Watching versus Doing: The Experience of Self-agency Mediates Visual Tracking

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Watching versus Doing:

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Abstract

We investigated self-agency – the ability to know that you caused an event – using a computerized task in which a doer controlled an onscreen avatar while another participant watched. All humans experience self-agency, sometimes during normal tasks in which they cause effects in the world, and sometimes in an illusory way when they appear to cause an event but actually do not. We looked at self-agency as phenomena distinct from visual discrimination, such that we tried to distinguish the effect of self-agency from normal visual tracking. We also investigated which types of sensorimotor cues, past experiences, and skills affect self-agency. Specifically, we tested whether video gamers (thosewith a lot of experience identifying their actions) would do better than a normal population of college students. We found that people who play video games showed a significant improvement over non gamers in their abilities to identify both their own and random movements probably due to their extensive experience. We raised new questions for future research about the effects of video games on learning, motivation, and agency through this study.

Watching Versus. Doing: The Experience of Self-agency Mediates Visual Tracking

Self-agency is the sensation of control over those actions that you identify as being responsible for. Metacognition, or understanding which actions are attributable to the self, is a vital component of experiencing self-agency. Previous studies have investigated the validity of metacognitive oversight and the feeling of self-agency that it creates (Couchman, 2012). Other studies have found that different brain regions are implicated in action monitoring – the detection of differences between observed actions and expected actions (usually in regards to self-directed behavior) – and conscious self-attribution of control (Miele, Wager, Mitchell, & Metcalfe, 2011). Aside from the implication of the diverse neurological roots of agency, this shows a dichotomy between metacognitive thought and executive action. Thus metacognition and the associated agency that comes from ownership of action is a discrete process from the action itself. However, do some people possess a greater degree of agency than others, and therefore a greater capability for discerning metacognitive thought? Do some individuals have stronger or more potent metacognitive abilities that spawn a greater sense of agency? Zalla, Miele, Leboyer, & Metcalfe (2015) found that adults with high functioning autism use sensorimotor cues less in making judgments of their own sense of agency. While this observed difference was due to autism, it naturally leads to the investigation of differences in agency among people without disabilities.

Various studies have shown that those who frequently engage in gaming have faster reaction times and greater hand-eye coordination stemming from a more thoroughly developed cortex (Kühn, Gleich, Lorenz, Lindenberger, & Gallinat, 2013). Other studies have shown that playing a video game can improve problem solving skills, spatial skills, and persistence (Shute, Ventura & Ke, 2015; Ventura, Shute, Wright & Zhao, 2013). Gaming especially has shown to enhance sensorimotor learning (Gozil, Bavelier, & Pratt 2014). Sensorimotor cues are vital to much of the experience of self-agency, as they are one of the primary ways a person gets feedback about their actions in the world. Spence and Feng (2010) demonstrated how video games can increase visual attention and inhibition of distracting information, while Berard, Cain, and Watanabe (2015) have shown that video gaming "not only enhances the amplitude and speed of perceptual learning but also leads to faster and/or more robust stabilization of perceptual learning". These studies demonstrate how playing video games has been shown to have lasting and clear cognitive benefits, from being a long time gamer to playing specific games over a period of time. While this may be the case, does gaming and the associated cognitive improvements also improve self-agency?

Research on the positive effects of video games is not as vast as it could be given the negative stereotype many have of them. This research delves into the as yet to be investigated topic of the effect of video games on self-agency. In this study, both gamers and non-gamers will be investigated by asking participants to play a custom-designed computer game where they must identify their own avatar or a randomly moving avatar from a field of distractor avatars. In addition, to the original test, participants will be grouped in pairs where one will play the game in proxy on a clipboard, which will rob them of any sensorimotor cues, while the other will play the game on a controller. By having participants play this computer game designed to assess their sense of agency, we can determine if having extensive experience playing video games improves the ability to identify one's own actions. We hypothesize that the video-gamer demographic will perform significantly better than the layperson non-gamer due to their experience with identifying their own actions while playing video games, and the players will perform significantly better than the watchers due to their increased sensorimotor cues.

Method

Participants

A total of 44 undergraduate students were recruited for the study, 31 non-gamers (20 female, 11 male) and 13 gamers (9 male, 4 female). Ages ranged from 18 to 22, with an average of 19.6 (*SD* = 1.35). Non-gamers students were all undergraduates recruited from Albright College psychology classes and gamers were recruited from Albright College's Gamer's Guild. All participants filled out a brief questionnaire where they reported their prior video game experience, including types of games played previously, frequency of video game playing, and their own evaluation of their video-game performance.

