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Vandalism of vending machines: Factors that attract professionals and amateurs

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Abstract

A series of surveys were analyzed to determine how vending machine location and properties affected the likelihood of being vandalized. Two broad categories of vandals were identified, professionals and amateurs, by their vandalism methods. Both types were found to be rational in the sense of being drawn to areas where they could remain anonymous and could escape detection. Professionals were found to respond to the size of the monetary prize. Amateurs were drawn to public areas such as schools, parks, and grocery stores, where they appeared to be motivated by the possibility of an audience. As such, the behavior of amateurs is less amenable to economic analysis than to psychological or sociological study.

Introduction

Vandalism is a form of petty crime that is difficult to study. Property rather than individuals is typically the target, so witnesses usually are limited. Prosecution is often not cost-effective because each particular act of vandalism has a relatively low value, even though the aggregate cost is high. These factors make it difficult to collect data about vandalism or to learn about the motives of its perpetrators.

This article attempts to reveal the vandal's motives and thought processes by analyzing data sets on vandalism against soft drink vending machines. The data used in the study consisted of two surveys conducted in Philadelphia and Orlando, a related survey conducted by a major bottler in Atlanta, and the data from a bottler's survey of key-in frequency[1] at a set of hotels in Orlando. The questions on the survey related to the location of machine, some characteristics of the machine's location, and whether the machine had been vandalized, and if so, how. The type and relative frequency of attack was connected with the characteristics of the machine and its location, and the statistical relationships were used to obtain conclusions about vandal behavior.

The conclusions concern vandalism likelihoods in general. The data indicate that machines in hotels and apartments were much more likely than machines in other buildings to be attacked by vandals, and locations were more vulnerable when they were on major roads and in commercial areas. Factors that deterred vandals were a high frequency of machine service calls, fewer opportunities for concealment (places for the vandal to hide), and more expensive hotel rooms. These findings are similar to those obtained by other authors[2] who studied burglaries of homes and establishments, and they reflect a rational desire to vandalize most where anonymity is highest and detection is least likely.

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The second set of results is related to the price effect. Machines with a higher vend price have more money in them, which makes them potentially more attractive as targets. A difficulty arose in the estimation because hotels tend to have higher priced machines, and hotels tend to be targeted more frequently in general. Disentangling the two factors was not easy. In general, it seems that higher prices attracted more attacks, since higher prices attract more vandals, but more highly priced hotels tended to deter them; the fear of detection effect (in better hotels) dominated the effect of a greater prize, or loot.

The third set of results distinguished vandalism by amateurs from that by professionals. Several ways were used to determine if the vandal was an amateur or a professional. First, the surveys asked the vending machine routeman[3] to state whether he thought the vandalism was committed by a professional. Secondly, some types of attacks are used only by amateurs. The main example of this is "salting," a method whereby the vandal pours a saline solution into the coin or dollar slot, waits for a short circuit to result, and then retrieves the relatively small number of coins currently in the change mechanism. This process is slow and not financially lucrative. On the other hand, it does work, and might be used by someone that wanted to demonstrate prowess. Third, there are some methods of entry into a vending machine that are in the provenance of a professional. The prime examples being the use of contraband keys or a slide hammer to pop out the lock on the door.

The main conclusion in comparing the behavior of amateurs and professionals is that the amateurs tend to conduct their activity in areas that have a potential for a wide audience, such as in schools, parks, and grocery stores. Professionals have a relatively high presence in commercial areas of town as well as where the vending machine price is higher. Thus, the vandalism attacks done in an amateurish manner, like salting, seem to have motives more consistent with a desire to attract attention, while the vandalism attacks done in a more professional manner, with a key for example, are more likely in areas that allow for anonymity and a financial gain that is higher and quicker. Professionals' behavior can be explained with economic models of rational behavior. Explaining the behavior of amateurs requires more of the insights of psychology and sociology.

The remainder of the article is organized as follows: Vandalism Background and History section reviews previous research on the motives of those engaged in vandalism, burglary, and related criminal behavior. The Vulnerability of Various Locations to Vandalism Attacks section gives an overview of the distribution of vending machines and the likelihood of a vandalism attack for various locations and machine characteristics. A Multivariate Analysis of the Likelihood of Vandalism Attack section presents the results of several multivariate models that indicate the specific impact of machine location and characteristics on the likelihood of a vandalism attack. Vandalism in Hotels section contains an analysis of vandalism occurring exclusively in hotels, that supplements the results of A Multivariate Analysis of the Likelihood of Vandalism Attack section. Method of Attack: Professionals versus Amateurs section switches from a focus on the likelihood of attack to a focus on the method of attack. Here, the distinctions between amateur and professional attacks are most clearly drawn. The Conclusion section summarizes the article.

