Article

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The release of Grand Theft Auto V and registered juvenile crime in the Netherlands

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Abstract

Prior research suggests that playing videogames can have a *voluntary* incapacitating effect on criminal behaviour. The current study investigates whether this negative association between videogames *in general* and crime rates can also be found for the release of a single videogame – Grand Theft Auto V (GTAV) – and for registered juvenile crime in the Netherlands. A diminishing effect was modelled to estimate the active player base of GTAV (that is, the most players are active on and directly following release, with a decline in the weeks thereafter) and correlated with the number of registered offences in 2012–15 committed by males aged 12–18 and 18–25 years in a time series analysis. The effect of the release of GTAV was negatively associated with the number of registered offences in both age categories, while controlling for covariates (for example, day of the week). Implications are discussed.

Keywords

Grand Theft Auto V, juvenile crime, videogames, voluntary incapacitation

Internationally, juvenile crime is declining (for example, Ministry of Justice UK, 2016; Sickmund et al., 2015; Van der Laan and Goudriaan, 2016). One of the suggested explanations for this phenomenon is the increased digitalization of society, which occurs firstly and most strongly among young people (Van Dijk, 2006, pp. 180/205), who are also most at risk for criminal behaviour (Gottfredson and Hirschi, 1990). Digitalization opens up new avenues for criminal behaviour, allowing for a shift from traditional crime to cybercrime (Wall, 2007). Because cybercrime is more difficult to detect than traditional crime by both

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law enforcement and victims alike (McGuire and Dowling, 2013), such a shift – if true – would result in an apparent decline in traditional crime.

Furthermore, digitalization and the increasing consumption of, and dependence on, accompanying technology also changes non-criminal behaviour. Social media allow personal and professional contacts to be maintained online (for example, through Facebook and LinkedIn), films and television series can be watched on demand (for example, through Netflix; see also Matrix, 2014), and videogames have become the pastime of millions (for example, Entertainment Software Association, 2014) – significant parts of youngsters' social, leisure and professional life are now spent in front of a computer or on a smartphone (Wenneker et al., 2016). This shift in the way young people spend their (leisure) time from traditional to digitalized activities might cause (traditional) crime to decline as well. Given the growing abundance of entertaining things to do digitally (for example, daily uploads of YouTube videos are estimated in the hundreds of thousands; Golnari et al., 2014), one is only a few clicks away from keeping oneself occupied. As juvenile crime is suggested to originate in part from leisure boredom (Newberry and Duncan, 2001), the removal of offenders' boredom through indulgence in digital entertainment might be in part responsible for the decline in traditional crime. According to the *routine activity theory* (Cohen and Felson, 1979), crime occurs when a motivated offender meets a suitable target in time and space in the absence of capable guardians. Entertainment could nullify offenders' criminal motivations when they originate from boredom, and certain forms of entertainment physically distance offenders from suitable targets – *voluntary* incapacitation through entertainment (for example, watching violent movies at the cinema; Dahl and DellaVigna, 2009). This form of incapacitation differs from the more frequently examined *involuntary* incapacitation (for example, through imprisonment; Piquero and Blumstein, 2007).

In this paper, one form of incapacitation through the use of entertainment is addressed: playing videogames. With the widespread reach of the videogame industry (Entertainment Software Association, 2014), it is plausible that videogames also cater to criminal youth. Although videogames are not per se time consuming (for example, a round of *Bejeweled* [PopCap, 2001] could last as short as a few minutes), the addictive repetitiveness of many games, or the sheer scope of larger titles (for example, *World of Warcraft*; Blizzard, 2004), can take up hours to days of a person's time (see also Griffiths and Meredith, 2009). This element of time consumption, along with entertainment value and the fact that many videogames need to be played on game consoles or on PCs at home, suggests that videogames are 'effective' in keeping individuals occupied and off the streets, thus potentially buffering them from crime (Cunningham et al., 2016).

