prey loaders in OFT are perhaps more easily related to the various means of transport that perpetrators of property offenses have at their disposal. Like single-prey loaders, those who travel on foot have a much more limited carrying capacity than those who have access to a motor vehicle. However, this analogy too has its limitations, because in nature carrying capacity and speed of movement are inversely related, while in this criminological translation they are not (an auto or motor scooter is not significantly slowed down by a larger load). The translation of OFT into the practice of offenses against property thus needs to be adapted. The value of OFT is that it emphasizes that choices about distances, travel costs, and the transport of stolen property are important, and that the return trip is of greater import than the outbound run.

### **The Risk of Apprehension and Prosecution**

In general, behavioral ecologists proceed from the assumption that foraging is a risky business, if only because it demands, and diverts, attention that cannot be devoted to avoiding natural enemies, who are also foraging. If this assumption is not further specified, and there are thus no distinctions made among diverse risks involved in various alternative foraging strategies, then it functions only as a general condition for optimal foraging behavior (eat as much as possible given the time available, or eat as quickly as possible given the available food). The maximization of energy intake per unit of time can, however, conflict with the avoidance of natural enemies. One example would be a bird that avoids a patch containing abundant food because cats often lurk in the area. The choices that various species make in situations of this sort are also considered in OFT. Optimization presupposes a general "unit of exchange," and that criterion is not met if there are more interests in play than only optimization of nutritional value per unit of time. If that is the case, then there must be a weighing of the degree to which the various criteria for choices are being met. For situations of this sort, OFT makes use of the principle of benefit maximization and of the armamentarium of micro-economic choice theory.

With the inclusion of this element of the theory, OFT moves from being an a priori specification (in which behavior can be predicted purely on the basis of measured units) to an a posteriori approach, in which the behavior observed is retrospectively interpreted in theoretical terms (Stephens and Krebs 1986, 105), a situation which is common in economics and other social sciences. Most animals that run any risk of being eaten display behavior that reveals vigilance, and that interferes with the efficiency of foraging (Lima and Bednekoff 1999). For

example, birds that seek food on the ground are constantly searching their surroundings for signs of danger. Anyone observing rabbits will see them constantly moving their ears to detect danger on either side of them. Research indicates that animals can recognize an increase in the risk of predation and suitably adjust their behavior to it by showing increased vigilance. For criminals the police, victims, or bystanders can play the role that natural enemies play in OFT. For the offender involved in a property crime, they represent a potential danger or a threat of failure during the commission of a crime. In explaining the behaviors of perpetrators, we can make use of what we know about the behavior of foraging animals. For instance, it can be assumed that when the chance of arrest increases, offenders involved in property crimes will decrease the intensity of their criminal conduct in the interests of vigilance. The vigilance of offenders will be expressed in more frequently checking to see if the coast is clear, in more thorough arrangements for flight, more attempts at concealment and deception, and in the choice of locations for criminal attempts where the chance of being detected and arrested is relatively small and the possibilities for escape relatively plentiful.

## Discussion

In many respects, perpetrators of crimes against property are faced with choices that are analogous to those faced by foraging animals; and it is quite possible that they employ similar strategies and reach comparable conclusions. In the preceding I have tried to show that the diversity in foraging behavior and foraging circumstances do reveal analogies for offenders against property, which in many cases are usable for arriving at focused and specific hypotheses. There are two possible reservations which must, however, be stated. The first involves the question of whether OFT, which I introduce as a possible “empirical supplement” for rational choice theory, is not too much like rational choice theory itself. A second qualification involves an important difference between foraging strategies and the commission of crimes involving property. An animal has no alternative for the former, but the offender does for the latter. These points are further discussed below.