Vandalism background and history

Although property crime has received much attention from criminologists, the category of vandalism has received much less attention. Most existing studies focused on vandalism against schools and school property, and to a lesser degree, parking meters and phone booths.[4] The distinction between different types of vandalism is important because the motives are likely to be completely different. Vandalism against schools and public buildings is more likely to reflect anger and malice, while vandalism against vending machines is more likely to reflect the desire to acquire cash.

The magnitude of the vandalism problem is reflected in the official statistics. According to the Bureau of Justice Statistics (1995), total arrests for vandalism by all age groups rose by 16.3 percent between 1987 and 1996 and by 25.2 percent for those under eighteen. In the year 2000, there were 184,500 vandalism arrests in the U.S.[5] Between 1977 and 1989, vandalism incidents against the vending industry rose by 1.3–1.5 percent per year and dollar losses rose at 5 percent per year. A large Atlanta bottler reports that of the US$2 billion worth of machines in the field recently, roughly 10–15 percent are vandalized each year. With the growing presence of vending machines and increasing crime in urban areas, vandalism against vending machines is likely to continue to grow.

To understand the source of vandalism, the motives of vandals must be understood from the perspectives of both economics and social psychology. Cohen (1973) provided a general taxonomy of five types of vandalism: (1) *acquisitive vandalism*, committed to acquire money or property; (2) *tactical vandalism*, committed with the conscious intention of achieving some goal other than pure theft, such as promoting an ideology or drawing attention to some

cause; (3) *vindictive vandalism*, committed to avenge a wrong; (4) *malicious vandalism*, committed because the vandal enjoys inflicting harm and finds amusement in the destruction of property; and (5) *play vandalism*, committed to demonstrate skill or prowess, but not necessarily to inflict harm on the target.

Baron and Fisher (1984) suggested a class of motives that overlaps some of the Cohen taxonomy. They put forth an "equity-control" hypothesis that states that a vandal is conveying anger, expressing a view, and trying to achieve some psychological payoff. The anger is against a disrespecting world, the view is that he (the vandal) is worthy of respect, and the goal sought is respect from the world. "Equity-control" is the notion of obtaining a deserved and equitable level of control of the world by the vandalism act. Equity-control theory is related to the classical work of Hirschi (1969) that emphasized social control, and the notion that delinquency increases when the bonds to society are weakened or broken.

From a strikingly different perspective, Allen and Greenberger (1978) put forth an "aesthetic theory of vandalism," which attempted to relate the stimulus received from an act of vandalism with other stimuli that are known to be desirable, such as certain visual patterns, complexity, and surprises. From their perspective, vandalism is rational in the same sense that listening to music or observing fireworks is rational.

Economists tend to view vandalism as a type of burglary, which can be studied from the perspective of rational decision making, with decisions that balance potential gains against potential losses. The rational behavior assumption regards the burglar as motivated by the joint desire to acquire money or goods, but to avoid capture and punishment. Buck, Hakim, and Rengert (1993), Hakim, Rengert, and Shachmurove (2001), and Hakim and Shachmurove (1996) measured how much the likelihood of a burglary was affected by various features of the target location, such as its accessibility to major roads, the use of deterrents, and the value of the property contained in the home. They found, for example, that indicators of current occupancy, such as a car in front or motion-detecting lights, deterred burglars, whereas the presence of a dog generally did not. They also found that the probability of burglary diminished with the distance from a major road. Burglaries were more likely to occur on cul-de-sacs and quiet residential streets.

Further attempts to determine what makes property more susceptible to burglary and vandalism focused on routine activity and the social characteristics of the area.[6] Social factors that contribute to higher crime rates are relatively high levels of unemployment, young males, rental housing, and transient residents. These factors partially contribute to anonymity and reduce the likelihood of detection.

Physical characteristics of an area can also raise the susceptibility to burglary and vandalism. Malls and secondary schools are both common target areas. This may be due to the people drawn to those areas, or to the reduced likelihood of detecting and identifying a violator.[7]

An economics study that focused on the individuals committing crimes was that of Levitt (1998) who found that juveniles responded significantly to a change in the status of the courts that prosecuted them.[8] More punitive courts generated a lower incidence of crime among juveniles, other things equal.

The vandals that were the subject of this study were sometimes juveniles, as when vandalism occurred in schools and there was little pecuniary gain, but sometimes not, as with vandalism committed by professionals who were apparently more adept at obtaining pecuniary gain. The rational decision making assumption was the governing hypothesis throughout.

Vulnerability of various locations to vandalism attacks

The data was obtained from a number of sources, some of it directly by the authors through surveys conducted in cooperation with two bottlers in two majors cities during 1992 (Philadelphia and Orlando), and some was provided through proprietary records at a number of bottlers across the country.[9] Each survey provided a slightly different type of information, as described below.

