



Designing Serious Games for the Mitigation of the Impact of Massive Shootings in a Mexican Environment

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Abstract. Serious games have proven to be effective methods of communication and learning. Qualities that had been taken advantage of in Disaster risk management by developing serious games that mitigate the impact of natural disasters by incurring in preparedness. Design Against Crime and its derived methodologies and tools have proven effective in the reduction of fear of crime in Mexican communities. By combining the approach previously applied in Disaster Risk Management (DRM) by game creators and researchers with Design Against Crime, the current research project proposes the use of the resulting methodology in the design of serious games as interventions for crime related incidents with similar characteristics to natural disasters like massive shootings in public spaces.

Keywords: Serious games · Disaster Risk Management · Design Against Crime

1 Introduction

Serious games, accompanied by simulations, present the opportunity to improve the information retention process through emotion and repetition. These activities act as metaphors in which users face artificial conflicts through defined rules and quantifiable results [1]. This can facilitate the measurement of these experiences' impact on mitigation in a potential disaster before the disaster occurs.

Since the beginning of the war against drug trafficking in Mexico, which began in 2006 [2], the population has lived in a situation of violence as the confrontation between the authorities and drug cartels has been recurrently provoked. This has generated a climate of insecurity and has had considerable impacts on the population, such as the increase in insecurity perception indices.

In crime sociology, insecurity perception can be defined as the emotional response to the perception of crime-related symbols, this implies that security perception is determined by the individual and collective perceptions of crime [3]. Fear of crime and insecurity perception can stimulate and accelerate communities' decay and provoke individuals to retire physically and psychologically from community life, weakening the informal process of social control that inhibits delinquency [4].

Clashes in public spaces between members of organized crime and the authorities function as events that promote fear of crime and increase the perception of insecurity in the communities in which they occur. The consequences of this impact can be disastrous in the short term and long term since the fear of crime creates the risk of negatively impacting various aspects of life in the affected communities.

By matching intervention strategies to reduce the fear of crime in Mexican communities with interactive simulation experiences in the form of serious games, it was proposed to mitigate the situation from the perspective of disaster prevention as a result of the course. From the experience design of the player from the University of Monterrey, this research presents a methodology, as well as the initial documentation for the design of micro games in order to intervene in the positive mitigation of the problem.

During the project, a work methodology was developed. The steps to follow for developing this type of experience were selected, followed by a stage of conceptualization and defining the narrative elements to consider for the intervention.

2 Serious Games and Disaster Risk Management

Traditional Disaster Risk Management (DRM) methods tend to involve centralized decision processes, the responsibilities of which lie with members of the government and researchers [5]. These traditional strategies limit the participation of members of the affected communities. They tend to be perceived as imposed commands by affecting the existing culture and social participation in those communities [6].

However, the DRM strategies that have recently proven to be most successful involve community participation in the strategy and communication process [8]. By implementing these types of strategies, communities are treated as partners in co-creating products that reflect their participation, allowing these strategies to be better accepted and no longer perceived as impositions [7].

The application of interactive experiences such as serious games in these types of situations can facilitate the participation of communities, as they are perceived as tools capable of effectively and innately communicating essential concepts for disaster mitigation or prevention. It has been verified in different cases related to climate change mitigation and sustainable development, among others [8].

As highly interactive and social activities, games and simulations are able to activate a positive emotional response in players, transforming into convincing, memorable, and challenging learning experiences, making them fun and prolonging their impact on the user. Active learning methods have much greater information retention potential than passive or traditional methods. Studies show that only 5% of the information is retained in the case of reading, while in the case of an active experience, such as a training session, up to 75% of the information is retained [9]. Added to this is the evidence on adults' attention span, which is estimated to be 20 min, during which only in the first five minutes does the greatest learning impact occur [10].