The previous line of reasoning has been supported in a modest number of studies.[1] Ward (2011), examining the ecological validity of the theory that playing violent videogames leads to more aggressive behaviour (for example, Anderson et al., 2010), found that an increased prevalence of videogame stores was associated with lower crime rates (of, for example, robbery and larceny). One suggested explanation for this observation was the incapacitation of offenders through playing videogames. Another study on this topic (Cunningham et al., 2011) did find a positive behavioural association between the sales of violent videogames and violent crime. However, this link was nullified by a larger incapacitation effect of videogames sales. A third study, too, found a negative

association between releases of videogames and crime, but only for non-violent videogames and for a limited number of offences, and mostly for crimes committed by those younger than 17 years old (Impink et al., 2015). Violent videogame releases, however, were overall associated with an increase in crime. Lastly, a fourth study (Cunningham et al., 2016) did not replicate the positive association between violent videogame sales and violent crime, but did replicate the negative association between the sales of violent and non-violent videogames and crime rates. Although the results of these studies are not uniform, and stemming from proxies of videogame behaviour, all of them at least suggest that videogames can incapacitate. Also, in areas other than criminal behaviour, such as studying, an incapacitation effect of playing videogames is noticeable (Stinebrickner and Stinebrickner, 2008).

However, in contrast to the videogame studies discussed above, the current study does not explore the association between crime and videogames in general, but focuses on one specific videogame – *Grand Theft Auto V* (GTAV; Rockstar Games, 2013) – to explore whether the suggested incapacitating effect of videogames is also noticeable at the scale of a single title. GTAV was the most popular and highest-selling videogame of its time (Entertainment Software Association, 2014), making it the most likely candidate to have a noticeable incapacitating impact on crime all by itself. The incapacitation effect of an individual game on crime rates is expected to be at its strongest at release and directly after release, because that is usually when a videogame is most played (and is also the time when a videogame is most purchased in its lifetime; for example, Cunningham et al., 2016). After then, the number of players declines as players finish the game or lose interest.

Publicly available statistics on the peak number of concurrent players of the Windows release of GTAV (Rockstar Games, 2015; Steam Database, 2016a) support part of this line of reasoning (that is, the most players are active on and directly after release) and similar curves of peak concurrent players are also found with big releases in other genres, such as *Call of Duty: Black Ops III* and *XCOM2* (Activision, 2015; 2k Games, 2016; Steam Database, 2016b, 2016c). Put differently, when individuals are stuck behind their computers playing a new videogame release, they are unable to commit crimes elsewhere (see also Cunningham et al., 2016). However, when the videogame is done or loses its attraction over time, individuals are once again 'released' and are able to commit crimes (unless they find something else to play). Despite a decline, the number of players will probably never reach zero, because the online multi-player component of GTAV has no definitive 'ending' (in contrast to the offline single-player campaign) providing players with ongoing entertainment (as long as this online service is not discontinued) and not everyone will start playing directly at release. Therefore, the incapacitating effect of GTAV is also expected to be long term.

Furthermore, the focus is on registered crime by male minors (that is, 12–18 years of age) and young adults (that is, 18–25 years of age), because young males are overrepresented in crime statistics (Gottfredson and Hirschi, 1990; Van der Laan and Goudriaan, 2016). We differentiate between these two age groups, because minors and young adults are tried differently in the Netherlands. For example, considerable effort is made to keep minors out of the justice system through, for instance, the HALT programme (that is, a suspended *nolle prosequi* issued by the police under the condition of participating in

community service). Therefore, certain crimes committed by minors will never make it to prosecution, and thus registration, whereas something similar is not available for young adults. Hence, the registered offences of the two age groups may not reflect the same patterns of criminal behaviour, owing to the different judicial pathways and procedures associated with and available for both age groups, and may potentially distort the analyses when taken together. Moreover, these age groups, and males compared with females, are more likely to spend more time on playing videogames (Greenberg et al., 2010; Wenneker et al., 2016) and thus are more likely to be incapacitated for longer periods of time. In addition, males prefer videogames with physical elements (for example, shooting, fighting, racing) – the main elements found in GTAV – whereas females prefer more traditional game elements (for example, puzzles; Greenberg et al., 2010), which are not or are of secondary importance in GTAV. In other words, young males are the most relevant demographic group to examine when associating GTAV with criminal behaviour, based on their prevalence in crime and their interests in videogames.

Although GTAV is rated for *adults only* in Europe (Pan European Game Information, 2013), owing to its graphic and excessive violent content, and is thus not meant to be played by minors or sold to those under 16 years of age (Dutch Criminal Code, Article 240a), we still expect an incapacitation effect to occur for this age group. Namely, the laws and policies in place to keep harmful media content from minors are far from effective, because age verification has yet to become a standard in videogame stores – 90 percent of minors not yet of age said they were able to purchase a mature or adult videogame when they tried (EenVandaag, 2014). This issue of minors consistently obtaining mature or adult goods in the Netherlands was also found for the purchase of alcohol (Van Hoof et al., 2014) and cigarettes (with traditional age verification methods; Van Hoof et al., 2010). Also, when videogames are purchased online or by mail order, or purchased by adults (for example, parents) intending to provide it to a minor later, adult material can still be accessed by minors (see also Impink et al., 2015). Given the state of age verification in videogame stores and alternative ways of obtaining adult gaming material, it was likely that Dutch minors could be incapacitated by GTAV.