The data used in the first analytical section of the article analyzed how site attributes affected the *likelihood* of vandalism, and were from the surveys conducted in Philadelphia and Orlando, as well as data provided by a bottler in Atlanta. The second analytical part analyzed how site attributes affected the *type* of vandalism and focused primarily on behavior within hotels and was based on a survey conducted by a bottler.

The vending machines that were the focus of this study were distributed across various locations[10] as described in Table 1. In all three cities, the most prominent location for a vending machine was at a place of work. Stores, schools, and shopping malls were also prominent locations. Hotels and apartments were less prominent, although for bottlers hotels can be a significant source of revenue and, as seen in Table 2, hotels and apartments were also both sources of significant problems.

Before proceeding with the main analysis, the contribution of the various factors to the likelihood of a vandalism attack is exhibited. The survey asked

Table 1
Distribution of machines (percent at each location type)

	Orlando	Atlanta	Philadelphia
At work	53	30	50
Apartment	1	3	1
Hotel	12	11	5
School	11	10	20
Store	11	31	12
Mall/shopping center	12	4	2
Rec. department	0	4	0
Other	1	6	10
Total[a]	100	100	100

[a] Total may not sum exactly due to rounding.

routemen who visited approximately 2,200 vending machines in the cities to report on several attributes of the machines visited and also whether they had been vandalized. Visits during a two-week period allowed for a computation of the likelihood of vandalism during the two-week spell. From that, annual rates were computed. The annualized likelihoods are reported in Table 2.

The numbers in Table 2 reflect the likelihood that a vending machine in the particular category was vandalized at least once during the course of a fifty-two-week period. Thus, in Orlando, 88 percent of all machines located on a major road were likely to be vandalized during the course of one year, whereas only 7 percent of all workplace machines were likely to be vandalized during a one-year period.[11] The table entries can be thought of as the contribution of a single factor taken in isolation to the likelihood of a vandalism attack.

Most of these characteristics are self-explanatory. For example, "on a major road" means the machine was located in or by a facility located on a major thoroughfare. Exclusivity only occurs within groupings. Locations that were "on a major road" were not in a "commercial area." Likewise, an "apartment" building was not also a "hotel", but a "hotel" may have been located in "commercial area" or "on a major road" or elsewhere.

The "site attribute" characteristics refer to an identifiable feature of the machine or its location. "Workplace" means that the machine was used primarily by people at their place of work. "Opportunities for concealment" refers to whether (in the opinion of the routeman answering the survey questions) the machine was located near alcoves or other places to hide. "Public access" refers to an unrestricted clientele. "Well-lit" means the machine was not sitting in a dark spot. "Isolated" means the machine was by itself and not one of a bank of machines.

The machine attributes of "landscape" versus "flat" refer to two types of design. The "landscape" design was newer and had a plastic bubble face. It looked (to an amateur) to be more accessible to penetration because the bubble face was a relatively soft plastic. The flat face, which looked sturdier, was actually more easily penetrated, being of an older design. Thus, amateur vandals ought to have been more inclined to attack the landscape machines, while professionals ought to have been more interested in the flat-faced machines.

Table 2 suggests that the commercial area of town and facilities on majors roads were much more vulnerable to vandalistic attack than other areas. This is probably not too surprising, given the anonymity and ease of escape for such areas. Of the site attributes, machines dedicated to employees were by far the least vulnerable. A possible explanation is that employees would not want to damage a machine dedicated to serving them. This explanation

Table 2
Annualized likelihood of at least one vandalism attack, by machine characteristic

		Orlando	Philadelphia	Combined
Location within city	On a major road	88	42	80
	Commercial area	78	42	75
	Neither	21	12	19
Type of building	Hotel	84	71	83
	Apartment	93	62	91
	Neither (hotel nor apartment)	25	21	24
Site attributes	Outdoors	82	89	83
	Workplace	7	0	5
	Opportunities for concealment	84	0	76
	Public access	80	56	77
	Well-lit area	66	38	61
	Isolated (single)	72	33	68
Machine attributes	Landscape (modern design)	74	0	72
	Flat (older design)	46	31	40
Total		49	29	44

is countered by the high likelihood of attack in apartments, where the machines were similarly dedicated to a small relatively fixed group of individuals.[12] It seems more plausible that higher rates of detection and punishment, such as job dismissal, deterred attacks against employee machines. Another possible explanation is that vandals were a select group of outsiders who would have been easily recognized in an employee area.

The numbers of Table 2 reflect the contribution of each factor to the likelihood of a vandalism attack without considering the presence of other contributing factors. The joint effect of several factors is taken up in the following section.

