Journal of Economic Behavior & Organization xxx (2017) xxx–xxx

Contents lists available at ScienceDirect

Journal of Economic Behavior & Organization

journal homepage: www.elsevier.com/locate/jebo

Crime and violence: Desensitization in victims to watching criminal events☆

Rafael Di Tella[a], Lucía Freira[b], Ramiro H. Gálvez[c], Ernesto Schargrodsky[d,*], Diego Shalom[d], Mariano Sigman[d]

[a] Harvard Business School, CIfAR & NBER, United States
[b] Universidad Torcuato Di Tella, Argentina
[c] Universidad Torcuato Di Tella & ICC-CONICET, Argentina
[d] Universidad Torcuato Di Tella & CONICET, Argentina

ARTICLE INFO

Article history:
Received 31 December 2016
Received in revised form 30 July 2017
Accepted 2 October 2017
Available online xxx

JEL classification:
K42

Keywords:
Crime
Biological markers
Experiment
Victimization
Desensitization

ABSTRACT

We study desensitization to crime in a lab experiment by showing footage of criminal acts to a group of subjects, some of whom have been previously victimized. We measure biological markers of stress and behavioral indices of cognitive control before and after treated participants watch a series of real, crime-related videos (while the control group watches non-crime-related videos). Not previously victimized participants exposed to the treatment video show significant changes in cortisol level, heart rate, and measures of cognitive control. Instead, previously victimized individuals who are exposed to the treatment video show biological markers and cognitive performance comparable to those measured in individuals exposed to the control video. These results suggest a phenomenon of desensitization or habituation of victims to crime exposure.

1. Introduction

Crime is one of the main social problems in developing nations. It is particularly serious in Latin America, a region with 8.6% of the world's population, but 36.5% of the world's homicides.[1] Its citizens systematically rank crime as one of their main concerns (Latinobarómetro, 1995–2015). Yet, Latin American societies seem to show a tolerance for crime, and our understanding of the phenomenon is limited. For example, many incumbent politicians are re-elected even as crime increases or remains constant at extremely high rates. Moreover, the relationship between crime victimization and happiness looks weak (Di Tella and Schargrodsky, 2009; Graham and Chaparro, 2012). Fig. 1 illustrates one aspect of this problem: sometimes increases in crime victimization coincide with society's mounting concern over crime, yet, at other times, there is, if anything, a *negative* correlation (e.g., the correlation is 0.036 for the overall period 1995–2015, but −0.113 for 2005–2015).

☆ We thank the InterAmerican Development Bank for financial support. We thank participants at LACEA 2015, the 7th Transatlantic Crime Workshop, AL CAPONE 2016, IEA 2017, and several workshops for their helpful comments.
* Corresponding author at: Universidad Torcuato Di Tella, Av. Figueroa Alcorta 7350, (C1428BIJ) Buenos Aires, Argentina.
E-mail address: eschargr@utdt.edu (E. Schargrodsky).
[1] Authors' calculation from the World Development Indicators for 2014.

https://doi.org/10.1016/j.jebo.2017.10.005
0167-2681/

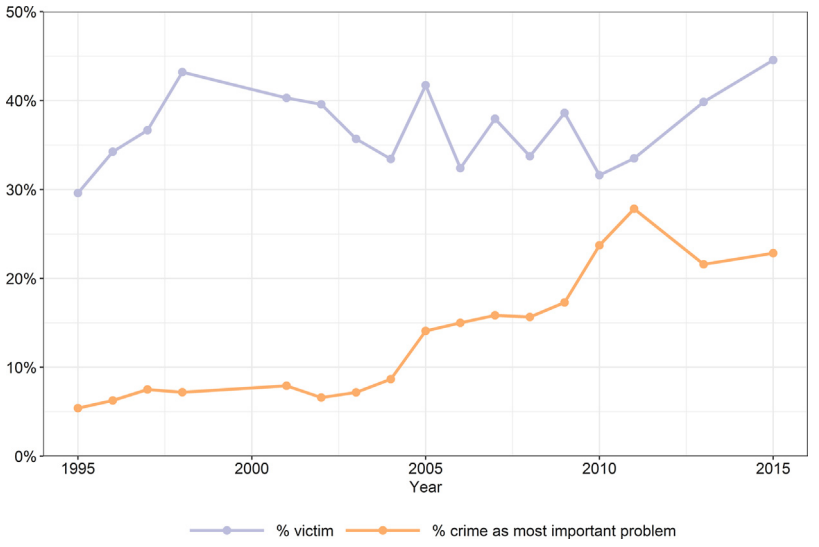

Fig. 1. Victimization and Crime as the most important problem in Latin America. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)
Source: Latinobarómetro (1995–2015). The top blue line shows the percentage of positive responses to the question: "Have you or a relative been assaulted, attacked, or the victim of a crime in the last 12 months?" The red line shows the percentage of crime responses to the question: "In your opinion, which is the most important problem in the country?"

A natural hypothesis in this context is that victims gradually become used to high levels of crime, so that perceptions of crime are not primarily driven by the actual amount of crime. This hypothesis follows "desensitization" (or "habituation" or "adaptation") phenomena, namely the reduction in the response to repeat stimuli observed in humans across many settings (see, for example, Thompson and Spencer, 1966; on hearing habituation to sound, Rosburg et al., 2002, 2006; Sörös et al., 2001). One strand of papers in this field has investigated "desensitization" to media violence (see, for example, Fanti et al., 2009; Huesmann et al., 2007; Bartholow et al., 2006, inter alia). More closely related to our paper, Carnagey et al. (2007) find that individuals who previously played a violent video game had a lower heart rate and galvanic skin response while viewing a video with scenes of real violence than the control group, which the authors interpret as demonstrating physiological desensitization to violence (for work connecting desensitization to aggression, see Engelhardt et al., 2011). A difference with our paper lies in the aims: whereas we want to study how people that were victimized experience new episodes of crime, they are interested in how people that play videogames might become desensitized and, in turn, increase aggressive behavior. Additionally, actively playing a violent videogame is different from passively being a victim of a crime. Our paper is also related to work by Mullin and Linz (1995), who document how repeated exposure to sexually violent films led to lower self-reported physiological arousal, emotional response, and ratings of the extent of sexual violence in films.

In this paper, we discuss an experiment we conducted to examine whether victims of crimes become desensitized to violence, on the assumption that watching footage of criminal events provides an approximation to suffering a criminal event in real life. We study implicit markers of habituation, including biological (cortisol and heart rate levels) and cognitive (executive functions) effects. Participants with different victimization experiences are monitored while watching footage of crime scenes (treatment) or of standard, non-violent footage (control) from the same real TV news programs.[2] The expectation is that participants that were previously victimized would exhibit small changes in cortisol, heart rate, and measures of cognitive function and fluid thinking in response to violent footage (desensitization), relative to control participants watching videos without violence. In contrast, we expect participants who were not previously victimized (whom we call "naive" subjects) to respond to exposure to crime-related videos with significant changes in physiological and cognitive tests relative to participants in the control group. Our findings confirm the "desensitization" hypothesis: naive individuals respond to the treatment, but previously victimized individuals exposed to the treatment video show instead biological markers and cognitive performance comparable to those measured in the control group, suggesting that prior victimization desensitizes subjects to violence.

A natural consequence of such desensitization is that concern over crime will not directly follow increases in crime, particularly when crime levels are high and a large proportion of victims have been previously victimized. Indeed, our evidence is consistent with the observed mismatch between the evolution of crime victimization and concerns related to crime in Latin America. If victims become desensitized, welfare evaluations of high levels of crime will require a better

[2] Our sample shows high victimization rates, although it does not include victims of very severe crimes like rape, kidnapping or homicide.