Materials and Procedure

Participants played a custom video game where players determined which on-screen avatar they were controlling when faced with a number of distracting avatars who move in deceptive patterns. In addition, there is a randomly moving avatar that the player must occasionally choose (see Figure 1). On the first (bottom) panel, participants saw an array of characters. They then used a joystick to move the characters for 3 seconds, until they stopped moving in positions shown on the second panel. The participant controlled one of the avatars while others moved in different, discrete, ways. They then used the small red cursor to touch the character they had been controlling or the randomly moving avatar, depending on which was the target avatar (explained below). Other participants watched this procedure, and indicated which characters were being controlled by the participant or random, as indicated at the top of the screen.

Avatars could move in the following ways: either controlled by the player, completely randomly, mirroring the player on only the X-axis, mirroring the player on only the Y-axis, or mirroring the player on both the X-axis and Y-axis. The avatar assigned to each of these movement logic patterns changes with each trial, so the participant must figure it out anew each time. In addition, they must look for both themselves (or the controlling player if they are watching) and the randomly moving avatar, since they have no idea which one will be the desired answer until after they have run the experiment.

Watchers were provided with a clipboard sheet with the 5 avatars used in the game and 60 rows for indicating their answer. The correct answer was coded if either participant (player or watcher) selected the target avatar, either the player controlled or random.

Participants were brought into the lab and were asked to fill out an informed consent form and then an anonymous demographic questionnaire. They were then given an in depth explanation of all aspects of the game including timing, the randomness of the target avatar, and the movement logic of the avatars. A short demonstration was given by the experimenter by playing the first couple of trials in front of the participants so they could see the game played firsthand. Then participants paired off and played, switching after 60 trials. Gamers were only ever paired with gamers, and non-gamers with non-gamers. After the testing phase was over subjects were debriefed and offered candy if they were in the video-gamer group, and extra credit if they were in the non-gamer group.

Results

In order to test the hypothesis that video-gamers would exhibit greater agency at choosing their own avatars, a Chi-square Goodness-of-Fit was performed to determine whether the target avatar was selected above chance. Both gamers and non-gamers were proficient at selecting themselves and random. Non-gamer players significantly selected themselves $\chi^2(4, N = 900) = 814.80$, $p < .001$. Non-gamer players significantly selected random χ^2 $(4, N = 900) = 492.31$, $p <$

.001 as well. Gamer players significantly selected themselves X^2 (4, N = 900) = 749.87, $p <$ 0.001, and gamer players significantly selected random X^2 (4, N = 900) = 543.15, $p < .001$.

However, gamer watchers performed better than non-gamer watchers. Gamer watchers significantly selecting the player x^2 (4, N = 360) = 23.14, $p < .001$, and gamer watchers significantly selected random x^2 (4, N = 360) = 33.86, $p < .001$. Non-gamer watchers only significantly selected random x^2 (4, N = 132) = 17.75, $p < .01$, while failing to select the player x^2 (4, N = 132) = 3.30, *ns*. A *t*-test between gamer and non-gamer conditions was performed. We found that gamers, at 75% correct (SE = .02, SD = .43) were better than non-gamers (57% correct, SE = .02, SD = .49) at identifying themselves, $t(1288) = 6.14$, $p < .001$ (SD = .48, SE = .01). At identifying random, gamers, at 67% correct (SE = .02, SD = .47) were better than non-gamers (49% correct, SE = .02, SD = .5), $t(1288) = 5.87$, $p < .001$ (SD = .49, SE = .01).

A mixed-models ANOVA using gamer versus. non-gamer as the between-subjects factor and watching versus. doing as the within-subjects factor showed a significant effect of being a gamer, $F(1,2068) = 23.6$, $p < .001$. Gamers outperformed non-gamers. There was also a significant effect of watching vs. doing, F(1,2068) = 796.2, $p < .001$, showing that doers outperformed watchers. Finally there was a participant by condition interaction, F(1,2068) = 35.2, $p < .001$, showing that gamer doers did better than gamer watchers, non-gamer doers did better than non-gamer watchers, gamer doers did better than non-gamer doers, and gamer watchers did better than non-gamer watchers. Overall, gamers performed better than non-gamers while playing, $t(2578) = -8.455$, $p < 0.001$, but did not while watching $t(2068) = .571$, *ns*. Figures 2 through 5 show the scores of the gamer and non-gamers between both doing and watching.