A multivariate analysis of the likelihood of vandalism attack

This section reports the estimates of a multivariate analysis of several factors and their statistical impact on the probability of vandalism occurring at least once during a year based only on the Orlando data. Table 3 reports that the probability of vandalism increased with vend price, accessibility of the machine, and opportunities for concealment, consistent with a model of rational decision making. The conclusion about rationality is somewhat weakened by the finding that ease of getting into the machine had a negative effect on the probability of vandalism.

The model coefficients reveal the contribution of the single factor when the other factors are simultaneously considered. Model 1 includes dummy variables for two building types—apartment and hotel, which are mutually exclusive[13]—and three site attributes—opportunities for concealment, commercial area, and being on a major road. These site attributes, which are also dummy variables, each had a significantly positive statistical effect on the likelihood of a vandalism attack. Furthermore, the effects compound each other. The fact of being located in a hotel raised the likelihood of vandalism attack by 3.8 percent, but a hotel located in a commercial area added an additional 5 percent to the likelihood of a machine being vandalized.

Table 2 implies that hotels and apartments both had a comparably high likelihood of attack during a given year (83 and 91 percent, respectively). In the multivariate analysis of Table 3, the apartment coefficient (.084) is nearly twice that for hotels (.038), which implies that much of the likelihood of attack in hotels can be attributed to the site attributes, such as the opportunities for concealment.

In Model 2, the price of the product and the frequency of service, both continuous, are included. A very high correlation between the vend price variable and the hotel dummy variable resulted in the exclusion of the hotel variable, a shortcoming that is rectified below with a study of price variability within different hotels. The results suggest that vend price had a significant positive statistical effect on the likelihood of attack, although it is impossible to determine yet whether the significance was due purely to a price effect or to the fact that higher priced machines were more likely to be located in hotels.[14]

The frequency of service had a negative statistical effect in most of the models reported here, though it was statistically significant only in Model 5, but that model happened to be the model with the best overall fit. Frequency of service is hypothesized to have an effect on vandalism rates if vandals are engaged in a conscious decision making process. Frequently serviced machines results in a smaller stock of cash in the machine at any given point in time; a lower payoff for

Table 3
Impact of various characteristics on the probability of vandalism occurring once in a year, $\pi_i = a_0 + a_1 x_{i,1} + \ldots + a_k x_{i,K} + \varepsilon_i$

Variables (the $x_{i,k}$)	Model				
	1	2	3	4	5
Intercept	− 0.018 (− 1.5)	− 0.194 (6.2)	− 0.172 (− 5.0)	− 0.000 (− 0.0)	− 0.314 (7.1)
Apartment	0.084 (4.3)	0.107 (4.7)	0.103 (4.5)	0.083 (3.9)	0.081 (3.4)
Hotel	0.038 (2.8)			0.034 (2.7)	
Conceal	0.048 (3.5)	0.041 (2.7)	0.042 (2.7)	0.048 (3.3)	0.049 (3.2)
Commercial	0.050 (3.6)	0.061 (3.5)	0.062 (3.6)	0.046 (3.1)	0.059 (3.4)
Major road	0.049 (3.8)	0.050 (3.3)	0.049 (3.2)	0.052 (3.8)	0.053 (3.5)
Price		0.315 (7.7)	0.299 (7.16)		0.578 (7.2)
Frequency of service		− 0.005 (− 1.5)	− 0.005 (− 1.7)	− 0.004 (− 1.5)	− 0.006 (− 1.9)
Price × hotel					− 0.139 (− 3.8)
Flat design			− 0.23 (− 1.6)	− 0.031 (2.3)	
Sample size	1,092	894	892	1,034	894
Adj. R^2	.07	.12	.12	.07	.13

π_i = probability of at least one vandalism attack per year when state $(x_{i,1},\ldots,x_{i,K})$ occurs.
t-values in parentheses.

the vandal. Also, attacking frequently serviced machines could result in the unhappy outcome of encountering the routeman. Both of these considerations would result in fewer attacks by rational decision-makers. The significantly (negative) impact reported in Table 3 is strong evidence that vandals engaged in such decision making.

Models 3 and 4 include the dummy variable for machine design. A flat machine is an older design that has the paradoxical feature of looking sturdier, while in fact being easier to successfully extract money from it. The features that made these older designs easier to break into included less sturdy locks and doors that were easier to pry back with a crow bar. If all vandals were highly skilled professionals, the coefficient on "flat design" would be significantly positive. If, on the other hand, most vandals were "naive amateurs," the coefficient would be negative. The reason is that the dependent variable indicates whether the machine is attacked, not whether money is extracted.[15] In Models 3 and 4, the coefficients are negative, suggesting a population of amateurs.

Model 4 has an additional implication. It differs from Model 3 by including the hotel variable and excluding its close correlate, the price variable. When the hotel variable is included, the coefficient on the flat design falls substantially in absolute value from $-.23$ to $-.031$. This suggests that the professional–amateur distinction depends on whether the machine was in a hotel: a professional was more likely to go to a hotel, although hotel machines were still vandalized by a significant number of amateurs.

