PLAYING AND WORKING TOGETHER:

CAN VIDEO GAMES INCREASE REAL WORLD COOPERATION?

By

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Abstract

Video games are incredibly popular and their prevalence in society increases year to year. Looking at the effects of video games, research has found that cooperative gameplay results in increased cooperation post-game. However, these findings have been mixed, and accordingly the true effects of in-game cooperation are unclear. This study investigated the relationship between short-term cooperation in a video game and post-game cooperative behaviour. Sixty participants were randomly assigned to play a non-violent game (Portal 2) either by themselves, or in a split-screen cooperative game mode for 20 minutes. Following this, cooperation was measured both by a digital form of the give-some dilemma (a coin sharing game) and by the Everyday Cooperation Scale (self-report questionnaire). As prior research has identified social dominance orientations as an important factor in cooperation, participants also completed a questionnaire assessing their Social Dominance Orientation. Based on the General Learning Model and past research, it was predicted that participants who played cooperatively would show higher cooperation levels post-game than those who played the same game in single-player mode. Results did not support the core hypothesis. There was no significant effect of in-game cooperation on post-game cooperation. However, results suggested a small non-significant trend toward participants in the cooperative condition cooperating slightly more following gameplay than participants in the single player condition. This trend was much smaller than suggested by previous research. Social Dominance Orientation did not moderate the relationship between in-game cooperation and post-game cooperation. These results challenge the General Learning Model by showing that cooperation in video games does not appear to have a significant effect on post-game cooperation following short exposure durations. Moreover, the results suggest that social dominance orientation is not a personality factor which moderates the effects of in-game cooperation on post-game cooperation. However, as a large cooperation effect was expected it is possible a small effect exists but was not detected due to the study being underpowered to detect small effects. As such, replication studies with larger samples are recommended.

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I would also like to thank my partner Keri Wheeler, who listened firstly with consternation and then with resignation when I explained that I would be spending a year playing video games for “study”. Her support was clear from the outset and never wavered. It is with pleasure I can now state that as this project is finished I will finally get around to mowing those lawns... Just as soon as I reach the next save point of course.

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Playing and working together:

Can video games increase real world cooperation?

Video games are becoming easier to access, more acceptable to play across age groups, and more integrated into everyday lives through smartphones, social media, and new technologies like augmented reality. Consequently, there are 2.3 billion gamers worldwide (Newzoo, 2018), with at least 70% of college students considering themselves gamers (Barlett, Anderson, & Swing, 2009). While the majority of research into video games have focused upon the potential for them to have negative effects their prevalence leads to critical questions such as: Are there possible benefits of games beyond just entertainment? Could utilising video games assist with learning and social cohesion? Could video games be used to increase specific prosocial behaviours like cooperation among players in and outside of gaming environments? This thesis will explore the effects of video games on one prosocial behaviour - cooperation.

In the US, research from the past decade shows that the average child aged between 2-17 has been reported to play approximately 7 hours of video games per week on average with this increasing to 9 hours for those aged 13-14 (Barlett, Anderson, & Swing, 2009; Gentile, Lynch, Linder, & Walsh, 2004). These numbers would likely be higher today. One area of growth for games involves advancements in computers and communication technology - namely the internet (Chung & Fung, 2013; Curtin, 2008). The internet has facilitated gamers' abilities to build digital communities together and to play in teams with and against each other. Fifty six percent of the most frequent gamers play multiplayer games at least once a week, spending an average of 7 hours playing with others online (Entertainment Software Association, 2018). Recently there has also been a resurgence of split screen multiplayer games, which enables gamers to play physically side by side and explore digital worlds with one shared screen (Tassi, 2015; Gartenberg, 2017). This increase in multiplayer gaming, combined with the significant portion of leisure time many choose to commit to it, highlights the importance of investigating the psychological effects of multiplayer games.

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Much of the past research on video games has focused on the potential negative effects of video games, such as the effects of violent games on aggression (Wilkinson, Ang, & Goh, 2008). This may in part be because video games have been proposed to be much more influential than other forms of entertainment due to their interactivity (Gentile, Groves, & Gentile, 2014). For movies and television, viewers are a passive audience however with video games, players are active participants, shaping story and committing actions (Buckley & Anderson, 2006; Gentile, Groves, & Gentile, 2014).