In conclusion, the current study examines the association between the release of GTAV and the levels of registered juvenile crime committed by young males in the Netherlands. More specifically, the study tries to answer the question of whether the previously suggested incapacitating potential of playing videogames on crime (Cunningham et al., 2011, 2016; Impink et al., 2015; Ward, 2011) can also be detected at the level of a single game release. The hypothesis is that the modelled effect of GTAV's release (that is, initially strong, with a decline afterwards, as discussed above and further explained in the method section) is negatively associated with the number of registered criminal offences committed by male minors and young adults.

Method

Sample and dependent variable

The time period of interest was January 2012 to the end of December 2014, with the measurement unit set on days (that is, 1096 time units). The dependent variable was the

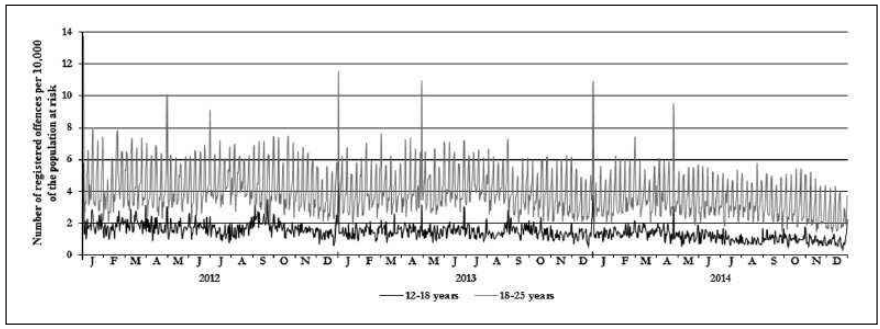

Figure 1. Number of registered offences by males aged 12–25 years per 10,000 of the population at risk, 2012–15.

number of registered offences in the Netherlands by males aged 12–18 years and 18–25 years. This number of registered offences per day was obtained from the Dutch Offender Index (DOI) – a database containing all court decisions regarding criminal cases in the Netherlands. In the DOI, a registered offence is a crime or *cluster* of crimes belonging to a specific statutory provision and offence date. The DOI also contains information on offender specifics (for example, age during offence). Furthermore, offences that were prosecuted by the Public Prosecution Service (PPS) but that did not result in conviction were included (approximately 20–25 percent of all offences) because we were more interested in (registered) behaviour than in conviction rates. However, the DOI does not include offences by minors that were dismissed with alternative sentences outside of the criminal court or offences that were reported to the police but not reported to the PPS by the police (for example, owing to lack of evidence). These parameters resulted in 98,702 registered offences committed by males aged 12–18 years and 320,685 by males aged 18–25 years. These numbers were adjusted for the population at risk, which was obtained from Statistics Netherlands (2016). A visual representation of the trends in offences for both age groups is shown in Figure 1. The mean number of offences per day per 10,000 individuals at risk was 1.47 for 12–18 year olds (range was 0.27–5.78) and 3.95 for 18–25 year olds (range was 1.45–13.72).

Analysis strategy and independent variables

The data were analysed through a time series analysis performed in Eviews 9. The autoregression lag coefficient (AR) – a predictor based on *previous* observations within a time series that is used to account for trend effects not explicitly specified in the model – was set at 1. Put differently, crime levels and the associated error term one day *prior* to observation were used to predict the crime levels *during* observation. The independent variable was the modelled effect of the PS3/Xbox 360 release of *Grand Theft Auto V* (GTAV; Rockstar Games, 2013). The effect was based on the daily peak of concurrent players of the Windows release of GTAV on and after its release (which was two years later than the console release; Rockstar Games, 2015). We used a proxy because no public data were available on the number of people playing GTAV on the PS3/Xbox 360

