Journal of Crime and Justice, 2015
Vol. 38, No. 2, 222–234, http://dx.doi.org/10.1080/0735648X.2013.864570

Were cell phones associated with lower crime in the 1990s and 2000s?

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(*Received 29 August 2012; accepted 3 November 2013*)

Empirical studies of the crime decline of the 1990s and early 2000s have focused on factors such as: incarceration, economy, policing, demographics, security-related technology, and abortion. One recent analysis examined the growth in mobile phone technology, finding tentative support for a deterrent effect, but is in need of expansion and replication. The current study uses national-level data from 1984 to 2009 and performs time-series analysis to examine the relationship between cell phone ownership and a range of crime types. Results indicate a significant, negative relationship between changes in cell phone ownership rates and changes in the property crime index, even with controls for relevant crime-drop variables, but a very minimal relationship to the violent crime index. Implications and directions for future research are noted.

Keywords: crime drop; cell phone ownership; security hypothesis; violent crime; property crime

Introduction

Even with the development of an expanding body of scholarship that seeks to explain the drop in crime rates, conclusions on the factors that have caused the decrease in crime have remained elusive. Further, the declining crime rates were completely unexpected and went against prevailing predictions (DiIulio, 1996; Fox, 1996; Wilson, 1995). Some support has been found among both criminal justice and demographic factors for playing a significant role in the crime decline. Some of these explanations receiving limited support for specific crime types, in specific geographies and time periods, have included: the increased use of incarceration (Spelman, 2005, 2006), increases in the numbers of police or better policing strategies (Levitt 1997, 2002; Marvell and Moody, 1996; Travis and Waul, 2002), changes in gun laws and gun ownership rates (Lott, 1998), unemployment or poor economic conditions (Freeman, 2001) or lack of consumer confidence (Rosenfeld, 2009), cultural shifts away from violence (Rosenfeld, 2000), waning of the crack cocaine epidemic (Blumstein, Rivara, and Rosenfeld, 2000), as well as factors such as the legalization of abortion (Donohue and Levitt, 2001). However, any proposed explanation for the observed drop in crime rates has been met with as much, if not more, evidence suggesting a null effect. There has been no single factor that can be identified as the cause of the crime drop in the 1990s (Blumstein and Wallman, 2000, 2006; Levitt, 2004; Rosenfeld, Terry, and Chauhan 2013; Travis and Waul, 2002; Tseloni et al., 2011).

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The security hypothesis

Farrell et al. (2010) outlined and discussed an extensive set (21 in total) of possible causes of the crime drop, including those that may apply cross-nationally. As one of these potential crime drop explanations, Farrell et al. included the hypothesis of 'new technologies and routine activities' (33). This hypothesis suggests the possibility of a real or perceived deterrent effect from emerging technologies, and in advancing this possibility the authors identified the security hypothesis as a promising area for future research.[1]

In an extension of their work, Farrell et al. (2011) took a comparative approach and suggested that an important causal factor of the crime drop stemmed from the 'change in the quantity and quality of security' (147). In developing their security hypothesis, the authors cited research by Van Dijk et al. (2005, 24), which proposed that '… [p]erhaps a more significant factor inhibiting crime across the Western world is the universal growth in the possession and use of private security measures by households and companies over the past few decades.' Thus, Farrell et al. presented a security hypothesis, operating in conjunction with routine activity and opportunity theory, to suggest that the reduction in car theft was a result of improvements in technology and security-related developments, and used motor vehicle theft data from the United States, England and Wales, and Australia to assess the influence of increases in vehicle security devices. Findings based on trends in vehicle thefts and comparisons of the prevalence of security devices in cars (i.e., central locking, electronic immobilizer, car alarm, window etching, and mechanical immobilizer) indicated that these devices had a protective effect.

Drawing from Blumstein and Rosenfeld's (2008) suggestion of a similarity between motor vehicle theft trends and certain violent crime trends, and the notion that motor vehicle theft may operate as a *keystone crime* (i.e., a crime that promotes or facilitates other crimes), Farrell et al. (2011) speculated that increases in security devices, through decreases in motor vehicle theft, would then, perhaps, reduce other crimes too, including violence (166). While there may be value in the security hypothesis, it is less clear whether these effects, operating through motor vehicle theft, would be salient enough to produce such a major reduction in all other crime types. To their credit, the authors presented an extension of the security hypothesis in their discussion, which included the way in which routine activity or lifestyle theories link to the security hypothesis through criminal opportunities. They observe, as a possible widespread change in routine-activities, that perhaps 'portable telephones allow potential victims and passersby to mobilize guardianship far more efficiently, for example, while integrated cameras and video threaten digitized proof of any offender's identity' (165). This statement warrants further consideration and empirical attention.