Please cite this article in press as: Di Tella, R., et al., Crime and violence: Desensitization in victims to watching criminal events. J. Econ. Behav. Organ. (2017), https://doi.org/10.1016/j.jebo.2017.10.005

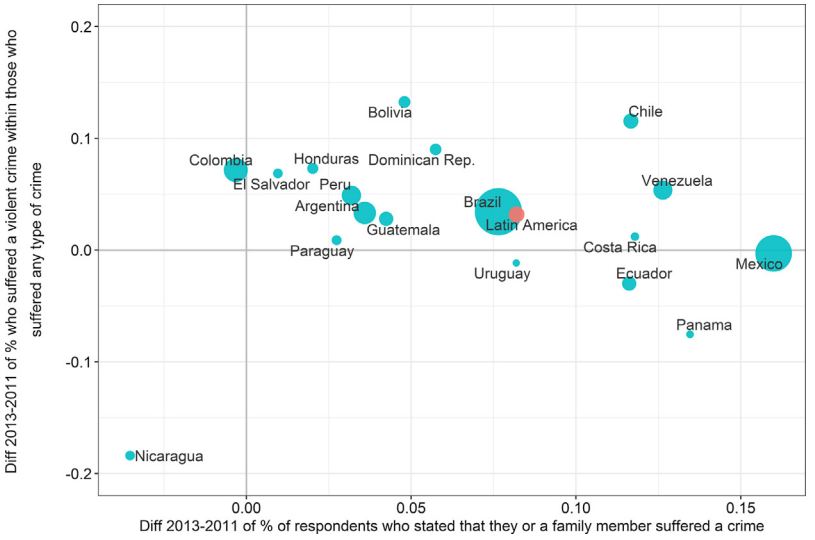

Fig. 2. Victimization and Violent Crime in Latin America. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)
Source: Latinobarómetro (2011, 2013). The horizontal axis shows the change in the percentage of positive responses to the question: "Have you or a relative been assaulted, attacked, or the victim of a crime in the last 12 months?" The vertical axis shows the change in the percentage of respondents that, having themselves or a relative suffered a crime, indicate that the crime was violent when asked: "Was it a violent crime or a nonviolent crime?" This last question is only available for the 2011 and 2013 Latinobarómetro surveys. The size of each circle is proportional to the country population, but the red circle represents the average for the whole region.

understanding of the costs of victimization, a parameter that is central in Becker (1968) and about which there is a dearth of empirical work.

Our findings may also be helpful in explaining episodes where the share of violent crime grows as crime does: more violence may be necessary to induce desensitized subjects to surrender their possession in a robbery.[3] In fact, Fig. 2 illustrates how most countries in the region have recently experienced a positive correlation between victimization rates and the proportion of violent crimes.[4]

The organization of the paper is as follows. After this introduction, Section 2 develops the main hypothesis of the paper, Section 3 describes our method, and Section 4 presents our results. Section 5 summarizes our conclusions.

2. Main hypothesis

The aim of this study is to examine whether individuals who had been previously victimized became desensitized and, thus, respond less to exposure to crime images than naive individuals (not previously victimized). To this aim, we asked treatment participants to watch a series of videos obtained from open TV programs in which different real crime scenes were presented. A key assumption of this exercise is that, within what is an acceptable cost to subjects and other ethical constraints, watching these short films provides a reasonable proxy of what the victim of a crime experiences during a real-life criminal event. One possible channel involves identification: at least one of the videos may resemble the type of crime that victimized participants have previously suffered. Another channel involves altruism: at least one of the videos may resemble the type of crime that a family member of a victimized participant has previously suffered. This is a relevant dimension of crime: it is not unusual for our participants to voice fear for their family's safety and several videos were selected to prime participants on this dimension. Indeed, one of the videos shows footage of a father covering his children during a homicide, and several videos show footage of interviews of victims' (very distressed) family members.[5] A third possible channel involves expectations: The videos could change our participants' perceptions of the likelihood and characteristics (such as violence) of future crime episodes. A control group watched, instead, videos which had the same duration and context, and were obtained from the same TV programs, but did not contain scenes of violence and crime. Subjects were asked to remain in control and watch the videos without moving or stopping.

[3] In terms of Becker (1968)'s simple model, potential criminals might see the costs of crime change as victims react less to threats, and they are forced to exert growing physical violence to extract the same loot. For a model with a separating equilibrium with high/low violence, see, for example, O'Flaherty and Sethi (2010).

[4] Of course, other factors can also explain the observed increase in violence as crime grows. One of them is that, as crime increases, people protect themselves. Di Tella et al. (2010) document a growing use of private security devices in Argentina as crime increased (see also Amodio, 2013).

[5] On altruistic fear of crime see Warr (1992), Warr and Ellison (2000), Tulloch (2004), and Snedker (2006).

Please cite this article in press as: Di Tella, R., et al., Crime and violence: Desensitization in victims to watching criminal events. J. Econ. Behav. Organ. (2017), https://doi.org/10.1016/j.jebo.2017.10.005

We hypothesize that for non-victimized participants, the violent videos will result in increased stress and in the engagement of the executive function system to remain in control. The critical prediction is that victimized participants may have become desensitized to crime and will hence present cognitive and biological measures more similar to those in the control group.

A main novelty of our work is that we propose to use hard biological measures of suffering or stress: salivary cortisol and heart rate, and cognitive measures of executive functions. The use of objective measures is crucial as self-reporting of stress might be very different across people of different socioeconomic and educational levels.[6]

Cortisol is a steroid hormone commonly employed in experimental settings as an index of the individual's response to stress (Kirschbaum and Hellhammer, 2000). It can be measured through non-invasive salivary tests and has been used in similar contexts to ours in Heinrichs et al. (2003), Dickerson and Kemeny (2004), Young (2004), Wirtz et al. (2008), Ditzen et al. (2009), Schultheiss and Stanton (2009), and Carney et al. (2010). According to our hypothesis, cortisol should increase in the non-victimized population in the treatment group relative to the control group. Instead, for the victimized population, watching the crime videos should not induce an increase in salivary cortisol relative to watching the control videos.

Heart rate, by being innervated by the sympathetic and parasympathetic systems, is another autonomous variable known to change under different stimulus. Heart rate measures have been used in similar contexts to ours in Hubert and de Jong-Meyer (1991), Palomba et al. (2000), and Roelofs et al. (2010), inter alia. In particular, heart rate deceleration has been consistently reported in studies in which participants watch unpleasant images or videos containing violence, disgust, sadness or fear (Bradley et al., 1993; Lang et al., 1993; Angrilli et al., 1994; Palomba et al., 1997). This result may at first seem paradoxical and unexpected. It is natural and intuitive to believe that heart rate should increase with the perception of violence. The interpretation of this consistent finding is however important for our hypothesis. The decrease in heart rate in response to passive exposure to unpleasant visual material might have been related to attentional requirements of such emotional stimuli, which is associated with a parasympathetic dominance in the autonomic nervous system (Lang et al., 1997). Heart rate is governed by the balance between the sympathetic and the parasympathetic components of the autonomic nervous system. Engagement of the sympathetic system is related to fight or flight responses and results in an increase in heart rate. Instead, engagement of the parasympathetic system is related to rest and digest. Hence in the case of real crime violence, a domination of the sympathetic system is expected, leading to very fast responses of aggression or defense. However, in a situation of passive viewing of violence in which participants have to avoid reacting to violence and are asked to stay still, this response has to be inhibited leading to an engagement of the parasympathetic system and, as a consequence, a decrease in heart rate. In summary, the consensus over a large number of studies is that passive observation of violence leads to decreased heart rate. Our hypothesis is that heart rate decreases will be larger in the non-victimized population in the treatment group. Instead, for the victimized population, whom we conjecture are desensitized to violence, watching these videos should not lead to a similar decrease in heart rate.