Discussion

Both gamers and non-gamers were able to play the video game proficiently, such that they were able to select themselves and random at above chance levels, showing that it is not too difficult for the average college student. Overall, the players did better than the watchers, with gamer players 75% correct at selecting themselves (57% for non-gamers) and 66% correct at selecting random (49% for non-gamers). This is contrasted with the gamer watchers 29% correct at selecting the player (22% for non-gamers) and 17% correct at selecting random (16% for non-gamers). The observed advantage that players had over watchers was expected due to the player having sensorimotor cues and a sense of agency over the avatar’s actions. This helped the player to both distinguish himself and served as an eliminating factor for determining the random avatar. The watcher’s inability to distinguish distractor avatars, as watcher probabilities hovered around chance levels (20%), may stem from having no sensorimotor cues to distinguish with. Without these cues, and the lack of self-agency they provide, the watcher was reduced to mostly guessing.

As predicted gamers performed better overall at selecting themselves and selecting the random avatar, possibly due to prior experience with identifying their own actions while playing video games. Gamer watchers reached a level of significance for their selection of the player while non-gamer watchers did not, implying an increased ability to determine the agency of others developed from video games even when not playing the game itself. This finding was unexpected but raises many interesting questions about the nature of video-gaming in identifying others actions, rather than just one's own personal actions.

Video games, while frequently given a bad reputation, have shown to improve a plethora of cognitive skills (Kühn, Gleich, Lorenz, Lindenberger, & Gallinat, 2013; Shute, Ventura & Ke, 2015; Ventura, Shute, Wright & Zhao, 2013). This could have a profound effect on educational policy, developmental psychology, and cognitive psychology. The present study shows that having video game experience improves one's ability to identify the agency of self and others. If this increased aptitude for identifying agency can affect learning, this could have possible motivational or teaching applications. While most modern and older video games are generally not designed with therapeutic or educational goals in mind (barring unsuccessful attempts to 'gameify' skills like typing) future games could be built with cognition improving goals in mind. This is increasingly relevant, as video games are a constantly growing part of today's society, with 60% of individuals aged 8 to 18 playing digital games on a typical day in 2009, compared to 52% in 2004 and 38% in 1999 (Rideout, Foerh, & Roberts, 2010).

This study had a number of limitations that need addressing. Aptitude at video-games was completely self-assessed, with no diagnostic metric being given beforehand. As there might be overlap between the two populations we drew from (gamers in the non-gamer condition) or even 'secret' gamers who failed to report their video-game use or don't identify video-game use as games, some diagnostic would be vital in future experiments. The latter is especially relevant with the emergence of mobile gaming, where people who otherwise would have no video-game experience have logged hours playing on their phone. Future research would need to control for this, via questionnaire or otherwise.

. The current study observed two small demographics -- college-aged students who are either gamers or not. The experience of self-agency is ubiquitous, and potential comparisons between groups could be further explored in future investigations. An interesting direction would be to observe differences in age – do older gamers show more or less agency than younger gamers? Perhaps avoid the video-game question altogether, and focus on whether men and women show different degrees of self-agency? The field for this research is wide, and virtually untouched.

This study looked at differences in self-agency, or the sensation of ownership of action, between video-gamers and non-gamers. By having a watcher and a doer play the same game, and robbing the watcher of the sensorimotor cues of the doer, we showed how agency is directly tied to the experience of control of one's actions. Comparing between the gamer and non-gamer conditions showed that gamers performed better overall, and interestingly gamers were also able to distinguish the agency of others where non-gamers could not. This raises questions about the cognitive effects of video-games and the variable nature of self-agency, a virtually unplumbed field of inquiry.