Game-based learning strategies present a similar environment to those presented in problem-based learning. They are normally guided by a facilitator who provides the necessary information and determines the rules of the game. In this type of environment, participants face the collection of information by applying critical thinking, which allows

participants to conclude with a broader picture of the issue presented to them, gaining a deeper understanding of systems or complex concepts [11].

Current interactive learning experiences like serious games present players with the opportunity for immersions in a simulated reality representing crucial elements of a particular process or problem. This environment allows the user or participant in the experience to take a specific role in the situation or problem, often inviting them to interact with other participants in the same environment, resulting in specific strategic decision-making, as well as consideration of the consequences produced by said decisions in the game environment [12]. This also allows players to explore and compare multiple causes and effects concerning the game's reality, which can then be extrapolated to other systems, resulting in players' ability to recognize the links between decisions made in the game.

Gaming and the mechanisms that govern reality turn serious games into practical tools for mitigation in DRM processes, both in the pre-disaster stages, such as mitigation, prevention, and preparedness, and in the post-disaster stages, such as response, reaction, and recovery, since it is entirely related to the main objectives of serious games, which are message broadcasting, training, and data exchange [13].

As cultural artefacts, Serious Games also represent an opportunity for those involved in an emergency situation to consider the ethical ramifications derived from their role and decision making during this type of situation. As experiences, video games in general can be used for developing ethical thinking skills [14].

Allowing players to reflect about the consequences derived from their actions. This is often achieved through assuming new identities that allow to experience these situations within the game space [15].

3 Design Against Crime and Serious Games

This research documents the work process followed in the conceptualization and design of an interactive micro-experience as a serious game to prepare a Mexican population sector to face a shooting situation in a public space. For this purpose, this study refers to strategies used in disaster prevention to mitigate the impact of natural disasters, as well as the design of interventions to mitigate the impact of crime in Mexican communities [16]. The use of a design methodology derived from the strategies above was conceptualized and put into practice, consisting mainly of involving stakeholders in the co-creation process directly or indirectly as well as a series of steps that have allowed for knowing the situation in relation to the needs derived from both the agents and the environment involved in the situation.

In the Design Against Crime, Crime Lifecycle Methodology [17], which has previously proven its effectiveness in the design of interventions to mitigate or prevent the impact of a crime situation by involving stakeholders in the planning and design process [18], community members or participants in various activities are invited to visualize and identify the most effective point at which to carry out an intervention so that the crime in question can be prevented, participants can react adequately to its occurrence, or, in the case of identifying a stage after the occurrence as the most relevant in the situation, participants can limit spread of the economic, emotional, or psychological impact of crime in the community.

Shootings in public spaces were selected as the central theme for the development of this project since these phenomena can be considered and analyzed from the perspective of both Design Against Crime and DRM, the latter being one of the fields in which the application of serious games has previously demonstrated its effectiveness as tools capable of mitigating such situations [19].

4 Designing Serious Games for the Mitigation of the Impact of Massive Shootings in a Mexican Environment

Once the topic was selected, the project participants undertook to investigate the background and registered cases of that type of occurrence and the main reactions of the participants or victims of said events in Mexico. Among the cases registered in the last decade, the situation derived from the capture of Ovidio Guzman in 2019 stands out, where the city of Culiacán and its surroundings were seized and virtually besieged by organized crime, resulting in dozens of shootings in public spaces and 14 deceased and 21 wounded people [20]. Something that stands out, in this case, is the high number of recordings resulting from this incident, due to the reaction of the witnesses and civilian victims who, contrary to what could be assumed, decided to react to the shootings by trying to follow their actions or staying immovable in the space of the action. However, despite keeping low to the ground or keeping cover, by broadcasting live on social networks or recording the situation, they put themselves even more at risk.

Such a reaction to this type of situation puts those involved physically at risk [21] and spreads the impact of the crime far beyond the environment and agents involved. When the captured images are disseminated, they end up affecting the perception of insecurity of all those inhabitants of nearby communities, possibly even affecting the indexes of security perception at state or national levels.