Our hypothesis also makes predictions on how participants perform in tests that measure cognitive control. Raven's progressive matrices are a nonverbal test typically used to measure "fluid intelligence", the ability to reason and solve problems involving new information, without relying extensively on an explicit base of declarative knowledge derived from either schooling or previous experience (see Carpenter et al., 1990).[7] In turn, the Stroop-like "flower-heart" test is a nonverbal task designed to measure aspects of cognitive and inhibitory control through exposing participants to tasks for which the correct answer is often contrary to their initial impulse (MacLeod, 1991; Davidson et al., 2006; Wright and Diamond, 2014).[8] Asking participants to watch scenes of violence while remaining calm requires engaging response inhibition (controlling emotions). However, the control of emotional reactions during our experiment should lead to an engagement of other components of executive functions that, in turn, could improve performance in tasks that use similar resources such as Raven or Stroop tests (Posner and DiGirolamo, 1998; Engle et al., 1999a; Engle et al., 1999b; Raven, 2000; Davidson et al., 2006; Hunt, 2010). It is then expected that exposure to violence in the non-victimized treatment group should increase subsequent performance in the cognitive tasks examined in this study.

In summary, our main hypothesis is that, for a similar episode, the stress of victims may be different depending on their previous victimization history (i.e., if there is some habituation). We explore this hypothesis in an experimental setting using biological markers of stress and behavioral indices of cognitive control. We are not aware of previous empirical research analyzing these issues.

3. Methods

3.1. Participants, victimization history and treatment assignment

With the assistance of a recruiting agency, a sample of 160 individuals from 24 to 65 years old were invited, induced by a cash payment, to participate in the experiment. In order to replicate Argentina's socioeconomic distribution and given

[6] For seminal work on differences in crime reporting by income level (and other individual characteristics) see Soares (2004).

[7] For example, the Raven's test has been used in Linde and Bergströme (1992) to study the effects of spending a night without sleep on the performance of complex cognitive tasks, or in Mani et al. (2013) to study the effect of poverty on cognitive function.

[8] Amir et al. (1996) uses the Stroop tests to study performance under high anxiety scenarios, while Shah et al. (2012) uses Stroop tests to study the effect of scarcity on cognitive fatigue. Other examples include Mani et al. (2013), Shibasaki et al. (2014) and Goldin et al. (2014).

Please cite this article in press as: Di Tella, R., et al., Crime and violence: Desensitization in victims to watching criminal events. J. Econ. Behav. Organ. (2017), https://doi.org/10.1016/j.jebo.2017.10.005

Table 1
Types of Crime.

Type of Crime[1]	Respondent		Respondent's household	
	Freq.	Percent	Freq.	Percent
Robbery	22	55.0	42	63.6
Larceny/Attempted larceny	13	32.5	18	27.3
Objects stolen from a vehicle	2	5.0	3	4.6
Car theft	1	2.5	2	3.0
Burglary	1	2.5	1	1.5
Fraud	1	2.5	0	0.0
Total	40	100.0	66	100.0

Note: In the pre-treatment short questionnaire, participants were asked "Have you or a member of your family living with you been a victim of a crime in the last 12 months?" For the individuals that responded affirmatively that they had been a victim of a crime, they were asked what was the crime. If more than one crime was suffered, the most serious crime suffered by the respondent was considered. For the individuals that responded affirmatively that a member of her/his family living with her/him had been a victim of a crime, they were asked what was the crime suffered by the family member. If more than one crime was suffered by the respondent's household member during the last twelve months, the most serious crime was considered. Both positive responses were recorded if both the respondent and a household member were victimized. The first two columns correspond to respondent's victimization, while the last two columns include victimization of all household members. Using the detailed description from the second, post-treatment part of the survey, the 22 robbery cases suffered by the respondent can be disaggregated into 8 cases of violent armed robbery with violence, 9 cases of armed robbery, and 5 cases of robbery without use of arms (or unknown). The 42 robberies suffered at the household level can be disaggregated into 12, 9, and 21 cases, respectively.

Table 2
Pre-treatment Characteristics and Measures for Control and Treatment Groups.

Pre-treatment Characteristics	Control Group (mean)	Treatment Group (mean)	p-Value	Observations
Age	41.42	42.94	0.3641	160
Sex	0.49	0.47	0.749	160
Income (mean test)	16732	17979	0.6371	160
Income (median test)	12000	15000	0.268	160
% Respondent victimized	0.28	0.22	0.3183	160
% Respondent's household victimized	0.46	0.37	0.2519	160
Pre-treatment Measures				
Cortisol	0.46	0.40	0.1373	156[a]
Raven (C and D)	0.49	0.48	0.825	160
Time Stroop[b]	−0.27	−0.27	0.9478	125[c]
Time Stroop (all cases)[b]	−0.29	−0.25	0.5017	160
Heart Rate[d]	−3.14	−2.47	0.1141	132[e]

Notes:
[a] In four cases it was not possible to measure cortisol levels because the volume of saliva was insufficient (2 cases), or it was not clean enough (2 cases).
[b] Time Stroop is measured in logs of time (seconds).
[c] We discarded those participants that have accuracy equal or lower than 75% considering all incongruent trials from the mixed blocks.
[d] Heart rate is normalized by deducting from the mean of each respondent, her/his own mean up to the video section.
[e] 28 participants were unable to be measured due to poor ECG quality signal. Age is measured in years. Sex is a dummy variable that equals one for males. Income measures monthly household income expressed in local currency.

potential correlations between socioeconomic status, crime victimization, and crime reporting (see Soares, 2004, and Di Tella et al., 2010), the recruiting agency was instructed to follow a sampling quota scheme based on gender and socioeconomic status.[9]

Apart from obtaining saliva samples and measures of heart rate, cognitive ability, and cognitive control, participants were administered a two-part survey. The first and shorter part took place closely upon arrival of the participants, before the observation of the videos. The second and longer part took place just before ending their participation.

Our measures of prior exposure to crime were obtained from standard victimization questions included in the first part of our survey. The first measure is *Respondent's Victimization*, a dummy variable indicating that the respondent had been a victim of a crime in the last twelve months. The second measure is *Household Victimization*, a dummy variable indicating that the respondent or a family member living with her/him had been a victim of a crime in the last twelve months. The first measure, *Respondent's Victimization*, is especially useful to study the first and third channels through which exposure to videos might affect our participants, namely by inducing identification with victims or changing their expectations with respect to crime. The second measure, *Household Victimization*, is especially useful to study the second channel (involving altruism towards family members).

Table 1 describes previous victimization at the respondent and at the respondent's household level. Victimization rates in our sample are high: 25% of the respondents (40 subjects) have personally been victims of a crime in the last 12 months, while

[9] The recruitment quotas did not cover the full 160 participants, but just 70% of them. Once the quotas were covered for each quota group the agency was allowed to recruit freely without any restriction.

Please cite this article in press as: Di Tella, R., et al., Crime and violence: Desensitization in victims to watching criminal events. J. Econ. Behav. Organ. (2017), https://doi.org/10.1016/j.jebo.2017.10.005

Table 3
Pre-treatment Characteristics and Measures for Victims and Non-Victims.

Pre-treatment Characteristics	Respondent Victimization		p-Value	Household Victimization		p-Value	Observations
	Victims	Non-Victims		Victims	Non-Victims		
Age	40.80	42.63	0.3089	42.09	42.22	0.9368	160
Sex	0.48	0.48	0.9282	0.42	0.52	0.2286	160
Income (mean test)	17783	17203	0.8271	18468	16561	0.4433	160
Income (median test)	13000	15000	0.4670	12000	15500	0.108	160
% Treated	0.43	0.52	0.3197	0.44	0.53	0.2519	160
Pre-treatment Measures							
Cortisol	0.47	0.42	0.3178	0.47	0.41	0.1749	156[a]
Raven (C and D)	0.49	0.48	0.9743	0.48	0.49	0.7778	160
Time Stroop[b]	−0.25	−0.28	0.6662	−0.26	−0.27	0.8188	125[c]
Time Stroop (all cases)[b]	−0.30	−0.26	0.6486	−0.26	−0.27	0.8862	160
Heart Rate[d]	−2.66	−2.87	0.6686	−2.86	−2.78	0.8485	132[e]

Notes:
[a] In four cases it was not possible to measure cortisol levels because the volume of saliva was insufficient (2 cases), or it was not clean enough (2 cases).
[b] Time Stroop is measured in logs of time (seconds).
[c] We discarded those participants that have accuracy equal or lower than 75% considering all incongruent trials from the mixed blocks.
[d] Heart rate is normalized by deducting from the mean of each respondent, her/his own mean up to the video section.
[e] 28 participants were unable to be measured due to poor ECG quality signal. Age is measured in years. Sex is a dummy variable that equals one for males. Income measures monthly household income expressed in local currency.

the percentage is 41% (66 subjects) for victimization of all the respondents' household members.[10] Those who answered affirmatively that they or their household members had been victimized were then asked what the type of crime suffered was. Although victimization is high, participants were not exposed to very severe crimes, like murder, rape, or kidnapping, in the last twelve months. The most severe and frequent crime is robbery, with 55% of the cases (63.6% at the household level), followed by larceny with 32.5% (27.3% at the household level), while the rest entails different forms of car theft, burglary and fraud.