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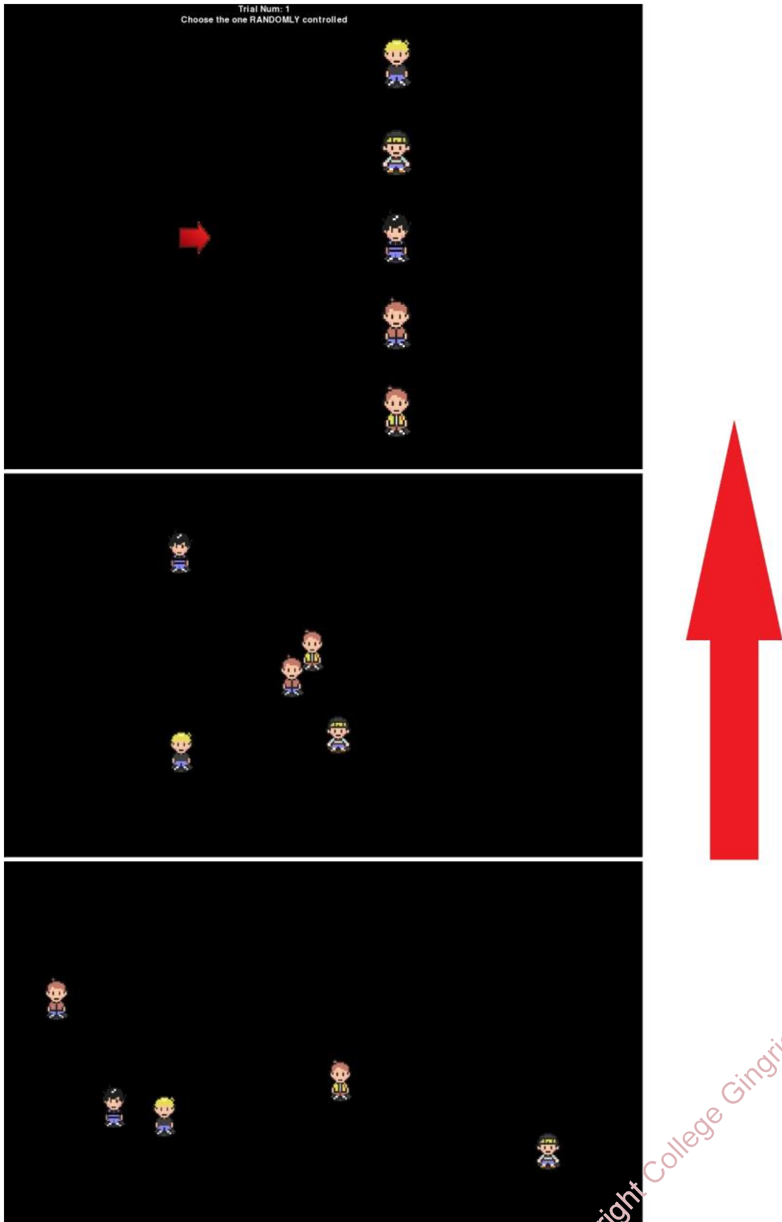