Although this case best exemplifies the lack of preparation or knowledge of the population when facing this type of situation, it is not isolated. Outdoor shootings have occurred both in Tamaulipas [22] and Coahuila [23], as well as in Nuevo León [24]. They show similar reactions and characteristics throughout the years.

Due to this type of reaction, as well as the fact that it is an apparently random and unexpected situation, out of control of the majority of those involved, it was decided to select the reaction to this situation as the stage for the intervention design. In this case, a serious game can teach potential victims how to react to this type of phenomenon. Derived from this, the city of Monterrey, Nuevo León, was selected to test this concept, and the students of the player experience design class, of the video game design master's degree from the University of Monterrey, were chosen to put the conceptualized methodology into practice. In order to put the participating students into the context and facilitate the assimilation of the process to follow in the design of the intervention against crime, the team opted to synthesize and replace the elements of the Crime Life Cycle [25] methodology, and the conjunction of criminal opportunity [26], previously used in the design of interventions against crime in Mexican communities [27], with procedures and elements related to or derived from the process of designing interactive experiences, as well as with video games. Both methods mentioned above consist of identifying the agents and environments involved in the crime situation, their needs and vulnerabilities,

and the most important stage of the crime situation in which to apply an intervention capable of completely stopping or mitigating the impact of said crime, followed by designing the said intervention, applying it in the situation, and measuring its impact.

Following these guidelines as a basis, the students began by analyzing the agents involved in the situation, in this case, the profile of the potential victims, members of the general population of Nuevo León. A total of 12 participants, men and women with an average age of 26 years, were initially analyzed with a survey to determine from written text their profiles according to the traits of the Big Five Personality Model [28]. Previous research has used the relationship between these personality traits and gamer archetypes [29], so the same system was chosen to identify each participant's video game profile. Using this method determined those elements necessary to generate a greater emotional impact on the participants to facilitate the learning of the correct reactions or instructions to follow when facing a shooting in public spaces.

According to the Autonomous University of Hidalgo [21], if someone is in the middle of a shooting in a public space, hear gunshots from a distance, or have the shooter within sight range, it is recommended to drop to the ground, not to kneel nor bend down, and to let go of everything you're holding. Wait until you identify the shooter and withdraw from the area if possible. In the case of running, it is recommended not to run since you could be heading in the direction where the shots originate and running could also attract the shooter's attention. When hitting the ground, it is necessary to check where the shots have come from and how far away the shooter is and avoid any investigation. Use the ears and be prepared to stay away from the sound, if possible.

An attempt should be made to determine if the shots are directed at you or if there are immediate threats nearby. If you need to look, you should not raise your head, and it is recommended to look from the sides, taking into account that the shots can come from all directions. If there is an accessible escape route, you should try to evacuate the present people as long as you do not risk your life and that of others. It is recommended to leave belongings. As much as possible, prevent people from entering the area where the shooter is. Keep your hands visible and follow the instructions of any security officers or trained personnel present.

If evacuation is not possible, it is recommended to find a hiding place out of sight of the shooter, which protects you if shots are fired in your direction. Facing or trying to catch shooters is not recommended. If the shooter is close, it is recommended to silence your cell phone. Turn off any noise source, hide behind large objects, and stay calm. Stay calm and dial 911, if possible, to alert the police to the shooter's presence. If you cannot speak, leave the line open and allow the operator to hear you.

It is recommended that the player take action against the active shooter as a last resort. Only when your life is in imminent danger should you try to disrupt or incapacitate the active shooter. When the authorities arrive, it is recommended to stay calm and follow the instructions of the officers.

Following this stage, each participant's profile was developed with the results of the applied surveys. This profile included within it the elements the player archetype identified as the main ones, in this case, Mastermind-Manager, as well as the elements and characteristics of the most attractive video games for said profile.