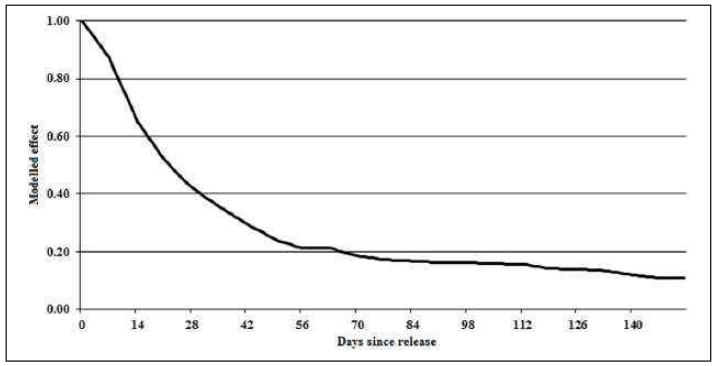

Figure 2. Modelled effect of the release of Grand Theft Auto V over time.

platforms following release. These proxy numbers were obtained from publicly available information on the Steam digital game platform (Steam Database, 2016a; see the Reference list for the URL).

Firstly, a main effect representing the natural decay of a player base was modelled by comparing the number of peak concurrent players at release, and every seven days thereafter. To illustrate, the peak of concurrent players on the release day of GTAV for Windows was approximately 300,000, and the modelled effect was set at 1.00 for T_0. At 7 and 14 days later these peaks were approximately 262,000 and 196,000 concurrent players respectively, so the effects were set at 0.87 for T_7 (262,000 is 87 percent of 300,000) and 0.65 for T_{14} (196,000 is 65 percent of 300,000). This procedure was repeated for every week thereafter. To complete and smoothen the curve, the number of peak concurrent players for the days between these benchmarks was estimated linearly using the weekly benchmarks before and after these days as anchor points.

Hence, for the first week the average daily decay of peak concurrent players was estimated at 5400 individuals (that is, T_0[300,000] – T_7[262,000]/7) – a loss of effect of approximately 0.02 per day (that is, 5400 is 2 percent of 300,000). This resulted in the following linear estimation of effect for the first week: $T_0 = 1.00$, $T_1 = 0.98$, $T_2 = 0.96$, and so on up to $T_7 = 0.87$. For the following week the average daily decay of peak concurrent players was estimated at 9400 (that is, T_7[262,000] – T_{14}[196,000]/7) – an effect loss of approximately 0.03 per day (that is, 9400 is 3 percent of 300,000). This resulted in the following linear estimation of effect for the second week: $T_7 = 0.87$, $T_8 = 0.84$, $T_9 = 0.81$, and so on. The main effect was set at a constant of 0.11 at T_{147} and beyond (that is, after approximately five months after release) because the spikes in the number of peak concurrent players thereafter were likely caused by promotional events or discount sales. As we had no way to ascertain whether or when such events happened for the PS3/Xbox 360 release and how they affected the number of people playing, these spikes were disregarded. The main effect had an event date of 17 September 2013 and is visually represented in Figure 2.

Secondly, seasonal control variables were implemented to account for seasonal effects on crime – weekdays (that is, more crime on weekends, including Friday night), summer

vacation (that is, less crime during July and August, because young people are on vacation abroad or under the supervision of parents on domestic vacations), holidays with nationwide festivities (that is, more crime during the festivities of Queen's/King's Day and Night, and New Year's Eve and Night), and the meteorological seasons (that is, less crime in autumn and winter). Also, two control variables representing registration practices by law enforcement were implemented – first day of the month (that is, more crime, because offences with only an approximate date are often registered as occurring on the first of that month) and a period potentially susceptible to registration lag (that is, less crime during the final two quarters of 2014). Furthermore, interaction terms of the main effect of GTAV and weekend (that is, Fridays, Saturdays and Sundays) were implemented to account for and to separately examine seasonal effects not modelled in the main effect (that is, a greater number of active players on the weekends; see Steam Database, 2016a).

Results

Main analysis

Table 1 shows the results of the time series analyses predicting the number of registered offences by male minors and young adults from the modelled effect of GTAV's release (also see Figure 2), its interaction terms with weekend, and control variables (that is, weekdays, summer vacation, national holidays, meteorological seasons, and registration controls). For both age groups the modelled effect of GTAV's release was significantly and negatively associated with the number of registered offences, when accounting for control variables, which supports the voluntary incapacitation effect of playing videogames on crime hypothesis. Its interaction terms with Fridays, Saturdays and Sundays were non-significant for both age groups. When comparing the explained variance of a model with only the control variables to the model including the GTAV effects, the increase in explained variance was 0.9 percent for minors and 0.4 percent for young adults – (very) small effects. The addition of the GTAV effects did significantly improve the model for both age groups (respectively, $LR = 23.343$, df = 4, $p < .001$, and $LR = 31.614$, df = 4, $p < .001$).