The vend price variable and hotel dummy variable should both be included. Since the vend price and hotel dummy are highly correlated, one of them must be excluded. Model 3, which includes the price variable, is contrasted with Model 4, which contains the hotel variable. Other things equal, the price variable is more important than the hotel variable. That is, what attracted vandals to hotels was the higher vend price, and the implication is that those machines have more cash in them waiting to be stolen.

Finally, Model 5, which has the best fit overall, contains an interaction term of price and hotel, the coefficient of which is negative and significant. This suggests that while higher prices tended to attract more vandals, the effect was reversed within hotels. Since vending machine prices tend to be higher at higher priced hotels, this evidence suggests that higher product prices tended to attract vandals, while vending machines in more upscale and costly hotels were less likely to be attacked.

There are several general messages from Table 3. First, there is a significantly positive impact on the likelihood of a vandalism attack when (a) the size of the jackpot upon successful entry is higher, as indicated by the positive coefficient for the price and the negative coefficient for frequency of service; (b) the means of attack and escape are easier, as in a commercial area or on a major road; (c) the ease of remaining undetected is higher, as measured by the positive coefficient for "opportunities for concealment" and the negative coefficient on "frequency of service." These results all support the hypothesis of the rational behavior of vandals.

Secondly, the negative coefficient on the "flat design," which would be positive with strongly rational vandals, suggests limitations on the degree of vandal rationality.[16] Finally, the irrationality reflected in the negative "flat design" coefficients is much smaller (in absolute terms) when the hotel variable is included. This suggests that the nature of vandalism is different in hotels, and also that the subgroup of vandals that are highly professional, may be especially attracted to hotels. The next section focuses exclusively on data within hotels.[17]

Vandalism in hotels

The analysis of the previous section treated the hotel dummy variable as one of several variables, and it was difficult to completely disentangle the effect on the probability of vandalism of a machine in a hotel from the effect of product price. This section uses a completely different data set, one that was provided to us by a bottler and that was based entirely on vandalism events in hotels.

The data was obtained over an eight-month period in 1992 and involved a total of 377 actual incidents of reported vandalism in the city of Orlando, Florida. The results are presented in Table 4. The dependent variable is the proportion of machines in a given hotel that were found to have been vandalized in a given incident. The hotel locations originally were divided into distinct district and highway zones, which were treated as independent variables.[18]

The first observation is that, for the machines in this data set, being located on the interstate highway was advantageous, for it significantly lowered the likelihood of vandalism in each of the four models of Table 4. The reason might be the social strata of the clientele-travelers are less likely to be tempted to commit vandalism. Secondly, the price effect is negative in Models 2 and 3. That is, the likelihood of vandalism fell when either the room price was higher or the vending machine product price was higher. This is consistent with the notion that more upscale hotels are less susceptible to vandalism. It also suggests that the jackpot size effect, which rises with the product price, is dominated by the deterrent effect that comes with more highly priced hotels.

Table 4
Probability of vandalism in a hotel, $\pi_i = a_0 + a_1 x_{i,1} + \ldots + a_k x_{i,K} + \varepsilon_i$

Variable	Model			
	1	2	3	4
Interstate highway	− 2.22 (− 1.8)	− 1.82 (− 1.5)	− 1.37 (− 1.1)	− 1.84 (− 1.5)
Major road	− 1.09 (− 5.3)	− 0.61 (− 2.3)	− 0.26 (− 0.9)	− 0.63 (− 2.4)
District 1	− 1.12 (− 3.4)	− 0.56 (− 1.5)	− 0.25 (− 0.6)	− 0.56 (− 1.5)
District 2	− 1.21 (− 2.6)	− 0.81 (− 1.7)	− 0.34 (− 0.7)	− 0.81 (− 1.7)
Room rate		− 0.01 (− 2.8)		
Vend price			− 1.11 (− 4.1)	
Price × room rate				− 0.01 (− 2.8)
Sample size	377	377	377	377
Adj. R^2	.16	.18	.21	.18

π_i = probability of at least one vandalism attack per year in the particular hotel when that hotel has $(x_{i,1},\ldots,x_{i,K})$ as the state vector. *t*-values in parentheses.

As before, it is difficult to accurately interpret a model that contains both product price and room rate, because these two variables are highly correlated. Model 4 contains a term that is the product of price and hotel room rate. The result is close to that of Model 2, which suggests that the dominating factor is the level of the hotel, as measured by its room rate.