Figure 1. An example of gameplay, including selection

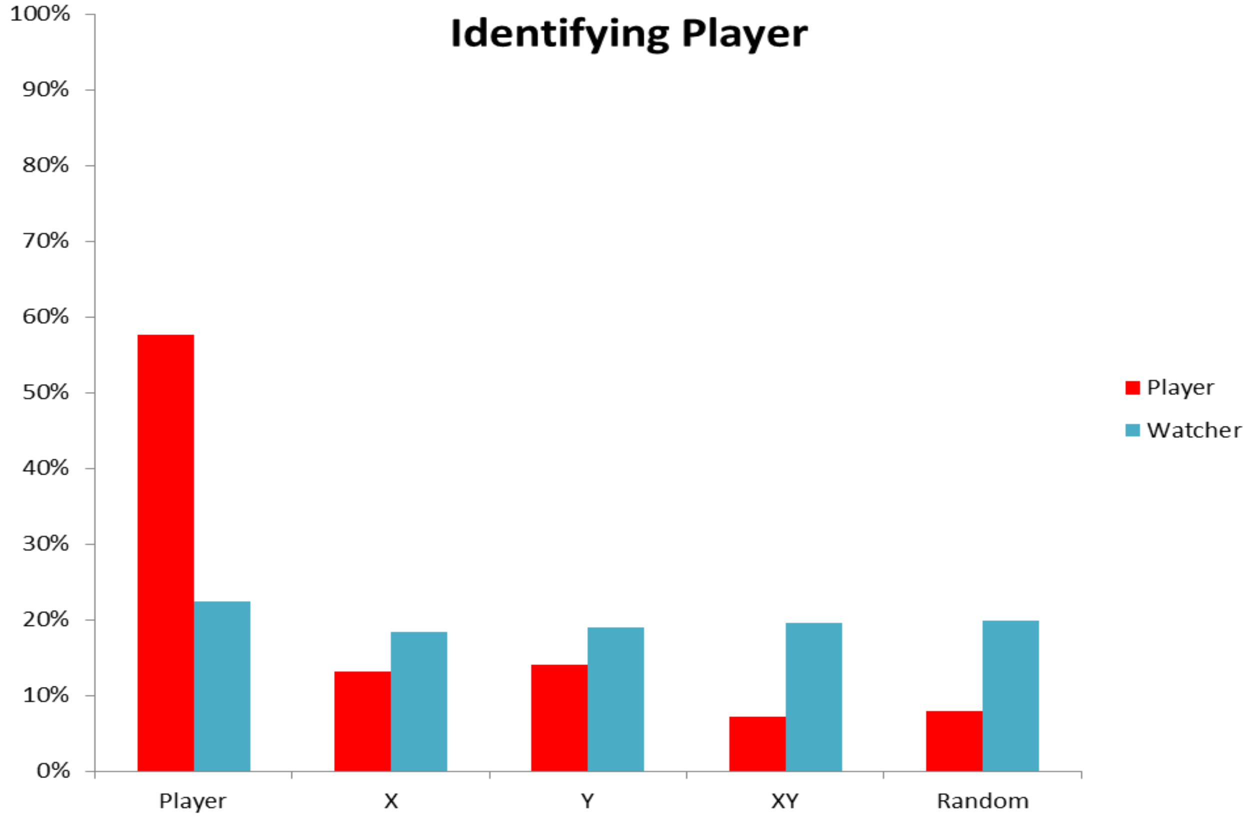

Figure 2. Non-gamers selection rates when identifying the player controlled avatar