Furthermore, weekends and holidays with nationwide festivities were associated with more registered offences for both age groups, and for young adults summer vacation was also associated with more registered offences. The autumn season was (marginally) associated with more registered offences for minors and young adults, whereas the winter season was associated with fewer registered offences for young adults. Lastly, the first day of the month was associated with more registered offences for both age groups, and the period susceptible to registration lag was associated with fewer registered offences in both age groups.

Sensitivity analyses

To examine the robustness of the analyses, we performed sensitivity analyses with alternative modelled effects of the release of GTAV, and with shorter observation periods.

Table 1. Time series analysis predicting registered offences in 2012–15 by male minors and young adults from Grand Theft Auto V and covariates.

Predictor variables	Registered offences per 10,000 (log)					
	12–18 year olds			18–25 year olds		
	B	SE	95% CI	*B*	SE	95% CI
Constant	0.330***	0.027	0.277–0.383	1.052***	0.016	1.020–1.084
Σ^2	0.052***	0.002	0.048–0.056	0.020***	0.001	0.019–0.021
AR(1)	0.345***	0.028	0.290–0.401	0.326***	0.025	0.276–0.375
Controls						
Weekdays						
Monday	ref.			ref.		
Tuesday	0.012	0.022	−0.031–0.055	0.092***	0.013	0.067–0.117
Wednesday	0.022	0.025	−0.027–0.071	0.123***	0.015	0.094–0.153
Thursday	0.062*	0.026	0.010–0.114	0.199***	0.016	0.167–0.231
Friday	0.175***	0.029	0.118–0.231	0.363***	0.018	0.328–0.398
Saturday	0.121***	0.028	0.066–0.176	0.636***	0.018	0.600–0.672
Sunday	0.203***	0.025	0.154–0.251	0.747***	0.015	0.717–0.777
Summer vacation	−0.043	0.046	−0.132–0.047	0.130***	0.031	0.070–0.191
National holiday	0.636***	0.042	0.554–0.718	0.639***	0.019	0.601–0.677
Seasons						
Spring	ref.			ref.		
Summer	−0.000	0.043	−0.084–0.084	0.007	0.026	–0.044–0.058
Autumn	0.104**	0.035	0.035–0.174	0.039†	0.022	–0.004–0.081
Winter	−0.040	0.029	−0.098–0.017	−0.077***	0.018	−0.112–−0.041
First day of the month	0.273***	0.036	0.202–0.344	0.214***	0.020	0.175–0.253
Registration lag	−0.489***	0.031	−0.550–−0.429	−0.333***	0.020	−0.371–−0.294
Grand Theft Auto V						
Main effect	−0.399***	0.093	−0.581–−0.216	−0.324***	0.059	−0.440–−0.208
Main effect × Friday	0.259	0.180	−0.094–0.611	0.085	0.087	−0.085–0.255
Main effect × Saturday	−0.020	0.180	−0.374–0.334	0.025	0.133	−0.237–0.287
Main effect × Sunday	−0.131	0.165	−0.455–0.193	0.121	0.119	−0.113–0.355
Adjusted R^2	.517			.829		
Durbin-Watson	2.127			2.117		

Note: ***$p < .001$; **$p < .01$; *$p < .05$; †$p < .10$; method of estimation was maximum likelihood; the analysis included 1096 observations (that is, three years at the daily level).

Firstly, we modelled the effect of GTAV as an overall binary effect without an interaction with weekend (that is, pre-release = 0; release and post-release = 1), resulting in a significant and negative association with registered offences for minors and young adults (respectively, $B = -0.198$, SE = 0.024, $p < .001$, and $B = -0.140$, SE = 0.014, $p < .001$). However, when modelling the binary effect as limited to one, two, three or four weeks (that is, pre-release = 0; 7/14/21/28 days after release [including release day] = 1; other post-release days = 0), none of the binary short-term effects exhibited a significant association for either age group ($p \geqslant .10$).

Also, the accelerated effect (that is, the decay of active players towards the constant was twice as fast) was significantly and negatively associated with crime for both age groups (respectively, $B = -0.514$, SE = 0.101, $p < .001$, and $B = -0.404$, SE = 0.062, $p < .001$). This negative association also occurred for the decelerated effect (that is, the decay of active players towards the constant was twice as slow; respectively, $B = -0.364$, SE = 0.073, $p < .001$, and $B = -0.282$, SE = 0.048, $p < .001$). None of the interactions effects was significant ($p \geqslant .10$).