Derived from said profile, the participants opted to propose a puzzle-like experience in the form of a maze. Users were confronted with the simulated situation of a street shooting and needed to find the route, making correct decisions to survive and complete their journey.

For the environment, the team chose the Monterrey metropolitan area. Considering previous occurrences of shootings and acts of violence by organized crime in the area [30], the municipality of Guadalupe, Nuevo León, was selected as a real space/location to be used as a basis for the design of the environment of the proposed experience.

In both DRM and Design Against Crime strategies, the background of the situation, the decisions available to those involved in the situation, and the possible consequences of making such decisions are taken into account. Following this scheme as a basis, the work team proposed using a similar structure for the construction of the message or complex concept to be transmitted as a form of teaching through interaction with the proposed experience. The students were invited to select the background, the possible decisions, and their consequences to be transmitted as a message, which was later used as the narrative basis of the proposed serious game, derived in the introduction, climax, and conclusion.

Once these narrative elements were determined, the students were invited to transfer these narrative elements into a real geographic area, using a digital map of the Guadalupe area (See Fig. 1), to distribute said elements, selecting three relevant points to use as base locations for the narrative, followed by a starting and an ending point. With this completed narrative, the team chose to start the creative conceptualization stage and the construction of the necessary elements for the execution of the experience.



Fig. 1. Map of Guadalupe zone, with narrative elements distributed and marked.

5 Life Oppression

As a result of this process, the students proposed “life oppression,” a five-minute experience built using the Unity Engine [31], with the concept of run from the block. Here the players are immersed in a situation of being in-between an armed confrontation between the authorities and organized crime groups on the streets of Guadalupe, Nuevo León (See Fig. 2). The player must make correct decisions to survive, get out of the situation, and reach a safe area. The player can quickly visualize if their decisions are successful and have saved his life, or if they are incorrect and have led him to panic and die within the game (See Fig. 3).

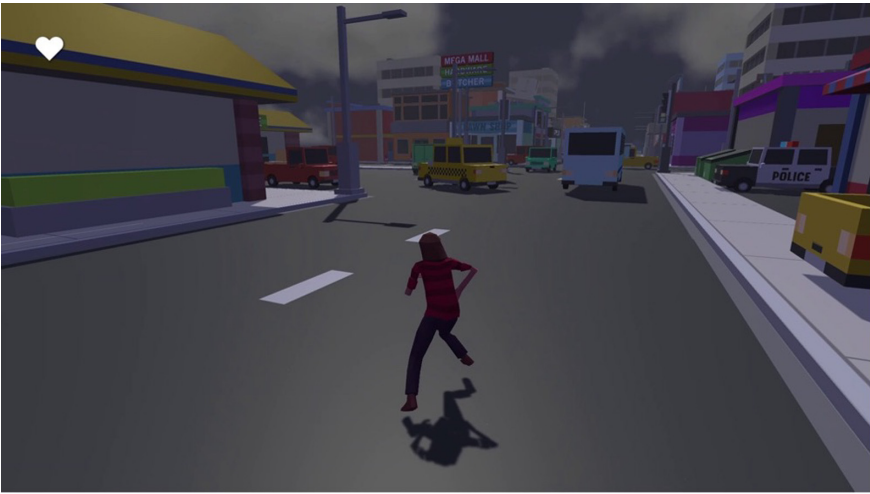


Fig. 2. Game location inspired by Guadalupe Nuevo León

The game takes as inspiration the locations previously selected by the team and reinterprets them in a closed environment, like a labyrinth in which secondary agents are distributed, representing both members of organized crime and of the authorities. Members of organized crime may be able to directly shoot and “kill” the player by mistaking him for a member of the authorities, and in the same way, the authorities may mistake him for a member of organized crime. The player is also faced with situations where, depending on their decisions, they may find themselves in the crossfire and die amid accidental shooting. Along the way, the player receives messages that give her suggestions or, where appropriate, specific indications on how to react to survive the situation. To confront the player with different versions or cases in which a real victim can face an outdoor shooting, secondary agents are distributed so that the player can face different distributions and cases along the way. If the player makes the correct decisions and completes the route satisfactorily, fleeing the sound of the shots and trying to get as far away as possible within the confines of the available space, he ends up finding a safe area protected by the authorities where he can take refuge and conclude the experience



Fig. 3. Making the wrong decisions can lead to the player to death

satisfactorily, Fig. 4 shows the resulting environment map, player routes and agents' distribution.