Recently, Klick, MacDonald, and Stratmann (2012) sought to examine a novel explanation for the crime drop, which falls in line with the security hypothesis – the growth of mobile phone technology. At first glance, this potential correlate may yield a puzzled look – as have the legalized abortion (Donohue and Levitt, 2001) and lead exposure (Reyes, 2007) hypotheses. The idea of phones being associated with a protective effect could produce some skepticism, specifically because mobile phone theft is one crime that failed to follow the 1990s crime decline (see Harrington and Mayhew, 2001). Yet, the mobile phone-crime relationship can be situated in complementary routine activities (RA) and deterrence theoretical frameworks.

RA theory suggests that crime increases with the convergence, in time and space, of suitable targets, the lack of capable guardians, and the presence of motivated offenders (Cohen and Felson, 1979), while deterrence holds that swift, certain, and severe punishments will deter offending among offenders and would-be offenders as a function of alterations to perceived sanction threats (Beccaria 1764; Nagin, 1998; Piquero et al., 2011). As suggested by Klick, MacDonald, and Stratmann (2012), mobile phones can prevent victimization by at least three mechanisms: (1) increasing the guardianship of a potentially suitable target (at least from the perspective of a motivated offender); (2) increasing the likelihood of a victim providing quick information to the police via a phone call or even a photograph/video taken with their phone; and (3) altering the offender's decision to offend, in part by increasing their perception of being detected and ultimately punished for committing the offense.[2] To be sure, the availability of cell phones has altered routine activities with respect to changes in guardianship, and the informal social control of youths (Geser, 2004), who may be potential offenders or suitable targets, and perhaps the potential offenders' perceived risk of police mobilization (Lianos, 2003). The ways in which cell phones are used have expanded and evolved over time (Palen, Salzman, and Young 2001).

In their analysis of the aggregate relationship between mobile phone use and crime rates, Klick, MacDonald, and Stratmann (2012) used state-level data from 1999 to 2007 to examine how mobile phone rates were related to rape and aggravated assault, primarily because those two crimes were 'likely to occur among strangers and most plausibly deterred by mobile phones' (6). Using the number of mobile phone subscriptions obtained from the FCC, crime rate data from the FBI, as well as state and year fixed effects to account for differences across states as well as non-linear time trends, they found that mobile phones were linked to lower violent crime – and to a lesser degree with property crimes – and that this negative relationship remained unchanged after conducting several robustness tests and consideration of alterative crime-drop explanations.

Current focus

Klick, MacDonald, and Stratmann (2012) recognized the preliminary nature of their findings and encouraged further exploration using additional data and/or a better research design. Our study attempts to build on their effort in several respects. First, we use national-level data allowing a broader perspective that permits a more focused comparison to the more general crime-drop research (see Blumstein and Wallman, 2000, 2006; Levitt, 2004). Second, we use a longer time-series of data, 1984–2009, which captures the period of time prior to the increase and peak of the US crime rate in the early 1990s. Third, we focus on different crime types in order to gauge the sensitivity of the mobile phone-crime relationship. Klick, MacDonald, and Stratmann concentrated primarily on rates of rape and aggregated assault, although they presented results for aggregate violent and property crime rates. Fourth, we use a different (and more inclusive) measure of mobile phones, as well as a different set of measures for our control variables – both features that permit us to examine the same substantive relationship but with a different data source and variable operationalization as a form of sensitivity and generalizability analysis. Finally, we use time-series analysis, which helps to correct for the serial autocorrelation present in studying crime rates over time. The analysis presented herein, therefore, is complementary to that conducted by Klick, MacDonald, and Stratmann, by asking a similar question, but does so with an alternative approach, different data, and different variables.