Secondly, when using the original modelled effect (including its interaction terms with weekend and control variables) with an observation start of 1 September 2013 (instead of 1 January 2012), the effect of the release of GTAV was non-significant for both age groups ($p \geqslant .10$). When preponing the end of observation to 1 March 2014 (instead of 31 December 2014), and excluding the registration lag effect, the GTAV effect remained significant and negative for both age groups (respectively, $B = -0.298$, SE = 0.100, $p < .01$, and $B = -0.235$, SE = 0.066, $p < .001$). The interaction terms with weekend were non-significant in these analyses ($p \geqslant .10$).

In sum, the results of the sensitivity analyses were in accordance with the main analysis when the GTAV release effect was modelled as a very long-term binary effect or with a preponed end of observation. In addition, changing the slope of the modelled effect did not alter the results. In contrast, the sensitivity analyses were not in accordance with the main analyses when a one-to-four week limited binary effect was modelled or when the start of the observation was delayed. Hence, the alternative binary operationalizations suggest that, if GTAV was capable of incapacitating juveniles, this effect was long term, instead of only immediate and short term. Moreover, the inclusion of ample pre-release observation was crucial, because starting the observation in the release month of GTAV nullified the association.

Replication analyses

To examine whether similar incapacitation patterns also occur for other videogames, next to the GTAV effect, we imputed the modelled effect as shown in Figure 2 on the release dates of *Call of Duty: Black Ops II* (CoDBO2; 13 November 2012 for PS3 and Xbox 360; Activision, 2012) and *Call of Duty: Ghosts* (CoDG; 5 November 2013 for PS3, Xbox 360, Windows and WiiU; Activision, 2013), alongside interaction terms with weekend, the GTAV effects and the control variables. These two videogames were, respectively, the most popular videogame of 2012 (Entertainment Software Association, 2013) and the second-most popular videogame of 2013 (Entertainment Software Association, 2014). Given the serial nature of the yearly releases of *Call of Duty*, we let the incapacitation effect end on the date of the subsequent *Call of Duty* release, as it was likely that players then made the transition to the new release.

The main effects of all three videogames were (marginally) significant and negatively associated with crime levels for minors and young adults (minors: GTAV, $B = -0.324$, SE = 0.101, $p < .01$; CoDBO2, $B = -0.185$, SE = 0.104, $p < .10$; CoDG, $B = -0.446$, SE = 0.124, $p < .001$; young adults: GTAV, $B = -0.286$, SE = 0.068, $p < .001$; CoDBO2, $B = -0.153$, SE = 0.066, $p < .05$; CoDG, $B = -0.246$, SE = 0.066, $p < .001$). None of the interaction terms were significant ($p \geqslant .10$). Furthermore, these negative main effects

independently remained for CoDG in both age groups when both the other videogame effects were omitted (respectively, $B = -0.465$, SE = 0.120, $p < .001$, and $B = -0.272$, SE = 0.064, $p < .001$), but not for CoDBO2 ($p \geqslant .10$).

In sum, the results suggested that the incapacitation effect of a single videogame release was not limited to GTAV, but also occurred for at least one other popular videogame, and perhaps two, when assuming incapacitation patterns similar to that of GTAV.

Discussion

The current study examined whether the suggested voluntary incapacitating effect of videogames overall (Cunningham et al., 2011, 2016; Impink et al., 2015; Ward, 2011) was detectable at the level of an individual game release – that of *Grand Theft Auto V* (GTAV; Rockstar Games, 2013). The results suggested that such an effect is indeed detectable, because the effect curve of GTAV's release – modelled after the estimated number of active players over time – was significantly and negatively associated with the number of registered offences committed by male minors and young adults.

These results are in accordance with the routine activity theory of criminal behaviour (RAT; Cohen and Felson, 1979). RAT theorizes that crime occurs when motivated offenders meet suitable targets in time and space in the absence of capable guardians; removing the offender from the equation (that is, incapacitation) should prevent crime from taking place. When motivated offenders are playing videogames in the confines of their own home, they are unable to commit crimes elsewhere. Furthermore, the same may go for suitable victims, when criminal behaviour concerns a human target; for instance, when likely victims of violence on a night out are at home playing videogames, they are less likely to be assaulted (see also Messner and Blau, 1987; Mustaine and Tewksbury, 1999). Hence, both offenders and victims might be incapacitated via videogames. Regarding capable guardians, we believe that the release of a videogame is less relevant. If informal guardians (for example, parents) might be similarly incapacitated by videogames, and thus no longer able to oversee and prevent offenders from offending, this should result in an increase in crime, which we did not find (or is nullified by the incapacitation of offenders and victims). Moreover, we expect no effect with formal guardians (for example, law enforcement officers), because they are less – if at all – capable or allowed to play videogames while on duty.