We tried to keep priming on crime to a minimum. The initial questions regarding victimization were a short part of a longer set of general questions (including basic socioeconomic variables, voting intentions, preferences on sports, etc.). Similarly, we did not recruit participants based on previous victimization, but rather using quotas on gender and socioeconomic status, as explained above. A standard victimization survey was included in the second part of the survey after the videos. But as watching crime-related videos could impact on the participants' recall of victimization events, we used, of course, pre-treatment answers for our empirical analysis.[11]

For participants of each socioeconomic status, we randomly selected one group to receive the treatment (watching a series of crime-related videos) and another one the placebo (watching alternative videos with no crime-related content). 79 participants received the treatment and 81 were assigned to the control group.[12]

In Table 2 we show the balance between our treatment and control groups regarding the pre-treatment characteristics of the participants. There are no statistically significant differences in age, gender, income levels (mean and median tests), and previous victimization at both the respondent and household level, suggesting the randomization was successful. Moreover, measurements of the four outcome variables (cortisol, Raven test, Stroop test, and heart rate) were taken before treatment, and the differences in these variables across treatment and control groups were insignificant, again suggesting that the randomization was successful.

In turn, Table 3 shows the balance of pre-treatment characteristics and dependent variables of the participants by victimization status. Again, there are no statistically significant differences in pre-treatment characteristics (age, gender, mean income, and median income), treatment status, and pre-treatment outcome variables (cortisol, Raven test, Stroop test, and heart rate), between participants both by their victimization status or their household victimization status.

[10] These figures are in line with results from LICIP victimization surveys for the Buenos Aires Metropolitan Area for the months of January (37.1%) and February (36.2%) of 2015 when the experiment was performed.
[11] The more detailed questions regarding crime included in the second part of the survey reveal an increase in victimization rates (in part because a list of all possible crimes −including for example threats, vandalism and bribes- was read and participants should give an answer for each of them). This increase in victimization is larger for the treated group, but the difference is not statistically significant for neither the respondent nor the household victimization measures.
[12] Before running the experiment, assignment of the participants covered by quotas to treatment or control groups was done randomly for every socioeconomic group. Once the recruiting agency covered the quotas and could summit participants from any socioeconomic group freely, the assignment of treatment was done upon order of arrival. We used the following scheme: for each socioeconomic group j we defined two groups, A^j and B^j, and randomly assigned A^j to represent treatment or control (while B^j represented the opposite group), so the first participant from socioeconomic group j was assigned to group A^j, the second one to group B^j, the third one to group A^j, and so on. As the order of arrival of participants is presumed to be random, this scheme conserves randomness and intra-socioeconomic-group balance of treated and control group participants at the expense of potentially not splitting the final sample exactly in half between treatment and control groups.

Please cite this article in press as: Di Tella, R., et al., Crime and violence: Desensitization in victims to watching criminal events. J. Econ. Behav. Organ. (2017), https://doi.org/10.1016/j.jebo.2017.10.005

3.2. Procedure

In order to control for possible circadian rhythm effects that might affect cortisol levels, all sessions of the experiment were run from 12pm to 8pm. Upon arrival, the experiment was explained in detail to each participant and time was given for her/him to ask every question they might have. Once each participant opted for participation in the experiment, she/he was asked to sign a written informed consent.[13] Upon signing, the first part of the survey was administered. Then, she/he received a small recipient, and was asked to submit a first sample of saliva. Afterwards, she/he was asked to sit in front of a computer, and the equipment for measurement of cardiac rhythm was installed. From this moment on, the heart rate of the participant was measured.

The participant was then asked to start the completion of a set of tasks, for which she/he received instructions on the screen. In this stage and before each task, the participant completed a few training trials of each task. During training trials, the participant was encouraged to ask the lab assistant for guidance in case of not understanding the task or system interface. The first task consisted in providing answers to a series of eight Raven's Progressive Matrices. Then the participant completed a "flower-heart" Stroop-like test and reaction time was recorded for each trial. Upon completion of both tasks, one minute was given to the participant in order for she/him to rest. The mean heart rate during this time was taken as the pre-treatment level of heart rate.

After this rest period, the intervention was performed. Each person participated individually and the randomization was done at the individual level, so that there are no clustering issues involved. The intervention had the objective of making salient the concern about crime. It consisted of showing the participants a series of videos. If the participant had been assigned to the treatment group she/he was shown TV videos showing situations of violent crime, theft and insecurity. If she/he had been assigned to the control group, she/he was exposed to neutral trails with similar duration, location, colors, etc., but without any content of violent crime, theft or insecurity. All the videos had been obtained from recent open TV programs from Argentina. The treatment and placebo videos are described in detail in Annex I in Supplementary material. All participants were indicated to pay attention to the videos.

Following the observation of the videos, the participant repeated both the Raven's Progressive Matrices test (with new matrices), and the Stroop-like test. At this time no training trials were offered. Next, participants responded to the second part of the survey containing detailed questions covering socio-demographic characteristics and victimization history. Once the survey was completed, the participant submitted a second sample of saliva in a new recipient, payment was done, and the experiment concluded.

3.3. Econometric specification and response variable definitions

After the data collection process, we ran panel fixed-effect regressions for the different dependent variables under consideration obtained before and after the intervention on the treatment dummy, and on the interaction of the treatment dummy with the past victimization dummy. In particular, we used the following regression model:

$$S_{it} = \alpha_i + \beta_1 \times Post_t + \beta_2 \times Treatment_{it} \times Victimization_i + \beta_3 \times Treatment_{it} \times (1 - Victimization_i) + \varepsilon_{it}, \quad (1)$$

where S_{it} are our four different dependent variables (cortisol level, Raven test, Stroop test, and heart rate) for individual i and time t, α_i is a fixed effect for individual i, $Post_t$ is an indicator dummy for measures obtained after the interventions (the videos). There are two observations (pre and post) for each individual. $Treatment_{it}$ is an indicator dummy for the crime video. $Victimization_i$ is a dummy variable measuring previous crime victimization suffered by individual i (*Respondent's Victimization*) or her/his household members (*Household Victimization*). It is obtained from the response of the participants to the standard victimization question asked before the videos on whether the interviewed person or any household member had been victim of a crime in the last twelve months. ε_{it} is the error term. We used robust standard errors. The coefficients of interest for our hypothesis are β_2 and β_3 which measure the interactions of the treatment, which makes crime salient, with previous respondent or household victimization.

The four dependent variables under consideration are the following:

i. Cortisol is a steroid hormone which is released, among other things, in response to stress. Cortisol levels vary across individuals. Moreover, individual levels usually vary by time of the day, with a circadian cycle that peaks in the morning at awakening, and falls during the rest of the day. For each participant, we obtained two saliva samples, one obtained about 10 min after arrival and another one after the video at the end of the survey. For cortisol levels (in μg/dl) we take the first provided sample as the pre-treatment value and the second one as the post-treatment value. Cortisol levels were measured from these saliva samples.[14]

[13] All participants provided written consent to their participation in the experiment.