The main message of this section is that more highly priced hotels were less likely to be victimized by vandalism attacks.[19] The more lucrative prize that occurred with higher vend prices was not sufficient to induce would-be vandals to subject themselves to the higher risk of detection that occurred with more upscale hotels. Table 4 also refines the message of Table 3. Table 3 suggests that being on a major road raises the likelihood of vandalism attack. Table 4 suggests the opposite is true for machines located exclusively within hotels, and when some measure of price is included.

Method of attack: professionals versus amateurs

Methods of attack at different locations

The analysis thus far has focused on how building types and location attributes contributed to the overall likelihood of being attacked by vandals. This section analyzes how site attributes contributed to the manner in which the machines were attacked. The first part used a survey of routemen that helped to distinguish "amateur" from "professional" vandals. The second part examined a smaller data set that looked at a behavior that was thought to be the strict domain of professionals-key-in entry.

The first data set was a survey conducted by a bottler in Atlanta, where the routemen were asked about the nature of the vandalism as they saw it. Specifically, the routemen recorded three aspects of the machines that had been subject to a vandalism attack. First, they reported whether the attack was, in their opinion, conducted by a professional. Second, whether entry occurred. Thirdly, they reported if the attack had been conducted with the "salting" technique.

"Salting" is a crude method of extracting a small number of coins from vending machines. It involves pouring a saline solution into the dollar changer slot, waiting for a short circuit to result, and then retrieving the coins released from an active register or coin stack. Wait times are high, and money extracted is small since coins that have already been deposited by a purchaser have reached retaining bins and are not released, and salting does not cause the dollar bills in the machine to be ejected. It is believed by the routemen and bottling officials that salting, despite the high levels of damage inflicted on the machines, is not a technique that professional vandals would use. The wait time is too risky and the money obtained too small to make the attack financially attractive. On the other hand, vandals that are seeking fun and trying to demonstrate prowess, and are otherwise not concerned with high dollar per hour returns, might be inclined to attempt the salting attack.

The three aspects of attack as reported by the routemen (professional, non-entry, and salting) are nearly, but not completely exclusive. Their relative frequency of occurrence by venue is exhibited in Fig. 1.

What was perhaps most striking in this data was the very high rate of "salting" attacks that occurred in grocery stores, where 86.5 percent of all vandalism attacks involved the use of salt. On the other hand, vandals in hotels used the salting technique only 15.3 percent of the time. Salting was used by a large fraction of the vandals at strip malls, parks, and schools. A plausible interpretation is that these areas attract a large number of fun-

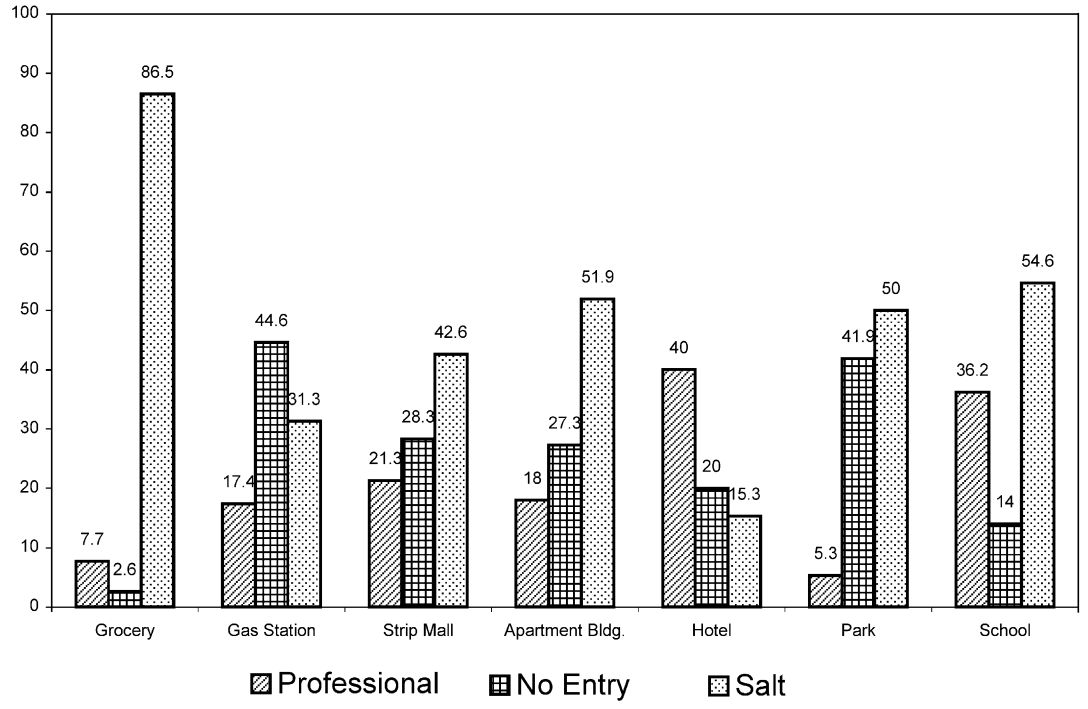

Fig. 1. Type of vandalism by location.

seeking amateurs with low opportunity cost of the their time.