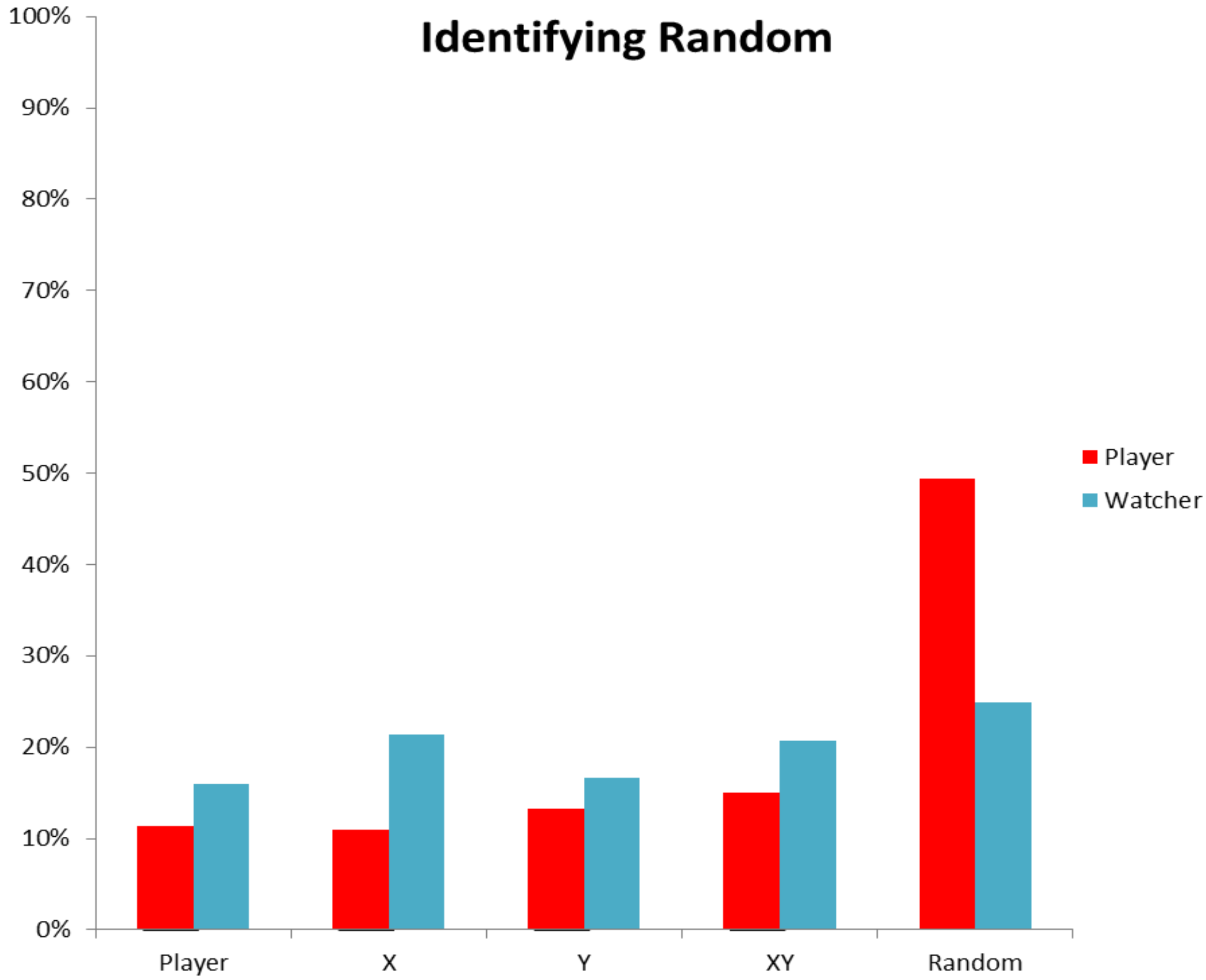

Figure 3. Non-gamers selection rates when identifying the randomly moving avatar.