[14] Saliva samples were analyzed at the Laboratory ManLab in Buenos Aires. Diez et al. (2011) used this laboratory to measure salivary cortisol for their study of bus drivers in Argentina. The variable is low-censored at 0.08 μg/dl (all measures below that level are reported at 0.08). In two cases the volume of the saliva was insufficient, and in two other occasions it was not clean enough. The results of five people were excluded because the absolute value variation between pre and post cortisol levels were larger than 2.5 standard deviations.

Please cite this article in press as: Di Tella, R., et al., Crime and violence: Desensitization in victims to watching criminal events. J. Econ. Behav. Organ. (2017), https://doi.org/10.1016/j.jebo.2017.10.005

Table 4
Overall Treatment Effects.

Variables	(1) Cortisol	(2) Raven C & D	(3) Time Stroop	(4) Heart Rate
Post	−0.119***	0.190***	−0.0980***	2.158***
	(0.0203)	(0.0341)	(0.0214)	(0.343)
Treatment	0.0211	0.0656	−0.0425*	−1.255**
	(0.0286)	(0.0474)	(0.0255)	(0.490)
Observations	302	320	250	264
R-squared	0.282	0.363	0.434	0.264
Number of individuals	151	160	125	132

Notes: Individual fixed effects are included in all the regressions. Robust standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1. **Post** is a dummy variable that equals one if the observation was recorded after the videos, zero otherwise. **Treatment** is a dummy variable that equals one if the respondent belongs to the treated group, and zero otherwise.

Table 5
Treatment Effects for Victimized and Non-Victimized Participants (Respondent Level Victimization).

Variables	(1) Cortisol	(2) Raven C & D	(3) Time Stroop	(4) Heart Rate
Post	−0.119***	0.190***	−0.0980***	2.158***
	(0.0204)	(0.0341)	(0.0215)	(0.344)
Treatment×	−0.0847**	−0.0372	−0.0271	−0.840
Victimization	(0.0402)	(0.0781)	(0.0288)	(0.962)
Treatment×	0.0503*	0.0937*	−0.0460*	−1.351***
No Victimization	(0.0302)	(0.0501)	(0.0270)	(0.511)
Observations	302	320	250	264
R-squared	0.318	0.373	0.435	0.265
Number of individuals	151	160	125	132

Notes: Individual fixed effects are included in all the regressions. Robust standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1. **Post** is a dummy variable that equals one if the observation was recorded after the videos, zero otherwise. **Treatment** × **Victimization** is the interaction of the **Treatment** and **Victimization** dummies. **Treatment** is a dummy variable that equals one if the respondent belongs to the treated group, and zero otherwise. **Victimization** is a dummy variable that equals one if the respondent has been victimized during the last twelve months, zero otherwise. We cannot reject the null hypothesis that the four coefficients associated with the **Treatment** × **Victimization** variable are jointly equal to zero (F = 1.57, p = 0.1803). Instead, we reject the null hypothesis that the four coefficients associated with the **Treatment** × **No Victimization** variable are jointly equal to zero at the 99% confidence level (F = 4.03, p = 0.0031). Moreover, we reject the joint hypothesis that the coefficients of the variables **Treatment** × **Victimization** and **Treatment** × **No Victimization** in each equation are equal at the 99% confidence level (F = 3.56, p = 0.0071).

ii. Raven's Progressive Matrices are a popular test used to measure the capacity to think logically and solve problems in different situations. Each Raven matrix presents a sequence of shapes with one shape missing and eight alternatives for this missing space, and each participant must choose which one of these alternatives best completes the missing part of the main image.

Sixteen matrices were presented in total: eight before and eight after the video. Each set of eight matrices was selected from three different chapters of the Standard Set of Progressive Matrices (Raven, 2003), where each successive chapter contains matrices of increasing levels of difficulty. For each set of eight matrices, we selected three matrices from chapter C, two matrices from chapter D, and three matrices from chapter E. We found that most of the participants (in both groups, and before and after) were not able to solve the three most difficult matrices (from chapter E), with a failure rate of 72%, so we decided to focus on the easier five in order to have greater variance. The Raven variable indicates each respondent's percentage of accuracy for these five matrices, taking the pre-video task accuracy as the pre-treatment value and the post-video task accuracy as the post-treatment one.

iii. For the Stroop Test, a version known as the "flower-heart" test was used. This test is considered to measure selective attention, cognitive flexibility and processing speed. In this test, a series of images are shown to the participant. These can be flowers or hearts and are placed randomly on the right or left side of a screen. If the figure is a heart and the image is on the left side of the screen, participants have to press "s" on the computer's keyboard (a key which is located on the left side of the keyboard) and if it is on the right side he/she has to press "k" (a key which is located on the right side of the keyboard). Instead, if the figure shown is a flower, she/he has to press the key which is on the opposite side with respect to the flower (i.e., if the flower is on the right side, she/he has to press "s" and if it is on the left side, she/he has to press "k").

The test consists of three blocks presented in the following order. First, in the congruent block only hearts are shown randomly on different sides of the screen (twelve times, six times on each side). Second, in the incongruent block only flowers are shown on different sides of the screen (twelve times, six times on each side). Finally, in the mixed block both figures are randomly shown thirty-four times on different sides of the screen (seventeen times each figure, and seventeen times

Please cite this article in press as: Di Tella, R., et al., Crime and violence: Desensitization in victims to watching criminal events. J. Econ. Behav. Organ. (2017), https://doi.org/10.1016/j.jebo.2017.10.005

on each side of the screen).[15] For every figure shown, we record the response time (the time it took the participant to press the key since the picture was shown) and if the response is correct or not. Based on previous studies (Goldin et al., 2014), we focus on reaction times to incongruent trials from the mixed block for the participants with accuracy higher than 75% in the mixed trials. As a right skewness is seen in the distribution of reaction time, we took the logarithm of reaction time (in s) as our response variable and response times were saturated to a maximum of 5 s. We take the pre-video mean of the logarithm of the reaction time across trials as the pre-treatment value, and the post-video mean of the logarithm reaction time across trials as the post-treatment one.

iv. Heart rate, which also responds to emotional stress, was measured (in bpm) for each respondent throughout the experiment. Here we are comparing the mean of the heart rate during a minute of rest before the video is presented, as the pre-treatment value, relative to the mean of the heart rate during the video exposure as the post-treatment one. We normalize our variable by deducting from the measures of each respondent, her/his own mean up to the video section.[16] In other words, heart rate changes to the videos were computed as differential values between video presentation and the one-minute rest baseline.

4. Results

We ran a panel fixed effect regression for the four dependent variables under consideration measured before and after the intervention. In Table 4, we first analyze the overall effect of the video treatment, without considering interactions. The video per se produces no significant effects on cortisol and Raven matrices results. For heart rate, there is a significant reduction induced by watching the crime video. As explained, it has been shown that normal subjects exposed to affective filmed scenes show a reduction in their heart rate, the largest decelerations occurring during the viewing of unpleasant scenes.[17] There is also a reduction in time Stroop induced by the crime video.

Tables 5 and 6 present our main results. In these tables, we analyze the interaction of treatment and previous victimization for two different definitions of victimization: at the individual and household levels. A very interesting pattern emerges. The individuals who have been previously victimized show similar behavior as the control group. Instead, the treated individuals not previously victimized react to the treatment.

In Table 5, victimization is defined at the respondent's level. Non-previously victimized participants show higher cortisol levels, higher Raven scores, faster Stroop, and a lower heart rate than the control group. The differences are statistically significant for each variable, and they are jointly significant with a $p = 0.0031$. Instead, the treatment effects are not significant for the victimized group for Raven answers, time Stroop and heart rate, and they show a significant but opposite effect for cortisol. We cannot reject the joint null hypothesis of no effect for the previously victimized individuals at standard significance levels ($p = 0.1803$). Moreover, we reject the joint hypothesis of similar effects for the victimized and non-victimized treated groups ($p = 0.0071$).

In Table 6, victimization is defined at the respondent's household level. Non-victimized participants show higher cortisol levels, faster Stroop, higher Raven scores, and a lower heart rate, than the control group. The differences are statistically significant, but for the Raven scores, and they are jointly significant with a $p = 0.0035$. Instead, the treatment effects are not significant for the victimized group (joint $p = 0.562$). Again, we reject the joint hypothesis of similar effects for the victimized and non-victimized treated groups at standard significance levels ($p = 0.082$).

