

when studying the effects of open-world videogame exposure, a systematic bias might exist. While this question cannot be answered on the basis of the current study, the results lend support to the importance of investigating the "player" variable when studying videogames, in addition to studying the variables that have already been pointed out in the literature, such as content, context, structure, mechanics and time [2].

A second possible implication of the study's findings relates to the use of gameplay as an assessment tool for psychopathology. In this study, it has been shown that the diagnostic group is influential regardless of age and psychological attributes of aggression, impulsivity and anger. As the field of psychiatry on the whole is eager to develop tests that will capture the essence of a disorder, it is possible that the wide range of behaviors that are manifested in virtual environments encapsulate many of these hidden dimensions within a quantitative monitored environment. Psychological tests, cognitive as well as others, are heavily affected by motivation, interest, anxiety, setting and other factors related to the subject, the tool, and the context [30–32]. Thus, despite efforts to measure a specific attribute of the subject as precisely as possible, the artificial nature of the testing procedure itself colors the results (the observer effect) [33]. Using videogames, however, might lessen such obstacles: the question of motivation and even more so, of interest, would no longer be as relevant, and the point of the test would remain hidden from the player, thus diminishing factors of cooperation and malingering. In the current study, the differences that arose between the diagnostic groups were not reducible to core psychological elements of aggression, impulsivity and anger. This finding suggests that the game may offer a sort of gestalt that captures multiple aspects of behaviors and represents the core psychopathology better than unidimensional measures can.

While questionnaires and unidimensional tasks are aimed at a content-based outcome, the use of videogames allowed us to examine what the subject's approach towards the questionnaire was and how he used it. In the case of GTA, what we discovered was that the subjects, though they used the same amount of firepower, chose to fire for different reasons, a finding that would not have emerged if the question hadn't been viewed within the gameplay context. This example is analogous to two children who answer fewer questions on an exam than their classmates do. A tester measuring only the number of correct answers would not be able to account for the "why" of these results; however, a gameplay-analysis as proposed by our study would reveal that one of the children was more hesitant to answer questions, while the other child used half his/her exam time transforming the questionnaire form into a paper airplane.

An additional finding of our study bears further examination. Structured games would seem to focus on relatively uniaxial capabilities of the player — such as speed, accuracy, and visuospatial abilities. The fact that in those games we found no difference between children with psychopathology and healthy controls (nor did previous studies [15,16]), is puzzling, as these games often utilize and measure attributes similar to the ones that cognitive tests utilize and measure to evaluate ADHD. While our study cannot provide a definitive answer to this question, a possible explanation would be that immersion in the game can sift oppositional attitudes, or just plain lack-of-interest, which might be more prominent in the classical, less attractive, computerized cognitive tests.

The current study had several limitations. First, given the pilot nature of our study, our sample was small. Second, the setting of the study was not the "natural" setting in which videogames would ordinarily be played; rather they were played in a laboratory located within a mental health center. While this setting was similar to that in which assessment tools are commonly applied, it might have altered the playing behavior of the children in a differential manner. Moreover, they did not play a game of their choosing, a factor which might also altered motivation and, consequently, playing behavior [14]. Third, the children played the games only once, and therefore our results cannot attest to whether the differences reflected a trait or state