Data and methods

The data used in the analyses came from multiple sources. The primary outcomes of interest are national-level crime rates for a variety of crimes. The crime data were obtained from the Uniform Crime Report (UCR), spanning the years 1984 to 2009. Data for the various control variables were collected from the World Development Indictors Data Catalog, the Bureau of Justice Statistics' Correctional Populations in the United States Series, the United States Census, and the UCR Justice Expenditure and Employment data.

Dependent variables

Annual reported offense rates were collected for the annual aggregated violent crime and property crime rates from the UCR. These crime types were selected as they represent the major index crimes for which annual data are collected. Using aggregate crime types gives us a broader view of the impact cell phone ownership may have on offending rates, as well as whether there are any crime-type-specific relationships. Summary statistics of all indicators used are presented in Table 1.

Independent variables

Annual cell phone subscription rates were obtained from the World Development Indicators codebook (2010). The cell phone subscription rate includes 'mobile cellular telephone subscriptions to a public mobile telephone service using cellular technology, which provide access to the public switched telephone network. Post-paid and prepaid subscriptions are included' (World Bank, 2010). They are based on International Telecommunication Union, World Telecommunication/ICT Development Report and database, and World Bank estimates. Rates (per 100 people) were calculated based on national population estimates for each year. Cell phone ownership has become pervasive in American culture and daily life. The Pew Research Center estimated that 83% of American adults own a cell phone (Smith, 2011), while the International Association for the Wireless Telecommunications Industry reported that as of mid-year 2011, there were 322.8 million wireless subscriber connections in the United States (CTIA, 2012). In order to include a range of years covering both some of the increase and decrease in crime, we were limited to national estimates of cell phone subscriptions. While this level of aggregation is not ideal, sufficient data below the national level are not available for the time period of interest.

While the body of scholarship seeking to better understand the crime drop phenomena has offered a number of explanations on the correlates of the crime decline, little consensus has been achieved. In order to control for some of the major explanations that

Table 1. Descriptives of National-Level Variables, 1984–2009.

	Mean	SD	Min	Max
Dependent Variables				
Violent Rate	581.07	106.39	429.40	758.20
Property Crime Rate	4,197.36	703.01	3,036.10	5,140.20
Independent Variables				
Cell Phone Rate	31.19	32.85	0.04	97.20
Incarceration Rate	389.77	111.02	188.00	506.00
Gini Coefficient	0.38	0.02	0.34	0.41
% Youth Age 15–19	7.21	0.34	6.74	8.03
Police Officers per Capita	233.22	14.45	207.90	251.80

have been offered for the crime drop, measures for the incarceration rate, economic deprivation, the percentage of the population between the ages of 15 and 19, and a measure for the level of policing were also collected.

The incarceration rate for the time period of interest was obtained from the Bureau of Justice Statistics' Correctional Populations in the United States Series (Glaze, 2010). The incarceration rate is based on the average number of individuals incarcerated in state and federal prisons per 100,000 in the population. Between 1984 and 2009, the incarceration rate ranged from 188 to 506 per 100,000 individuals. Some previous research has suggested that increases in the incarceration rate had a significant impact in reducing the crime rate (Langan and Farrington, 1998; Levitt, 2004; Spelman, 2006). The inclusion of the Gini coefficient as a control for income inequality was based on the view that crime rates are influenced by resource or economic deprivation, and this relationship has been found to have a high level of overall empirical support (Pratt and Cullen, 2005). The Gini coefficient is a measure of income inequality where a coefficient of 0 indicates total income equality and a measure of 1 indicates total income inequality, and was obtained from US Census estimates. The data used for the measure of police was obtained from the reported Justice Expenditure and Employment data, reported in the UCR. Employment data on the number of police officers employed was converted to the number of officers employed per 100,000 in the population. We control for policing levels because they have been shown to have some relationship to crime (Marvell and Moody, 1996). Lastly, data on the percentage of the population aged 15 to 19 was also collected from the US Census and was included to control for the potential impact of demographic change (Fox, 2000; Steffensmeier and Harer 1987; Wilson, 1995).

Analysis plan

Traditional forms of regression analysis, such as OLS, are inappropriate for time-series data. For example, OLS assumes independence in the residuals, meaning that the residual from one observation is uncorrelated with any other residuals; time series data almost always violate this assumption. Any uncorrected results could be spurious due to the serial autocorrelation present in the residuals, meaning that the error terms are systematically associated with those from proximate points in time (see Pindyck and Rubinfeld, 1991). The use of time-series analyses allows for the adjustment of the autocorrelation present (Cochrane and Orcutt, 1949; Durbin, 1970; Durbin and Watson, 1950, 1951). Autoregressive- or lagged-response models, where within-subject dependence is modeled by allowing responses at a given occasion to depend on previous or lagged responses, are appropriate in cases where serial autocorrelation is present (Rabe-Hesketh and Skrondal, 2008).