Professionals are most prominent among vandals at hotels (40 percent of all vandalism in hotels) and in schools (36.2 percent). Professionals were least likely to visit grocery stores and parks due to the higher likelihood of detection at these relatively public places.

Key-in attacks at hotels

The final piece of evidence, presented in Table 5, is from a study by a bottler in Orlando of fifty vandalized machines.[20] This data reported on vandalism that was done with the use of keys, duplicates of those that the routemen used. By some means, sets of keys made it into circulation and were used by professionals to gain entry into vending machines.[21] This type of attack is the opposite of salting in that it is quick, nondamaging to the machine, and allows maximal extraction of money.

These results imply that professionals tended to use keys to attack machines in hotels, in commercial areas, and at locations along major roads (Models 2, 3, 4, and 6). Models 2 and 7 suggest that hotels were appealing to professionals, but that the impact was more likely to be due to the higher product price than the fact of being a hotel. This inference was drawn because the hotel coefficient is highly significant in

Table 5
Key-in attacks. Probability of a key-in attack, given that some vandalism has occurred, $\pi_i = a_0 + a_1 x_{i,1} + \ldots + a_k x_{i,K} + \varepsilon_i$

Variable	Model							
	1	2	3	4	5	6	7	8
Intercept	−0.97 (4.7)	0.25 (2.4)	0.04 (0.86)	0.13 (1.2)	−0.92 (−4.3)	−0.16 (−0.8)	−0.97 (−4.3)	0.02 (0.3)
Price	1.85 (7.4)				1.65 (5.5)	0.32 (1.2)	1.84 (5.8)	
Hotel		0.45 (3.4)					0.01 (0.1)	
Commercial			0.88 (12.8)			0.79 (7.3)		0.85 (10.5)
Major road				0.55 (4.1)	0.15 (1.2)			0.05 (0.6)
Sample size	50	50	50	50	50	50	50	50
Adj. R^2	.76	.60	.89	.63	.77	.89	.76	.89

π_i = probability of key-in attack when the state vector is $(x_{i,1},\ldots,x_{i,K})$.
t-values in parentheses.

Model 2, but less significant in Model 7, which includes the price variable.

Professionals aim for machines with higher prices (Models 1, 5, and 7). The question of whether price or location was more important has an ambiguous answer. Model 5, which includes being on a "major road," suggests that price was mildly more important (since "major road" loses its significance relative to Model 4). In Model 6, which includes being in a "commercial area," the location was more important (since the price variable loses its significance). Model 8, which includes both location variables, suggests that being in a "commercial area" was a more important attribute for predicting key-in attack. Models 3, 6, and 8, all of which have "commercial area" have the highest explanatory power.

The implication of Table 5 is that professionals who use keys are going to have a higher relative presence in commercial areas. They are attracted to hotels most likely because hotels have more vending machines than other areas and those machines have more money in them.

The combined results of Fig. 1 and Table 5 suggest how amateur vandals differ from professionals. The amateurs reveal themselves by a behavior that is slow, clumsy, and financially nonrewarding—the salting method. Amateurs tend to attack grocery stores, schools, and parks. These are areas most likely to have an audience. Professionals often reveal themselves by their use of a key (although professionals do use other methods as well, such as prying back the door enough to reach in and extract the stack of currency), a method that is quick, efficient, and profitable, but requires forethought. Professionals are attracted to machines with more money in them and to areas where they can maintain anonymity, such as commercial areas. It would seem that professional vandals adhere more closely to the economists' notion of rationality and that the rationality of amateur vandals must be tempered by sociological and psychological considerations.

Conclusion

The motives of vandals have been attributed to a variety of causes, including social, psychological, and economic models of decision-making. This study emphasized the role of economic factors, especially the combined desire to acquire a prize and to avoid capture and detection. The data examined provided further evidence that a large part of the behavior of vandals could be explained with economic models of costs and benefits. Factors that contribute to detection and difficulty of escape tend to reduce the likelihood of vandalism, whereas factors that contribute to the prize of vandalism, such as the amount of money in a machine, tend to raise the likelihood of vandalism.

The results do not provide pure support for the economic model. The evidence supports the notion that vending machine vandals fall into two broad categories, professionals and amateurs. Professionals seek maximal money with minimal risk of detection and apprehension. They can be identified after the fact by the manner in which they attacked a given vending machine, generally using a technique that was quick and successful. Amateurs can also be identified ex post by the techniques they used, which were often slow, destructive, and not financially rewarding.