Thus, previous victimization seems to induce a "desensitization" or "adaptation" effect: individuals previously victimized, or from previously victimized households, seem to develop no reaction to the treatment, showing similar performance than the individuals treated with the placebo. Instead, non-victimized respondent show significant reactions to the treatment videos.

The use of respondent and household victimization yields similar results, suggesting the presence of desensitization under both the case of respondents or their close relatives being victimized.[18] However, although household members may be altruistically linked, we could expect desensitization to be lower in response to more indirect stimuli. Indeed, if we split victimized treated participants into respondent's victimization and relatives' victimization, the impact of treatment for relatives' victimization seems somewhat intermediate between the effect on victimized respondents and the effect on non-victims.[19]

[15] Only during the pre-video test, the participants were instructed on how to respond to the task by showing them six training figures before each block (which did not count for the final test scores). For further details, see Wright and Diamond (2014).

[16] For similar normalization, see Hubert and de Jong-Meyer (1991), Lang et al. (1993), Palomba et al. (1997), and Palomba et al. (2000). Continuous electrocardiogram signal was acquired through a BioSemi electrode system. 28 participants were unable to be measured due to poor ECG quality signal.

[17] Palomba et al. (2000) explains that sustained heart rate deceleration is the systematic reaction to the sight of stimuli depicting mutilations, injuries or blood (see also Bradley et al., 1993; Gross and Levenson, 1993; Lang et al., 1993; Angrilli et al., 1994; Palomba et al., 1997). This phenomenon has been repeatedly observed in normal subjects as well as in blood phobics exposed to films depicting the feared situation (Klorman et al., 1977; Kleinknecht, 1988; Steptoe and Wardle, 1988; Lumley and Melamed, 1992).

[18] Purposely, treatment videos (#2, #5, and #7) show interviews to relatives of crime victims, while treatment video #4 shows a father covering his children during a homicide (See Annex I in Supplementary material).

[19] Results available upon request. Statistical power is not enough for conclusive results.

Please cite this article in press as: Di Tella, R., et al., Crime and violence: Desensitization in victims to watching criminal events. J. Econ. Behav. Organ. (2017), https://doi.org/10.1016/j.jebo.2017.10.005

Table 6
Treatment Effects for Victimized and Non-Victimized Participants (Household Level Victimization).

Variables	(1) Cortisol	(2) Raven C & D	(3) Time Stroop	(4) Heart Rate
Post	−0.119***	0.190***	−0.0980***	2.158***
	(0.0204)	(0.0341)	(0.0215)	(0.344)
Treatment×	−0.0320	0.0444	−0.0116	−0.871
Victimization	(0.0387)	(0.0710)	(0.0279)	(0.660)
Treatment×	0.0534*	0.0779	−0.0563**	−1.443**
No Victimization	(0.0316)	(0.0508)	(0.0280)	(0.559)
Observations	302	320	250	264
R-squared	0.302	0.364	0.441	0.267
Number of individuals	151	160	125	132

Notes: Individual fixed effects are included in all the regressions. Robust standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1. **Post** is a dummy variable that equals one if the observation was recorded after the videos, zero otherwise. **Treatment** × **Victimization** is the interaction of the **Treatment** and **Victimization** dummies. **Treatment** is a dummy variable that equals one if the respondent belongs to the treated group, and zero otherwise. **Victimization** is a dummy variable that equals one if at least one member of the respondent's household has been victimized during the last twelve months, zero otherwise. We cannot reject the null hypothesis that the four coefficients associated with the **Treatment** × **Victimization** variable are jointly equal to zero (F = 0.74, p = 0.562). Instead, we reject the null hypothesis that the four coefficients associated with the **Treatment** × **No Victimization** variable are jointly equal to zero at the 99% confidence level (F = 3.97, p = 0.0035). Moreover, we reject the joint hypothesis that the coefficients of the variables **Treatment** × **Victimization** and **Treatment** × **No Victimization** in each equation are equal at the 90% confidence level (F = 2.08, p = 0.082).

Table 7
Differences in Effects of Placebo Video for Victimized and Non-Victimized Participants (Respondent Level Victimization).

Variables	(1) Cortisol	(2) Raven C & D	(3) Time Stroop	(4) Heart Rate
Post	−0.0980***	0.256***	−0.141***	0.903**
	(0.0201)	(0.0331)	(0.0138)	(0.351)
Control×	−0.0442	−0.0296	0.0921*	1.064*
Victimization	(0.0453)	(0.0706)	(0.0470)	(0.600)
Control×	−0.0113	−0.0798	0.0196	1.341**
No Victimization	(0.0307)	(0.0523)	(0.0266)	(0.568)
Observations	302	320	250	264
R-squared	0.285	0.364	0.450	0.264
Number of individuals	151	160	125	132

Notes: Individual fixed effects are included in all the regressions. Robust standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1. **Post** is a dummy variable that equals one if the observation was recorded after the videos, zero otherwise. **Control** × **Victimization** is the interaction of the **Control** and **Victimization** dummies. **Control** is a dummy variable that equals one if the respondent belongs to the control group, and zero otherwise. **Victimization** is a dummy variable that equals one if the respondent has been victimized during the last twelve months, zero otherwise. We reject the null hypothesis that the four coefficients associated with the **Control** × **Victimization** variable are jointly equal to zero at the 90% confidence level (F = 2.03, p = 0.0894). We reject the null hypothesis that the four coefficients associated with the **Control** × **No Victimization** variable are jointly equal to zero at the 90% confidence level (F = 2.14, p = 0.0750). Instead, we cannot reject the joint hypothesis that the coefficients of the variables **Control** × **Victimization** and **Control** × **No Victimization** in each equation are equal (F = 0.80, p = 0.5255).

Additional tests reveal our results to be robust: for example, considering the Stroop time for all the participants and not only, as explained above, for those with 75% of positive responses; considering all the Raven matrices – including those from chapter E which showed high failure rates-; and excluding five individuals for whom cortisol readings were low-censored by the laboratory at 0.08 μg/dl (the laboratory's minimum μg/dl detection value for salivary cortisol). The results are also robust to considering victimization in the last 5 years, instead of the last 12 months. In all these cases, the pattern of previous victimization reducing the impact of treatment remains unaltered. The treatment shows no significant impact for the previously victimized participants, whereas it is significant for the non-victimized participants.[20]

A potential concern is that the different behavior between victimized and non-victimized participants might not be a result of our treatment video, but could also occur in the control group. One could think that victims and non-victims react differently to watching videos regardless of the contents of those videos. In Tables 7 and 8, we instead consider the placebo video as a treatment, and the crime video as a control. For both victimization definitions, the pattern of responses for victimized and non-victimized participants is extremely similar and we cannot reject the joint hypothesis of similar effects at standard significance levels (p = 0.5255 for respondent's victimization and p = 0.5507 household victimization). Thus, a

[20] Results available upon request. We also explored differential impact of the video treatment by socioeconomic level, and found no heterogeneous effects between rich and poor. It should be noted, however, that the differences in income in our sample are not large.

Please cite this article in press as: Di Tella, R., et al., Crime and violence: Desensitization in victims to watching criminal events. J. Econ. Behav. Organ. (2017), https://doi.org/10.1016/j.jebo.2017.10.005

Table 8
Differences in Effects of Placebo Video for Victimized and Non-Victimized Participants (Household Level Victimization).