### More Than Rational Choice Theory

OFT is based on principles of benefit maximization, and is closely related to rational choice theory. The question remains whether OFT offers advantages over rational choice theory. After all, even without reference to OFT, one can develop models for the spatial behavior, use of time, specialization and cooperation among criminal offenders with rational choice theory (see, for example, Deutsch and Epstein 1998; Deutsch, Hakim, and Weinblatt 1987; Elffers 2004). In formulating models of this sort, researchers may need models from other disciplines, but what they typically require are observations and interpretations from ethnographic research among offenders (Nee and Taylor 2000; Wright, Brookman, and Bennett 2006; Wright and Decker 1997). That is logical and sensible, because for underpinning a formal model one should seek a connection with reality, and not another formal model. Behavioral ecologists cannot ask their subjects for explanations, but criminologists often interview their subjects and should make use of the answers. If it is possible to enrich rational choice theory with observations from ethnographic research, it should also be possible for OFT. That the application of OFT to phenomena studied by criminology can be fruitful is primarily to be credited to the behavioral

ecology bridge assumptions that are necessary for the application of formal models to the behavior of animals. These appear to be productive in the formulation of new questions (for instance, regarding the use of time in the commission of crime) and new hypotheses (for instance about specialization) in criminology. The application of OFT is thus indeed an application of rational choice theory to criminality, but an application that is inspired by and can be enriched with developments and empirical findings in another discipline.

### **Eating Is Necessary, Stealing Is Not**

Another possible objection against the application of OFT to criminology is the observation that there is an important difference between the foraging behavior of animals and the behavior of people who commit offenses against property. All living beings must eat with some degree of regularity, or they die. There is no alternative for eating. Offenders against property, however, generally have legal alternatives available to them, rather than committing crimes. Perhaps the alternatives are less lucrative, or demand more time or effort, but they do exist. A further related difference between foraging behavior and the behavior of most offenders committing property crimes is the degree of involvement. For most animals, seeking and consuming food is a full-time, daily task that leaves only limited time for other activities such as defending their territory, reproduction, and caring for their young. For property offenders, seeking opportunities to enrich themselves is a secondary rather than a primary pursuit; and the proverbial opportunistic offender never even seeks out opportunities, but commits a crime only as the opportunity may present itself by chance. This means that the choices made by such opportunistic offenders (what, where, how, when and with whom to acquire property through crime) appear to lend themselves less to an explanation on the basis of OFT than choices of perpetrators who commit crimes involving property from strong and constantly recurring motivations (such as a drug habit). In the theory of Cohen and Machalek (1988) criminality involving property is regarded as an optional behavioral strategy that can co-exist alongside other behavioral strategies, and which, for certain categories of individuals or in certain life phases (youth) yields more than alternative (legal) behavioral strategies. A theory of this sort, however, addresses etiological questions, but teaches us little about environmental questions – questions on where, when, and how such behavioral strategies are enacted. The answer to those questions was the goal of this article.

### **What Can We Learn from Behavioral Ecology?**

There are not many theories available in criminology for answering questions about the way in which crimes are carried out. Only rational choice theory and routine activities theory contain elements that are able to answer environmental questions of this sort. These two theories are, however, formulated in such general terms that without further specification they are not verifiable. In many respects, OFT is more concrete, and therefore a means that can be used for this specification. Verifiable hypotheses about specialization and the use of time and space by perpetrators involved in crimes against property can be derived from OFT. These hypotheses can sometimes be surprising. This is the case for specialization, where according to OFT specialization is the norm and its opposite – versatility – does not arise from changing preferences or experiences, but exclusively from the scarcity of preferred targets. In other cases, OFT leads to new questions and hypotheses, as appears from the application of OFT to the use of time in crimes against property. Questions about how long burglars remain in a dwelling, and

questions about how long they continue to commit burglaries in a neighborhood, have seldom previously been addressed in criminology, although a recent study contains a detailed examination of the decision making and use of time by burglars when they are inside a dwelling (Nee and Meenaghan 2006). Finally, OFT also provides support for hypotheses that have previously been formulated and tested in criminology, for instance with regard to the phenomenon of distance decay and the relation between distance and the amount of the take. In various ways, then, behavioral ecology theories such as OFT can play a productive role in the development of criminological theory.

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