Amateurs and professionals were similar in some respects and different in others. Both were deterred from locations with a high chance of detection and apprehension, such as "at work" places and in well lit areas with little opportunity to hide. Both types were drawn to commercial areas and places with access to roads. Professionals seemed to know which machines had more money in them and which machines were easier to penetrate, and were drawn to them. Professionals were drawn particularly to hotels, especially when more money was in the machines, but not to very high-priced hotels, even though machines there had the most money. The behavior of professionals was consistent with rational behavior that attempts to maximize money acquisition while minimizing the risk of capture.

Although amateurs were deterred by features such as better lighting that increased detection, and were attracted by opportunities for anonymity such as commercial areas, they were much more likely than professionals to vandalize in public areas. Amateur techniques, such as salting, were more likely to occur in open areas such as in schools, parks, and grocery stores. The paradox that amateurs were deterred by areas that allowed detection, but were often drawn to public areas, might be explained by a behavior that is based more on sociological and psychological considerations, rather than on economic and acquisitive motives.

Notes

1. A key-in occurs when a vandal uses a key to open the vending machine and steals the money inside.
2. See "Vandalism Background and History" section for some of these authors.
3. Routemen are those individuals who refill the vending machines with soda, collect the money in the machines, and effect minor repairs on location.
4. For example, Slaybaugh (1975) reported on school losses by type of damage. In a related study, Tygart (1988) found a noticeable difference in school vandalism caused by seventh graders versus twelfth graders.

5. FBI Uniform Crime Report, Table 30.

6. Allan and Steffensmeier (1989), for example.

7. These issues are discussed in Beaulieu (1982), Erickson and Jensen (1977), and Gladstone (1978).

8. Levitt (1998, p. 1159) writes "When state-level panel data for the period 1978–93 are used, harsher punishments for juveniles are strongly associated with lower rates of juvenile offending." In other words, juveniles respond rationally to incentives set out for them.

9. In the United States, there is a number of large national and regional soda pop syrup manufacturers. The syrup is sold to local distributors, referred to as bottlers here. The bottler packages the syrup in bottles and cans for distribution from food stores and from vending machines. The bottler also packages the syrup for sale from a fountain in restaurants like MacDonald's or Burger King.

10. The table presents percentages rather than absolute numbers in order to preserve anonymity of the syrup manufacturer or the bottlers.

11. The numbers were obtained by extrapolating from the incidence of vandalism in the survey data, which covered a two-week period, to the fifty-two-week equivalent. The numbers reflect the likelihood for the sample data and not necessarily the true population.

12. In an apartment setting, the feeling of anonymity may precipitate vandalism.

13. Hotels and apartments are also the locations with the highest concentrations of machines. The baseline group would be machines located in the other locations shown in Table 1.

14. It is quite rational for the bottler to charge a higher vend price in a hotel rather than, say, a Seven-Eleven, where the customer has fewer opportunities for substitution.

15. Professional vandals are defined to be those who are more likely to attack in ways that will succeed.

16. An alternative possibility is that the amateur is acting rationally on the basis of all of the readily available information. That the amateur does not acquire the information on machine design and vulnerability suggests bounded rationality.

17. Hotels were of special interest to the sponsoring syrup manufacturer and bottlers. Hotels represent locations of very high concentrations of machines. Vend prices of machines in hotels are higher than machines in other locations. A machine in a hotel is seldom vandalized in isolation; the vandal typically goes through as many machines as possible in as short a time as possible and causes as little damage as possible. Hence, while physical damage to machines in hotels may not be great, the financial losses can be significant.

18. In the models reported here, there were only two district dummies and two highway dummies out of the original twelve. Individually, the remaining eight did not contain many observations. Due to the thinness of the data in the remaining eight, a problem of multicollinearity was encountered between the dummies and the intercept whenever the authors tried to aggregate and use an additional dummy.

For seasons of confidentiality, the regions and highways cannot be identified. Suffice it to say that perusal of a map of Orlando, with special regard to the location of Disney World and the hotels serving it, would allow the interested reader to infer the neighborhoods and highways used in the table.

This intercept was suppressed in the results for reasons of collinearity. There were two highway and two district dummies. Although room rate and vend price were in principal continuous, they took only a small number of values in practice. Adding an intercept did not improve the goodness of fit, and the higher degree of collinearity on the right-hand side resulted in much less precise coefficient estimates.

19. This is similar to the finding that the probability of burglary is lowest at the most expensive homes, all other things equal. See Hakim et al. (2001).

20. Although the origin of the data was the same as that used in Table 4, the same district and highway dummies were not used. The key-in incidents were so concentrated and the sample was so small that it was not possible to include the locational dummies.

21. Each machine does not have its own unique key. For the number of vending machines on the street, there really are a very small number of keys needed to open them all.

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