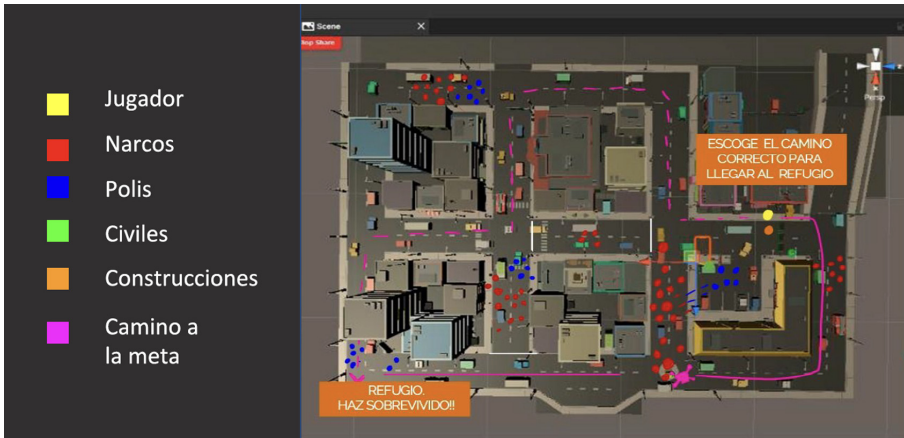


Fig. 4. Environment map.

For the evaluation of the experience in this stage of the project, the team opted to use a real-time facial recognition model, tensorflow-js in conjunction with a Single Shot Multibox Detector based on MobileNetV1 was used for face detection, while a depth-wise separable convolutions and densely connected blocks model was used for emotion expression recognition, both models derived from the approach originally proposed by face-api.js [32]. The resulting tool estimates the players emotional impact that the experience has on them throughout their participation from their facial expression. At the

end of the game, the participants were invited to provide feedback on their experience to improve future iterations of the game and to give a clearer idea of the learning impact it had on the participants. For the first test, a total of eight participants, men and women with an average age of 30 years, played the game.

Before interacting with the experience, the participants' profiles were evaluated using the same correlation method between the Big Five Personality Model and the player archetype to determine if there was a similarity between the profiles identified by the previous tests and the participants, with Mastermind–Manager being the profile identified among the participants. When analyzing the recordings of the different interactions, the participating students concluded that the participants showed sadness, anger, and disgust as the primary expressions of facial emotion throughout the experience when interacting with the game, such as surprise and sadness when dying and happiness when completing the game, Fig. 5 shows a participant interacting with the experience while their emotional reaction is being recorded. It should be noted that the fact that sadness, disgust, and anger were presented as the primary emotions may be related to the participants' lack of familiarity with the environment and the control of the experience, which must be improved in subsequent iterations.



Fig. 5. Participant interacting with the game.

There is a relationship between the characteristics of a video game and the level of excitement or satisfaction that users can obtain from that experience. Considering that the level of excitement can help maintain attention and improve learning through the experience, we opted for a type of game based on the personality and profile of the player identified among most of the participants.