Variables	(1) Cortisol	(2) Raven C & D	(3) Time Stroop	(4) Heart Rate
Post	−0.0980***	0.256***	−0.141***	0.903**
	(0.0201)	(0.0331)	(0.0138)	(0.351)
Control×	−0.0417	−0.0611	0.0711**	1.015*
Victimization	(0.0378)	(0.0571)	(0.0345)	(0.550)
Control×	−0.0030	−0.0693	0.0158	1.469**
No Victimization	(0.0325)	(0.0592)	(0.0316)	(0.633)
Observations	302	320	250	264
R-squared	0.286	0.363	0.445	0.266
Number of individuals	151	160	125	132

Notes: Individual fixed effects are included in all the regressions. Robust standard errors in parentheses. *** p < 0.01, ** p < 0.05, * p < 0.1. **Post** is a dummy variable that equals one if the observation was recorded after the videos, zero otherwise. **Control** × **Victimization** is the interaction of the **Control** and **Victimization** dummies. **Control** is a dummy variable that equals one if the respondent belongs to the control group, and zero otherwise. **Victimization** is a dummy variable that equals one if at least one member of the respondent's household has been victimized during the last twelve months, zero otherwise. We reject the null hypothesis that the four coefficients associated with the **Control** × **Victimization** variable are jointly equal to zero at the 95% confidence level (F = 2.50, p = 0.0417). Instead, we cannot reject the null hypothesis that the four coefficients associated with the **Control** × **No Victimization** variable are jointly equal to zero (F = 1.75, p = 0.1374). Moreover, we cannot reject the joint hypothesis that the coefficients of the variables **Control** × **Victimization** and **Control** × **No Victimization** in each equation are equal (F = 0.76, p = 0.5507).

different behavior by victimized vis-a-vis non-victimized participants is not observed in the group exposed to the control video.[21]

5. Conclusions

We find that victims of (non-very severe) crimes have smaller emotional and cognitive reactions to watching real crime scenes on a video than non-victims. Our data consistently reveal that victims of crime become "desensitized" compared with non-victims. The evidence might help to understand tolerance to crime and a weak relationship between crime and happiness in high-crime areas, like Latin America. It might also help to understand the correlation between crime levels and the proportion of violent crime, as it might be necessary to exert increasing levels of violence on previously victimized individuals to scare them.

Previous research has shown that people exposed to media violence, such as those playing violent video games, can become desensitized (Bartholow et al., 2006; Carnagey et al., 2007; Fanti et al., 2009). Indeed, it appears that, at least for some groups, playing a violent video game caused a reduction in the brain's response to depictions of real life violence. Our paper complements this literature by showing desensitization amongst crime victims. This phenomenon has both emotional (cortisol and heart rate levels) and cognitive (Raven's matrices scores and Stroop-like test reaction times) components.

The fact that watching crime did not affect the responses of those previously victimized is interesting, and might evoke several reactions. One concern is to think that the size of the stimuli was insufficient to provoke a response, but that being in the presence of a real crime −and not just one on a TV monitor – would be enough. Another concern is that some unmeasured factor might cause both a predisposition to avoid crime, and an increased response to images of crime on TV. Even in this case, it is important to note that as the rate of crime victimization increases, a larger group of the population shares this increased desensitization. Future research might investigate the use of stronger stimuli and the role of omitted factors in the victimization/desensitization link.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at https://doi.org/10.1016/j.jebo.2017.10.005.

References

Amir, N., Mcnally, R.J., Riemann, B.C., Burns, J., Lorenz, M., Mullen, J.T., 1996. Suppression of the emotional Stroop effect by increased anxiety in patients with social phobia. Behav. Res. Ther. 34 (11), 945–948.
Amodio, F., 2013. Crime Protection Investment Spillovers: Theory and Evidence from the City of Buenos Aires. Documento De Trabajo CAF N° 2013/06. CAF, Caracas.
Angrilli, A., Palomba, D., Stegagno, L., 1994. Modulazione psicofisiologica delle emozioni indotte da stimoli visivi. G. Ital. Psicol. XXI 5, 833–856.
Bartholow, B.D., Bushman, B.J., Sestir, M.A., 2006. Chronic violent video game exposure and desensitization to violence: behavioral and event-related brain potential data. J. Exp. Soc. Psychol. 42, 532–539.

[21] Of course, the statistical significance observed on the Time Stroop and Heart Rate variables in Tables 7 and 8 is just the mirror of the overall impact of treatment on these same variables shown in Table 4.

Please cite this article in press as: Di Tella, R., et al., Crime and violence: Desensitization in victims to watching criminal events. J. Econ. Behav. Organ. (2017), https://doi.org/10.1016/j.jebo.2017.10.005