Previously, studies have found that crime rates and rates of other economic indicators follow a nonstationary random walk process, in which the series steadily increases or decreases for an extended period of time (Granger and Newbold, 1974; Nelson and Plosser, 1982). Results from Dickey-Fuller tests confirmed that the time series used in the current analysis follow nonstationary random walk processes. In order to address this issue, all time series were transformed to first-differences, where the previous observation is subtracted from the current one. This was done for both the dependent and independent variables, and eliminates the trend present in the time series (Enders, 1995; Greenberg, 2001). What remains then, is an examination of whether differences in the crime rates are predicted by changes in the cell phone ownership rate, controlling for changes in the control variables. As such, all interpretation of the results from these models will be in the form of change predicting change.

For the current analysis, a generalized least-squares model to derive estimates for parameters that are serially correlated is employed. Assuming that the errors follow a first-order autoregressive process, corrections for autocorrelation are introduced and result in *d-statistics* within an acceptable range. In other words, crime rates at time t are a function of the crime rate at $t - 1$ plus any new influences. Linear regressions of the crime rate trends as a function of cell phone ownership rates and the various controls correcting for the first-order serial correlated residuals are estimated using Cochrane and Orcutt (1949) transformed regression estimates. Supplemental analyses were also conducted using ARIMA models with a first-order autoregressive parameter, which yielded substantively similar results as those presented. All models were estimated in Stata 12.1.

Before we proceed, it is important to note that there may be some concerns with studying the aggregate effect of mobile phone ownership on crime rates because as with many other events occurring in the 1990s (police, incarceration, age changes, economy), they all occurred at the same time and all may be related to a crime reduction. Moreover, there is not an ideal set of data on mobile phones nor as noted by Klick, MacDonald, and Stratmann (2012) is there a strong instrument or natural experiment to isolate the true causal effect of mobile phones on crime. Thus, we must work with the available data and control for several important correlates that could be related to mobile phones, crime rates, or both including: incarceration, income, and police size. Of course, omitted variables bias may still remain and this must be considered when interpreting the results.

Results

We begin with a graphical portrayal of the trends observed in violent and property crime rates, as well as the rate of cell phone ownership between 1984 and 2009. As can be seen from Figure 1, the availability of cell phones began in the early 1980s, but widespread ownership did not increase until the 1990s. Further, the graph suggests that the rise in cell phone ownership rates coincides with the declines in both types of aggregate crime rates.

Next, we move onto additional analyses that follow in multiple stages. We adopt a step-wise approach, first by estimating time-series regression models for the violent and property crime rates using only the mobile phone ownership rate, and then proceeding, one by one, to introduce the various control variables in a model with the mobile phone ownership rate. We do this in order to examine the relationship of cell phones to the crime rate while independently considering several of the prominent crime drop explanations. This process results in five models corresponding to the baseline relationship and one with each of the included control variables. The results for the property and violent crime rates are shown in Tables 2 and 3.

Reviewing the property crime results (Table 2), it can be seen from Model 1 that changes in cell phone ownership exhibits a negative and marginally significant ($p = 0.106$) association with changes in the property crime rate. Model 2 adds a control for changes in the incarceration rate, which shows a negative but insignificant relationship to changes in the property crime rate, but results in a significant, negative effect of changes in cell phone ownership on changes in the property crime rate. In Model 3, the results shows that controlling for the Gini index does not produce a significant Gini effect, nor does it eliminate the significant cell phone ownership effect. Model 4 adds the changes percent youth age 15–19 control measure, which has a negative but insignificant association with changes the property crime rate, although the inclusion of this control does render the significant estimate for changes in cell phone ownership insignificant. Lastly, Model 5 shows that changes in the number of police per 100,000 population has an