6 Discussion and Conclusion

This research documents the background, the method and the process utilized to design and develop a 5-min interactive experience as a serious game, with the goal of teaching possible victims of street mass shootings how to react when confronted by such situation, potentially mitigating its impact. To achieve a meaningful impact in the situation, the Monterrey Nuevo Leon metropolitan area was selected as the environment for the project. A team of students from this area, specifically members of the game design master program of Universidad de Monterrey, which in a sense can be considered stakeholders because of their links to the local community, were selected to design the experiences and test the proposed work methodology. A first version of the conceptualized game, “Life Oppression”, was developed in Unity Engine using stock assets and was consequently tested by members of the community, measuring the emotional impact by applying face recognition during their experience. Although the decision was made to measure users’ emotional impact by interacting with the experience using real-time facial recognition, future elaboration of protocols and methods for quantification are required. Both based on the emotional impact of the participants’ expressions, as well as the level of learning and retention of information after the experience. Further consideration and analysis should be directed towards the ethical ramifications and consequences derived from the interaction with the resulting game, particularly for members of the community that have been previous direct or indirect victims of a street shooting situation, which may be triggered by the simulation furthering the impact of the crime rather than mitigating it.

This research details the basis and methods applied in the first iteration of what is planned to be an annual recurrent program for the development of serious games that facilitate or promote the information necessary to mitigate the impact of this kind of violent situation. The possibility of expanding this method’s application to other types of situations such as natural disasters or human-made disasters that plague communities in the same geographical area is not ruled out.

References

1. Salen, K., Zimmerman, E.: *Rules of Play*. MIT Press, Cambridge (2004)
2. Meschoulam, M.: Terror and fear: the Mexican case. In: *Organized Crime, Fear and Peacebuilding in Mexico*, pp. 29–44. Palgrave Macmillan, Cham (2019). https://doi.org/10.1007/978-3-319-94929-1_3
3. Jarzabek, L.: How game can help flood-prone communities (2016). <https://games4sustainability.org/2016/08/18/flood-resilience-game-for-flood-pronecommunities/>. Accessed 6 Jan 2019
4. Keating, A.: Playing at flood resilience: using games to help vulnerable communities. <https://blog.iiasa.ac.at/2016/08/03/playing-at-flood-resilience-using-games-tohelp-vulnerable-communities/>. Accessed 12 June 2019
5. World Bank United Nations: Natural hazards, unnatural disasters. The World Bank (2010). <https://doi.org/10.1596/978-0-8213-8050-5>
6. Mechler, R.: Reviewing estimates of the economic efficiency of disaster risk management: opportunities and limitations of using risk-based cost-benefit analysis. *Nat. Hazards* **81**(3), 2121–2147 (2016). <https://doi.org/10.1007/s11069-016-2170-y>