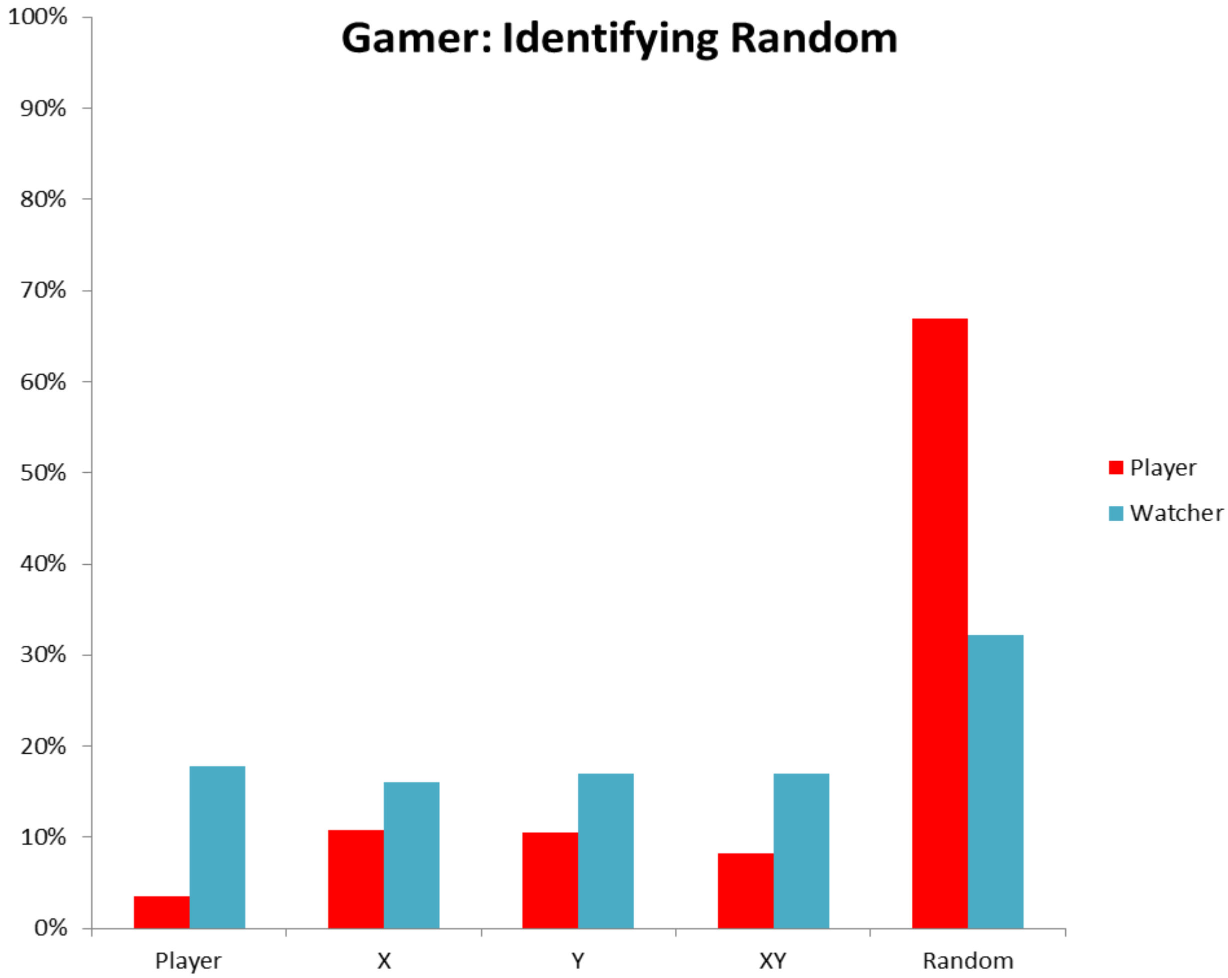

Figure 4. Gamers selection rates when identifying the randomly moving avatar

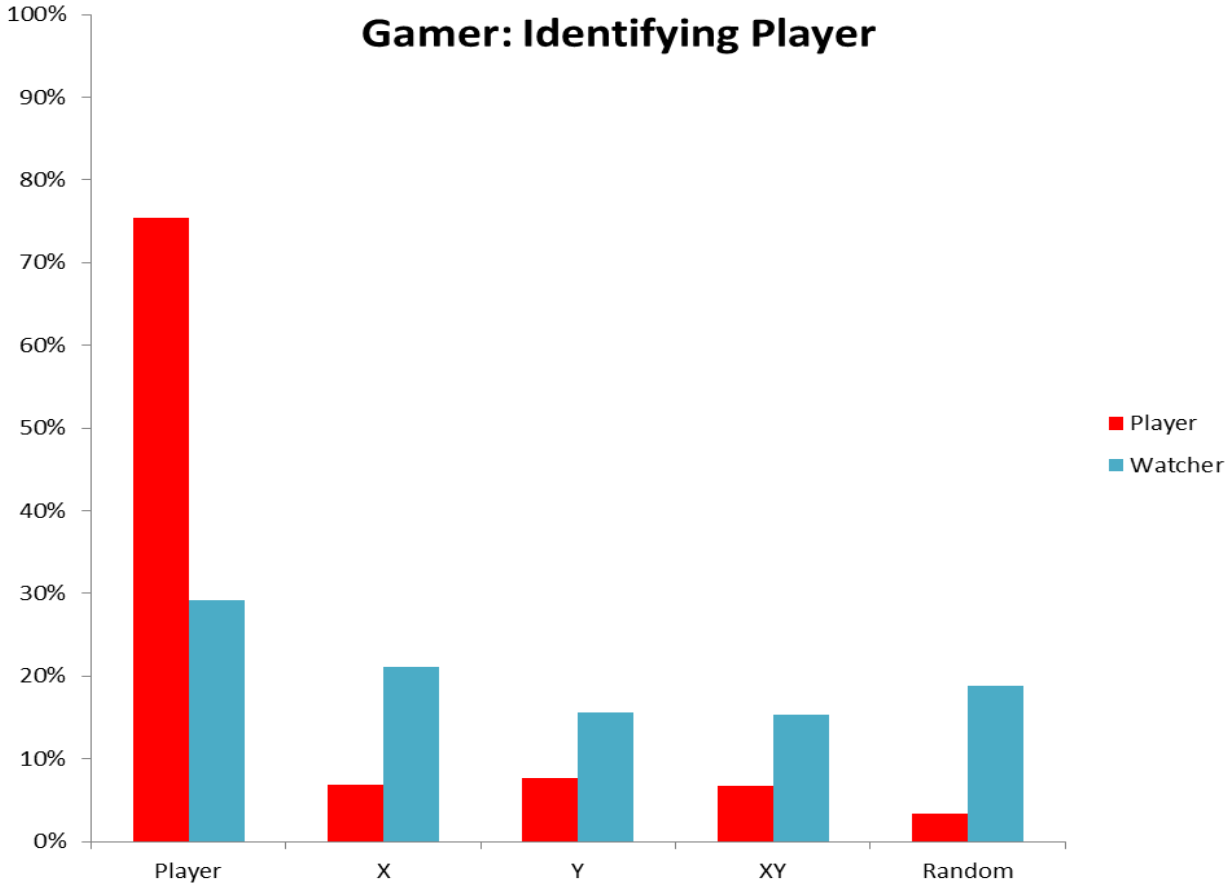

Figure 4. Gamers selection rates when identifying the player controlled avatar