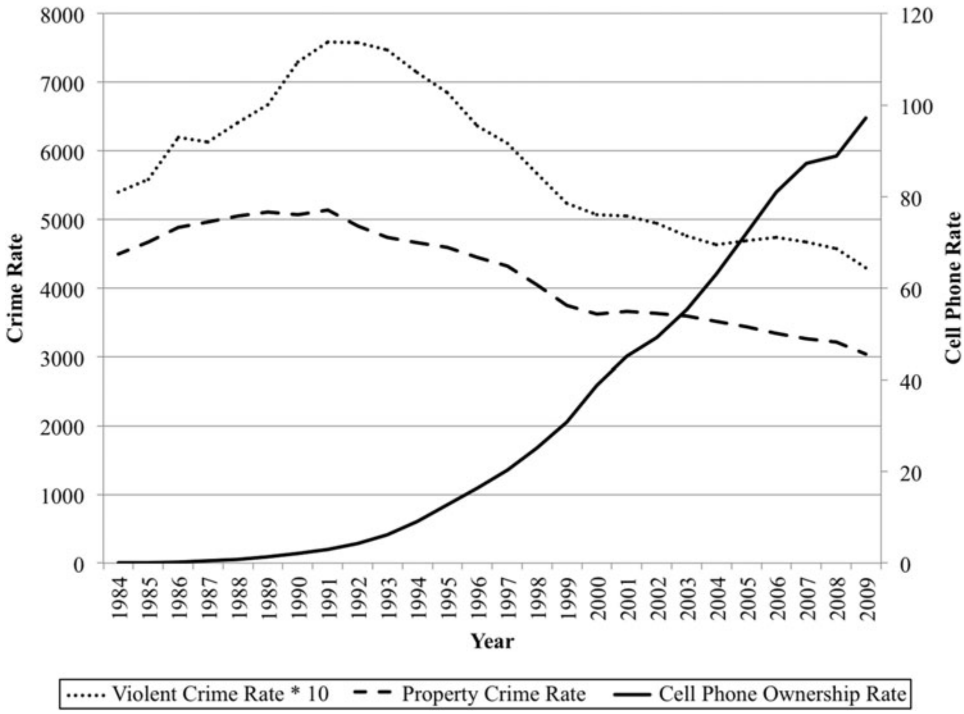

Figure 1. Violent and Property Crime with Cell Phone Ownership Rates in the United States, 1984–2009.

insignificant negative effect on the property crime rate, and its inclusion in the model did not eliminate the significant effect for changes in cell phone ownership.

Turning to the violent crime results (Table 3), Model 1 shows changes in cell phone ownership to be negatively, but insignificantly associated with changes in the violent crime rate. The addition of the control variables in the subsequent models (Models 2–4)

Table 2. Cochrane-Orcutt AR(1) regression with semi-robust standard errors for property crime[3].

		Model 1	Model 2	Model 3	Model 4	Model 5
Property Crime	Cell Phone Rate	−11.812*	−13.981*	−12.918*	−9.940	−13.841*
		7.001	7.067	7.209	8.379	7.674
	Incarceration Rate		−1.958			
			2.570			
	Gini Index			−1236.803		
				1097.287		
	% Youth Age 15–19				−381.243	
					227.550	
	Police per 100K					−2.760
						4.344
	Constant	−33.242	0.690	−24.940	−53.912	−20.207
		57.980	63.993	0.660	65.847	66.683
	$\rho =$	0.561	0.541	0.545	0.561	0.546
	$R^2 =$	0.068	0.098	0.087	0.178	0.083
	$DW =$	2.043	2.038	2.102	1.748	2.008

Note: Semi-robust standard errors are listed below the regression estimates.
$***p < 0.001$, $**p < 0.05$, $*p < 0.10$.

Table 3. Cochrane-Orcutt AR(1) regression with semi-robust standard errors for violent crime.[4]

		Model 1	Model 2	Model 3	Model 4	Model 5
Violent Crime	Cell Phone Rate	−2.376	−2.610	−2.322	−2.066	−1.408
		2.103	2.252	2.272	2.125	2.242
	Incarceration Rate		−0.203			
			0.491			
	Gini Index			46.796		
				424.349		
	% Youth Age 15–19				−150.262**	
					40.517	
	Police per 100K					1.003
						1.160
	Constant	2.904	6.397	2.550	−2.357	−2.903
		17.550	19.542	18.952	11.245	19.920
	$\rho =$	0.546	0.539	0.549	−0.015	0.594
	$R^2 =$	0.044	0.049	0.043	0.469	0.057
	$DW =$	2.050	2.031	2.052	1.602	2.118