7. Roncoli, C.: Ethnographic and participatory approaches to research on farmers' responses to climate predictions. *Clim. Res.* **33**, 81–99 (2006)
8. Bachofen, C., Suarez P., Steenbergen, M., Grist, N.: Can games help people manage the climate risks they face? The participatory design of educational games, Red Cross Red Crescent Climate Centre (2012)
9. DeKanter, N.: Gaming redefines interactivity for learning. *TechTrends* **49**(3), 26–31 (2004).
10. Burns, R.A.: Information impact and factors affecting recall. Paper Presented at the Annual National Conference on Teaching Excellence and Conference on Administrators, 7th, Austin, TX, 22–25 May 1985 (1985)
11. Duke, R.: *Gaming: The Future's Language*. SAGE Publications, Thousand Oaks (1974)
12. Kwok, R.: Scientists are designing board, card and digital games to convey scientific concepts. *Nature* **547** (2017)
13. Djaouti, D., Alvarez, J., Jessel, J.: Classifying serious games: the G/P/S model. In: Felicia, P. (ed.) *Handbook of Research on Improving Learning and Motivation Through Educational Games: Multidisciplinary Approaches*, pp. 118–136. IGI Global
14. Schrier, K.: EPIC: a framework for using video games in ethics education. *J. Moral Educ.* **44**(4), 393–424 (2015)
15. Schrier, K., Gibson, D.: *Ethics and Game Design*. IGI Global, Hershey (2010)
16. Chacon, J.C., Martinez Nimi, H., Watanabe, M., Ono, K., Paskevicius, A.: Reducing fear of crime through design against crime. *J. Sci. Des.* **2**(1), 1_29–1_36 (2018). https://doi.org/10.11247/jsd.2.1_1_29. Japanese Society for the Science of Design
17. Ekblom, P.: *Design Against Crime: Crime Proofing Everyday Products*. Lynne Rienner Publishers, Boulder (2012)
18. Davey, C., Marselle, M.: Engaging young people in designing against crime. *Swedish Des. Res. J.* **1**(12), 29–38 (2012)
19. Barreteau, O., Le Page, C., Perez, P.: Contribution of simulation and gaming to natural resource management issues: an introduction. *Simul. Gaming: Interdiscip. J.* **38**, 185–194 (2007)
20. Infobae. Aumenta a 14 el numero de muertos por los tiroteos en Culiacan (2019). <https://www.infobae.com/america/mexico/2019/10/23/aumento-a-14-el-numero-de-muertos-por-los-tiroteos-en-culiacan/>. Accessed 06 Nov 2019
21. Universidad autonoma del estado de hidalgo: protocolos de seguridad antes, durante y despues de una balacera, Aniversidad Autonoma del estado de hidalgo (2019)
22. Diario 43. Viernes Negro; Persecuciones y Balaceras Ponon en Pánico a la Ciudad, 8 abatidos. <https://eldiario43.com/2017/06/03/viernes-negro-persecuciones-y-balaceras-ponon-en-panico-a-la-ciudad-8-abatidos/>. Accessed 06 Nov 2019
23. Digital, M.: Captan persecución y balacera en Piedras Negras, Coahuila, 06 November 2019. <https://www.milenio.com/mileniotv/policia/captan-persecucio-balacera-piedras-negras-coahuila>. Accessed 06 Nov 2019
24. Intento de secuestro desata balacera en Nuevo León, 07 April 2018. <https://www.excelsior.com.mx/nacional/intento-de-secuestro-desata-balacera-en-nuevo-leon/1231010>. Accessed 06 Nov 2019
25. Wootton, A., Davey, C.: *Crime Lifecycle: Guidance for Generating Design Against Crime Ideas*. The University of Salford, Salford (2003)
26. Ekblom, P.: The conjunction of criminal opportunity: a framework for crime reduction toolkits, Institute for Public Policy Research (2001)
27. Chacon, J.C., Martinez Nimi, H., Watanabe, M., Kenta, O., Paskevicius, A.: Reducing fear of crime through design against crime II. *J. Sci. Des.* **3** 卷 (1) 号, 1_21–1_26 (2019). 公開日. https://doi.org/10.11247/jsd.3.1_1_21. https://www.jstage.jst.go.jp/article/jsd/3/1/3_1_21/article-char/ja. ISSN 2424-2217

28. John, O.P., Naumann, L., Soto, C.J.: Paradigm shift to the integrative Big Five trait taxonomy: history, measurement, and conceptual issues. In: John, O.P., Robins, R.W., Pervin, L.A. (eds.) *Handbook of Personality: Theory and Research*, 3rd edn., pp. 114–158. Guilford Press, New York (2008)
29. Lima, E.S., Feija, B., Furtado, A.: Player behavior and personality modeling for interactive storytelling in games. *Entertain. Comput.* **28**, 32–48 (2018). <https://doi.org/10.1016/j.entcom.2018.08.003>
30. INEGI: Encuesta Nacional de Victimización y Percepción sobre Seguridad Pública 2019, Mexico (2019)
31. Unity3D (2014). <https://unity3d.com/>. Accessed 07 Dec 2020
32. Mühler, V.: <https://github.com/justadudewhohacks/face-api.js>. Accessed 07 Dec 2020