Although the incapacitation of offenders usually refers to involuntary forms, such as imprisonment (for example, Piquero and Blumstein, 2007), the current study, alongside previous research (Cunningham et al., 2011, 2016; Dahl and DellaVigna, 2009; Impink et al., 2015; Ward, 2011), suggests that voluntary incapacitation might be similarly effective. That is, when we assume that these voluntary legal activities are preferred over criminal activities and remove or diminish the motivations of the offender to offend. To illustrate, employment is suggested to decrease the involvement of minors in property crime, but young adults are still likely to prefer crime when legitimate working conditions are considered to be unfavourable (that is, low wages and poor hours; Allan and Steffensmeier, 1989). Translating this more economic perspective on whether or not to participate in crime to the leisure perspective of the current study, when criminal behaviour originating from leisure boredom is more fun than playing videogames, videogames

are less likely to incapacitate. Given that it is plausible that not all videogames are equally attractive to play for individuals with criminal tendencies, such as a predisposition for violence (Ward, 2010), specific or violent videogames might be better suited for incapacitation than just any other popular, or non-violent, videogame (see also Cunningham et al., 2016). Furthermore, playing videogames can be a solitary endeavour, not necessarily providing any social interaction in the physical sense. Hence, videogames do not necessarily incapacitate youngsters who commit crimes with peers to satisfy their social needs.

Nevertheless, this suggested voluntary incapacitation effect of GTAV on crime is small. For videogames to continually incapacitate offenders, the effects of individual videogame releases need to follow each other rapidly, as their individual grip on crime diminishes quickly over time. Given that we found (partial) evidence of patterns of incapacitation for two other videogames besides GTAV, and that previous studies found similar patterns when examining more general videogame behaviour and crime (for example, Cunningham et al., 2016), the constant release of new videogames, parallel to an increasing consumption of videogames in society, might in small part be responsible for the decline in juvenile crime (alongside multiple other causes, for example, Zimring, 2007).

The study has limitations. Firstly, the offences measured were registered offences that were prosecuted by the Dutch Public Prosecution Service. Offences that were not reported to or detected by law enforcement and offences that were reported, but not prosecuted, were not included. Therefore, the presented levels of crime are not reflective or inclusive of all crime by male minors and young adults. Moreover, the usual caveats of registered crime regarding accuracy apply, and offences with no known offence date were unable to be included. However, as less than 2 percent of all registered offences in criminal cases from 2012 onwards had an unknown offence date, we are confident that the temporal elements of the registered offences are mostly inclusive and sound. Nonetheless, future studies on the incapacitation effect of videogames and other forms of digital entertainment should (wherever possible) explore or include other crime measures as well, for instance self-report.

Secondly, the effect of GTAV was modelled after the number of peak concurrent players worldwide from its Windows release (Rockstar Games, 2015), whereas we examined offences committed by Dutch juvenile males surrounding the PS3/Xbox 360 release (Rockstar Games, 2013). In other words, there is a discrepancy in game platform, time and geography within our study. Also, these proxy numbers do not differentiate in age and gender. The effect curve should therefore be considered more an estimation of GTAV's active player base on the PS3/Xbox 360 rather than a 'hard' indicator. Such 'hard' indications are not available, so the choice was made to model the effect after the player curve in the Windows release, because the content of GTAV on different platforms is virtually the same, likely attracting a similar kind of player. Nonetheless, the negative association found with the primary operationalization can be considered robust regarding more long-term incapacitation, because several alternative operationalizations representing long-term incapacitation replicate the negative association between GTAV and crime.