Note: Semi-robust standard errors are listed below the regression estimates.
$^{***}p < 0.001$, $^{**}p < 0.05$, $^{*}p < 0.10$.

did not substantively alter the results for the association between the change in cell phone rate and the change in the violent crime rate. The only significant association that appears is with the addition of the change in the percent youth age 15–19 (Model 4) and indicates that, while it has a negative, significant effect on the violent crime rate, cell phone ownership continues to have a negative, but insignificant effect on violent crime rates.[5] In sum, the relationship of cell phone ownership to the property crime rate between 1984 and 2009 indicates a negative, significant association – one that remains after controlling for most crime-drop variables, but virtually no relationship between cell phone ownership and violent crime. As noted, the same models predicting changes in the violent and property crime indexes were estimated using ARIMA, and this substantive relationship again held across the models including the other common predictors of the crime decline.

Discussion

The crime decline of the 1990s has been subject to much discussion but there have been few clear and universal explanations for the phenomenon (Zimring, 2007). Most explanations have focused on factors associated with changes in the age structure, changes in the economy, increases in police force and the tactics used by police, as well as the incarceration boom. Some scholars have moved away from these explanations to search for other potential correlates of the crime drop including an explanation focused on the security hypothesis and a related explanation based on the increase of mobile phone technology. Given the small knowledge base on these explanations, we focused on the relationship between cell phone ownership and crime rates. Building off the only other study on this issue (Klick, MacDonald, and Stratmann 2012), we collected data for a longer time period to ensure coverage of the increase in crime to its high point in the early 1990s and its decline in the 2000s, employed a new measure of cell phone ownership, considered several rival crime-drop variables, and examined the association of cell phone ownership to both violent and property crime rates between 1984 and 2009. The findings presented here are consistent with a deterrence perspective and are friendly toward a situational crime prevention perspective.

In total, our results provide evidence of a negative relationship of the mobile phone ownership rate on property crime rates, and this relationship held across multiple methods of analysis. Further, with one exception, the effect of changes in the cell phone ownership rate on changes in the property crime rate was not sensitive to controls for other variables that have been implicated in the crime drop of the 1990s. Thus, when considered with Klick, MacDonald, and Stratmann's (2012) investigation, the two studies, using two different types of data (including aggregate unit and time period), measures, and analyses provide substantively similar deterrent effects of mobile phone ownership rates on crime rates.[6]

Using Farrell et al.'s (2011, 150) 'phone theft test,' which stipulates that explanations for the crime drop should be able to adequately explain why rates for many crime rates fell in the 1990s while some, such as phone theft, increased, we believe that our explanation holds for property crimes, while still providing an explanation for the increase in phone thefts. Unfortunately however, the lack of data on mobile phone thefts in the United States makes it very difficult to empirically test this claim. Harrington and Mayhew's (2001) report from the UK indicated that by 2000 there were an estimated 710,000 thefts of cell phones annually. Any increase in cell phone thefts can likely be largely attributed to the increase in ownership and their attractiveness as targets (Kaplankiran et al., 2008). Since their introduction, cell phones have become smaller, more affordable, and include far more features, which have likely increased their desirability to potential thieves. However, they are also more likely to include various security features (e.g., password protection, GPS apps with tracking), as well as features that have been important in thwarting crime (such as cameras and text message alerting systems).

The availability of cell phones has also increased and enhanced the ability to report crimes. For example, the number of reported wireless 911 and distress calls per day has grown from a reported 55,000 in 1996 to over 396,000 by 2011 (CTIA, 2012). On this point, consider a horrific event that occurred after the NHL's 2012 Winter Classic game in Philadelphia. A large brawl broke out outside Geno's Steaks, a popular cheesesteak restaurant in south Philadelphia between fans of the Flyers and the New York Rangers. The fight was captured on cell phone video and after its posting and subsequent removal from YouTube, the Philadelphia Police released an edited version of the video asking for the public's help. Soon thereafter, a suspect was identified from the video, located, arrested, and charged with aggravated assault, among other crimes (Novak, Hunter, and Quinones 2012). Most recently, after three people were killed and many more wounded in the bombings near the finish line of the Boston Marathon, witnesses of the event submitted photos and video to the FBI that were taken at the scene, in order to provide the FBI with additional evidence. Within hours of the FBI releasing images of who they believed to be the main suspects, new and clearer photos emerged that spectators had snapped on their cell phones moments before and after the blasts. Shortly after many of the images became available, the suspects were identified, and just four days after the bombing, one suspect was killed and the other captured (Botelho, 2013; Kanalley, 2013).