Becker, G.S., 1968. Crime and punishment: an economic approach. J. Polit. Econ. 76 (2), 169–217.
Bradley, M.M., Greenwald, M.K., Hamm, A.O., 1993. Affective picture processing. In: Birbaumer, N., Ohman, A. (Eds.), The Structure of Emotion. Hogrefe and Huber, Toronto.
Carnagey, N.L., Anderson, C.A., Bushman, B.J., 2007. The effect of video game violence on physiological desensitization to real-life violence. J. Exp. Soc. Psychol. 43, 489–496.
Carney, D., Cuddy, A., Yap, A., 2010. Power posing: brief nonverbal displays affect neuroendocrine levels and risk tolerance. Psychol. Sci. 21 (10), 1363–1368.
Carpenter, P.A., Just, M.A., Shell, P., 1990. What one intelligence test measures: a theoretical account of the processing in the Raven Progressive Matrices Test. Psychol. Rev. 97 (3), 404.
Davidson, M.C., Amso, D., Anderson, L.C., Diamond, A., 2006. Development of cognitive control and executive functions from 4 to 13 years: evidence from manipulations of memory, inhibition, and task switching. Neuropsychologia 44 (11), 2037–2078.
Di Tella, R., Schargrodsky, E., 2009. Happiness, Ideology and Crime in Argentine Cities. IDB Working Paper Series, pp. 112.
Di Tella, R., Galiani, S., Schargrodsky, E., 2010. Crime inequality and victim behavior during a crime wave. In: Di Tella, Edwards, Schargrodsky (Eds.), The Economics of Crime: Lessons for and from Latin America. NBER-University of Chicago Press, Chicago and London.
Dickerson, S., Kemeny, M., 2004. Acute stressors and cortisol responses: a theoretical integration and synthesis of laboratory research. Psychol. Bull. 130, 355–391.
Diez, J.J., Vigo, D.E., Pérez Lloret, S., Rigters, S., Role, N., Cardinali, D.P., Pérez Chada, D., 2011. Sleep habits, alertness, cortisol levels and cardiac autonomic activity in short distance bus drivers: differences between morning and afternoon shifts. J. Occup. Environ. Med. 53 (7).
Ditzen, B., Schaer, M., Gabriel, B., Bodenmann, G., Ehlert, U., Heinrichs, M., 2009. Intranasal oxytocin increases positive communication and reduces cortisol levels during couple conflict. Biol. Psychiatry 65 (9), 728–731.
Engelhardt, C.R., Bartholow, B.D., Kerr, G.T., Bushman, B.J., 2011. This is your brain on violent video games: neural desensitization to violence predicts increased aggression following violent video game exposure. J. Exp. Soc. Psychol. 47, 1033–1036.
Engle, R.W., Kane, M.J., Tuholski, S.W., 1999a. Individual differences in working memory capacity and what they tell us about controlled attention, general fluid intelligence, and functions of the prefrontal cortex. In: Models of Working Memory: Mechanisms of Active Maintenance and Executive Control, pp. 102–134.
Engle, R.W., Tuholski, S.W., Laughlin, J.E., Conway, A.R., 1999b. Working memory, short-term memory, and general fluid intelligence: a latent-variable approach. J. Exp. Psychol. Gen. 128 (3), 309.
Fanti, K.A., Vanman, E., C.Henrichand, C., Avraamides, M.N., 2009. Desensitization to media violence over a short period of time. Aggress. Behav. 35, 179–187.
Goldin, A.P., Hermida, M.J., Shalom, D.E., Costa, M.E., Lopez-Rosenfeld, M., Segretin, M.S., Sigman, M., 2014. Far transfer to language and math of a short software-based gaming intervention. Proc. Natl. Acad. Sci. U. S. A. 111 (17), 6443–6448.
Graham, C., Chaparro, J.C., 2012. The linkages between insecurity, health, and well-being in latin America: an initial exploration based on happiness surveys. In: Webb, D., Wills-Herrera, E. (Eds.), Subjective Well-Being and Security. Social Indicators Research Series, vol. 46. Springer, Dordrecht, pp. 197–252.
Gross, J.J., Levenson, R.W., 1993. Emotional suppression: physiology, self-report and expressive behavior. J. Pers. Soc. Psychol. 64, 970–986.
Heinrichs, M., Baumgartner, T., Kirschbaum, C., Ehlert, U., 2003. Social support and oxytocin interact to suppress cortisol and subjective responses to psychosocial stress. Biol. Psychiatry 54 (12), 1389–1398.
Hubert, W., de Jong-Meyer, R., 1991. Autonomic, neuroendocrine, and subjective responses to emotion-inducing film stimuli. Int. J. Psychophysiol. 11 (2), 131–140.
Huesmann, Rowell, L., Kirwil, L., 2007. Why observing violence increases the risk of violent behavior in the observer. In: Flannery, D.J., Vazsonyi, A.T., Waldman, I.D. (Eds.), Cambridge Handbook of Violent Behavior and Aggression. Cambridge University Press (pp. 545–570).
Hunt, E., 2010. Human Intelligence. Cambridge University Press.
Kirschbaum, C., Hellhammer, D.H., 2000. Salivary cortisol. Encycl. Stress 3, 379–383.
Kleinknecht, R.A., 1988. Specificity and psychosocial correlates of blood injury fear and fainting. Behav. Res. Ther. 26, 303–309.
Klorman, R., Weissberg, R.P., Wiesenfeld, A.R., 1977. Individual differences in fear and autonomic reactions to affective stimulation. Psychophysiology 14, 45–51.
Lang, P.J., Greenwald, M.K., Bradley, M.M., Hamm, A.O., 1993. Looking at pictures: affective, facial, visceral and behavioral reactions. Psychophysiology 30, 261–273.
Lang, P.J., Bradley, M.M., Cuthbert, B.N., 1997. Motivated attention: affect, activation and action. In: Lang, P.J., Simons, R.F., Balaban, M.T. (Eds.), Attention and Orienting: Sensory and Motivational Processes. Erlbaum, Hillsdale, NJ.
Latinobarómetro, 1995. Informe Latinobarómetro (1995–2015) available at http://www.latinobarometro.org/latContents.jsp?CMSID=InformesAnuales.
Linde, L., Bergström, M., 1992. The effect of one night without sleep on problem-solving and immediate recall. Psychol. Res. 54 (2), 127–136.
Lumley, M.A., Melamed, B.G., 1992. Blood phobics and non phobics: psychological differences and affect during exposure. Behav. Res. Ther. 30, 425–434.
MacLeod, Colin M., 1991. Half a century of research on the Stroop effect: an integrative review. Psychol. Bull. 109 (2), 163.
Mani, A., Mullainathan, S., Shafir, E., Zhao, J., 2013. Poverty impedes cognitive function. Science 341 (6149), 976–980.
Mullin, C.R., Linz, D., 1995. Desensitization and resensitization to violence against women: effects of exposure to sexually violent films on judgments of domestic violence victims. J. Pers. Soc. Psychol. 69 (September (3)), 449–459.
O'Flaherty, B., Sethi, R., 2010. Peaceable kingdoms and war zones: preemption, ballistics and murder in Newark. In: Di Tella, Edwards, Schargrodsky (Eds.), The Economics of Crime: Lessons for and from Latin America. NBER-University of Chicago Press, hicago and London.
Palomba, D., Angrilli, A., Mini, A., 1997. Visual evoked potentials, heart rate responses and memory to emotional pictorial stimuli. Int. J. Psychophysiol. 27, 55–67.
Palomba, D., Sarlo, M., Angrilli, A., Mini, A., Stegagno, L., 2000. Cardiac responses associated with affective processing of unpleasant film stimuli. Int. J. Psychophysiol. 36 (1), 45–57.
Posner, M.I., DiGirolamo, G.J., 1998. Conflict, target detection and cognitive control. In: Parasuraman, R. (Ed.), The Attentive Brain. MIT Press, Cambridge, MA.
Raven, J., 2000. The Raven's progressive matrices: change and stability over culture and time. Cognit. Psychol. 41 (1), 1–48.
Raven, J., 2003. Test de Matrices Progresivas: Escala General, 2nd ed. Paidós, Buenos Aires.
Roelofs, K., Hagenaars, M.A., Stins, J., 2010. Facing freeze social threat induces bodily freeze in humans. Psychol. Sci. 21, 1575–1581.
Rosburg, T., Haueisen, J., Sauer, B., 2002. Habituation of the auditory evoked field component N100 m and its dependence on stimulus duration. Clin. Neurophysiol. 113, 421–428.
Rosburg, T., Trautner, P., Boutros, N.N., Korzyukov, O.A., Schaller, C., Elger, C.E., et al., 2006. Habituation of auditory evoked potentials in intracranial and extracranial recordings. Psychophysiology 43, 137–144.
Schultheiss, O., Stanton, S., 2009. Assesment of salivary hormonesin. In: Harmon-Jones, E., Beer, J. (Eds.), Methods in the Neurobiology of Social and Personality Psychology. Guilford, New York, NY.
Shah, A., Mullainathan, S., Shafir, E., 2012. Some consequences of having too little. Science 338, 682–685.
Shibasaki, M., Isomura, T., Masataka, N., 2014. Viewing images of snakes accelerates making judgements of their colour in humans: red snake effect as an instance of 'emotional Stroop facilitation'. R. Soc. Open Sci. 1 (3), 140066.
Snedker, K.A., 2006. Altruistic and vicarious fear of crime: fear for others and gendered social roles. Sociol. Forum 21 (2), 163–195.

Please cite this article in press as: Di Tella, R., et al., Crime and violence: Desensitization in victims to watching criminal events. J. Econ. Behav. Organ. (2017), https://doi.org/10.1016/j.jebo.2017.10.005

Sörös, P., Knecht, S., Manemann, E., Teismann, I., Imai, T., Lütkenhöner, B., et al., 2001. Hemispheric asymmetries for auditory short- term habituation of tones? In: Nenonen, J., Ilmoniemi, R.J., Katila, T. (Eds.), Biomag 2000, Proceedings 12th International Conference on Biomagnetism. Helsinki University of Technology, Espoo, pp. 47–49.
Soares, R., 2004. Crime reporting as a measure of institutional development. Econ. Dev. Cult. Change 52 (4), 851–871.
Steptoe, A., Wardle, J., 1988. Emotional fainting and the psychophysiologic response to blood and injury: autonomic mechanisms and coping strategies. Psychosom. Med. 50, 402–417.
Thompson, R.F., Spencer, W.A., 1966. Habituation: a model phenomenon for the study of neuronal substrates of behavior. Psychol. Rev. 73, 16–43.
Tulloch, M.I., 2004. Parental fear of crime: a discursive analysis. J. Sociol. 40 (4), 362–377.
Warr, M., Ellison, C.G., 2000. Rethinking social reactions to crime: personal and altruistic fear in family households. Am. J. Sociol. 106 (3), 551–578.
Warr, M., 1992. Altruistic fear of victimization in households. Soc. Sci. Q. 73 (4), 723–736.
Wirtz, P.H., Siegrist, J., Rimmele, U., Ehlert, U., 2008. Higher overcommitment to work is associated with lower norepinephrine secretion before and after acute psychosocial stress in men. Psychoneuroendocrinology 33, 92–99.
Wright, A., Diamond, A., 2014. An effect of inhibitory load in children while keeping working memory load constant. Front. Psychol. 5.
Young, A.H., 2004. Cortisol in mood disorders. Stress: Int. J. Biol. Stress 7 (4), 205–208.

Please cite this article in press as: Di Tella, R., et al., Crime and violence: Desensitization in victims to watching criminal events. J. Econ. Behav. Organ. (2017), https://doi.org/10.1016/j.jebo.2017.10.005