Previous studies on the link between videogames and crime operationalized the gaming element as the prevalence of videogame stores (Ward, 2011), the sales numbers of top-selling videogames (Cunningham et al., 2011, 2016) or event dates for multiple

videogames releases (Impink et al., 2015), in contrast to the estimated active player base of a single game in the current study. Furthermore, most of these studies looked at crime and videogames on the weekly aggregate, whereas only one study (Impink et al., 2015), besides the current study, does so on the daily level. These different approaches produced different specific results, but all studies provided at least some evidence that videogames can incapacitate. Also, a positive association more specifically between violent and delinquency-reinforcing videogames on the one hand, and violence and crime on the other, as suggested in the literature (for example, Anderson et al., 2010; Fischer et al., 2012), was found in two previous macro-level studies (Cunningham et al., 2011; Impink et al., 2015). In the current study we do not find a similar association for crime in general and GTAV – a videogame that could be considered violent and delinquency reinforcing. Regarding this lack of replication, different operationalizations of both crime and videogame behaviour and the associated sources, and the different countries in which the studies took place, make it difficult to pinpoint which of these factors are responsible for the contrasting results among the various studies. From a theoretical perspective, such an increase in aggression and criminal tendencies can coincide with a reduction in criminal behaviour. Namely, an increase in aggression and criminal tendencies is less likely to manifest itself in observable criminal behaviour if this increase occurs during an activity or within a context in which criminal opportunities are minimized – for instance, playing videogames at home (Cunningham et al., 2011, 2016). Put differently, the incapacitation effect 'overrules' the aggressor or criminal effect.

In addition, the element of gaming behaviour in the current study and the studies discussed above (Cunningham et al., 2011, 2016; Impink et al., 2015; Ward, 2011) was a proxy of actual gaming behaviour during the period of observation, with no definitive way to ascertain whether the correlations found are also causal. That being said, proxies had to be used because there was no feasible way of measuring the actual amount of time spent playing videogames per day by the population at risk, let alone by offenders. Future studies should try to incorporate measures of actual playing time (perhaps with smaller samples) and an experimental design to further investigate or validate the causality of the association between playing videogames and the commission of crimes.

The suggested incapacitation effect of GTAV applies to traditional crime, but at the moment nothing can be said about whether or how this effect applies to cybercrime. Although many minors and young adults report that they engage in various forms of cybercrime, almost no one is (detectably) prosecuted or convicted for such crimes in the Netherlands (Van der Laan and Goudriaan, 2016). Therefore, cybercrime is virtually non-existent in our operationalization of crime. Although it is plausible that an incapacitation effect also occurs for cybercrime from the leisure boredom perspective, various forms of cybercrime can (or must) be committed from a computer while playing a videogame. For instance, the theft of virtual goods in online videogames (Arias, 2007) or the bullying or threatening of other players (Yang, 2012) requires access to videogames. It is therefore plausible that such crimes actually increase with the releases of new online videogames. A similar association has been suggested for other online activities, because the increase in online purchases over recent years has coincided with an increase in monetary losses owing to cyber victimization (Brady et al., 2016). However, we cannot find such associations in the current study, because these cybercrimes are not yet detected by law enforcement or prosecuted, as mentioned above.

We would not suggest providing a videogame console with GTAV to every young delinquent to keep them occupied. This is not only because crime should never be 'rewarded', but also because various studies suggest that violent and delinquency-reinforcing videogames have an adverse effect on aggression and criminal attitudes (for example, Anderson et al., 2010; Fischer et al., 2012), which in turn might hinder resocialization. However, the results could still be used by policy makers and law enforcement agencies in relation to juvenile crime. In other words, the study does suggest that the decriminalizing effect of a single event, such as a popular videogame release, is noticeable at the national level. Given that the release dates of videogames are usually well known in advance and that pre-release indications of the expected popularity of a videogame are easily derived from media attention, anticipating such events, for instance through predictive policing models (for example, Perry et al., 2013), might be beneficial for law enforcement.

In conclusion, this study suggests that the overall incapacitation effect of videogames on crime previously found at the macro level (Cunningham et al., 2011, 2016; Impink et al., 2015; Ward, 2011) can be detected even for the release of a single popular videogame – *Grand Theft Auto V* (Rockstar Games, 2013). Hence, the study offers support to the hypothesis that changes in how people behave and spend their leisure time as a result of digitalization underlie, in small part, the decline in traditional juvenile crime. Furthermore, it suggests that this overall decline is not necessarily and solely due to a shift from observable traditional crime to (for the moment) undetectable cybercrime also brought on by digitalization.

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Note

1. We also found an unpublished bachelor's thesis that suggested a negative association between violent crime rates and (as a proxy for videogame behaviour) the number of Google searches for cheat codes for various Grand Theft Auto videogames (Rosene, 2013).

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