That cell phones may aid in the identification and arrest of suspects is no small matter. In his review of victimization research, Skogan (1984, 113–4), referencing Gottfredson and Gottfredson (1980), stated that 'the decision to report crimes may be the most influential one made in the criminal justice system.' Not only do citizen reports of crime set the operations of the criminal justice system in motion, the time between the crime and when it is reported has been found to be crucial to the likelihood of arrest (Spelman and Brown 1981). Spelman and Brown (1981) reported, in a replication of findings from the Kansas City Police Department's (1980) study on response time, that citizen-reporting, more so than police response time, had the largest impact on the probability of on-scene arrest.

There remains much to learn about the explanation underlying the cell phone-crime relationship, and here we highlight some limitations related to our study and some directions for future research. First, as has been cautioned in the literature (Piquero, 2005), association is not causation and this is certain in time-series investigations. As noted in the only other study of the mobile phone effect (Klick, MacDonald, and Stratmann 2012), there is a need for better identification strategies before the accumulated – but suggestive – results can be discussed with greater confidence. Second, there is a need to describe what individual-level mechanisms may be underlying the negative effect of mobile phones on crime rates – is it because offenders perceive or see potential victims, alter their perceived sanction risks, and subsequently decide against offending? As this study used official data, future research could benefit from the use of victimization or self-report data. It would be useful to conduct interviews among both potential victims (i.e., whether they have been victimized and whether they used their mobile phone in any capacity to lower the likelihood of a successful crime against them) and offenders (i.e., did they seek out persons with phones, did the presence of a phone alter their decision to offend and/or alter their perceived detection risks?) as data from both types of groups will be important to better understand what is linking cell phone ownership rates to crime rates. As Harrington and Mayhew (2001) noted, 'a fair proportion of victims are targeted when it is evident they have a phone. Offenders more often, though, take a phone when it would not be immediately evident that the victim had one' (51–52). It is therefore possible that offenders are aware of the situational circumstances and use these cues to inform decisions on whether or not to commit an offense (Farrell and Mailley 2007). Third, it would be valuable for future research to consider cell phone ownership concentration (i.e., phones per person) to assess the relationship to crimes per person as well as to study this relationship across different age ranges because of their own unique risks of victimization and offending. Lastly, the small sample size in the current study is not ideal; thus, it would be beneficial to consider the cell phone-crime linkage at other units of analysis (within a state – across counties, or within a county – across neighborhoods) as well as other countries in order to examine the extent to which the mobile phone rate effect is replicable, and of course to build a larger sample size by potentially obtaining monthly or bi-monthly data for a longer time period.

Acknowledgements

We would like to thank the reviewers as well as David Greenberg, John MacDonald, and David McDowall for useful comments and suggestions.

Notes

1. Some support has been found for the security hypothesis with regards to domestic burglary in the Netherlands (Vollaard and van Ours, 2011) and internationally (Van Dijk, 2010).
2. It is also important to note that mobile phones can also be seen as a tangible good worthy of an attempted theft, at least from the perspective of a motivated offender (see Cohen and Felson, 1979 for a similar argument regarding the expansion of television sets in the 1970s). While Klick et al. (2012) argued for the deterrent effect of cell phone ownership, Harrington and Mayhew (2001), in an early study of the relationship between phone ownership and crime, showed some evidence of a positive association between phones and increases in street violence in the UK.
3. The dependent variable and all independent variables are first-differenced. The crime rate is measured as numbers of crimes per 100,000 population.
4. The dependent variable and all independent variables are first-differenced. The crime rate is measured as numbers of crimes per 100,000 population.

5. The difference between this model and the others is noticeable with respect to the percent youth age 15–19 variable. There was however, no collinearity problems with this variable and cell phone ownership ($r = -.29$).
6. Additionally, in a subsequent analysis of individual crime types (results not shown), our results for changes in the rape and aggravated assault rates were substantively similar to those from Klick et al. (2012).

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