A strong focus on video game effects, regarding their interactivity but also for media in general, has led to the development of key theories attempting to explain overall media effects; such as the General Aggression Model (GAM) and the General Learning Model (GLM; Anderson & Bushman, 2002; Buckley & Anderson, 2006; Dewall, Anderson, & Bushman, 2011; Gentile, Groves, & Gentile, 2014). In these theories a key aspect is that interactivity (the person in the situation) occurs in a cycle or episode. These cycles - incorporating cognition, affect, and arousal - determine behavioural choice. It has been suggested that many video games present a unique danger as they present infinite digital cycles teamed with permissions -not just to witness- but to consciously enact violent acts in a multitude of differing digital environments. This then, according to the theories, leads to a generalisation of these responses (Anderson & Bushman, 2002; Buckley & Anderson, 2006). However the evidence supporting these positions are mixed (Ferguson, 2015a).

With mixed results regarding negative game effects it is concerning that a strong focus on restriction of this media is recommended by many researchers, journalists, and legislators alike in what has been described as a moral panic (Ferguson, 2015a; Ferguson & Dyke, 2012; Mailberg, 2018; Wilson, 2018). Additionally, as much of the recent focus has been on the harm video games could be causing this has resulted in neglect of others, namely; can video games be used as tools for potential positive prosocial effects?

There has been a paucity of studies looking at the positive effects of video games comparatively to their negative effects (Greitemeyer & Osswald, 2010; Jin & Li, 2007). However, a growing body of research into the potential use of video games for skills training, therapy, and

education has existed for decades. For instance, video games as a therapy were used as early as the 1980's utilising Atari games to assist with reflex training (Larose et al., 1989). More recently video games and virtual reality simulations are being used as forms of exposure to averse stimuli in therapeutic settings (Wilkinson, Ang, & Goh, 2008). Some hospitals are also integrating video games within physical therapies to increase muscle strength through the use of motion controllers (2012, October, John Hopkins Medicine), and building games like Minecraft are being utilised for the socialisation of children (Ringland, 2017; Riordan & Scarf, 2017). Players of games with historical simulation elements (e.g., Civilization, The Age of Mythology, Assassins Creed) have been shown to have greater knowledge about, and interest in, world history than players of other games when tested (Black, Khan, & Huang, 2014; Gee, 2003; Karsenti, 2019). Thus it is clear that some games have a positive effect on real world learning.

The present study aimed to investigate the effects of one aspect of video games – cooperative multiplayer gaming on the learning of prosocial behaviour. Specifically, this study investigated whether cooperative responses in two measures were increased by playing a video game in either single player or cooperative mode immediately prior.

Cooperation

Cooperation is a prosocial behaviour. It is the act of two or more people working together for mutual benefit. Cooperation occurs when goal structures are arranged positively with others - such as when goal attainment is contingent on working together or when rewards for cooperation are higher than individual rewards (Greitemeyer, Traut-Mattausch, & Osswalt, 2012). As such, while cooperation is prosocial, prosociality is not restricted to cooperation. Often the terms are used interchangeably but with a specific focus on cooperation in this study it is important to define their difference.

Furthermore, the concept of altruism is distinct from cooperation due to the concept of mutual benefit; altruism is the benefiting of another without benefit to self. Trivers (1971) outlined

the concept of reciprocal altruism as giving with the understanding that benefit to the self will occur at some undefined point in the future. These forms of altruism allow for the receiver of benefit to be a passive participant in these behavioural transactions. As such, cooperation is distinguished from both altruism and reciprocal altruism due to its focus on both mutual benefit and with the active participation of both parties in joint action (Rothstein & Pierotti, 1988).

Co-operation has been an essential part historically of social building and stability and continues to be integral in modern societies. Logically, increasing the prevalence of cooperation would seem to be a positive endeavour. However, individual and social factors often determine whether people choose to engage in positive-sum activities (win-win) or zero-sum (at another's expense) activities (Pinker, 2011). These differences have made effective training difficult to develop and implement (Gully & Chen, 2009; Jehn, Northcraft, & Neale, 1999; McGowen & Hart, 1990). However, cooperation manipulations in new experimental paradigms; such as video games and research based social dilemmas, are now allowing for more detailed investigations.

Looking specifically at video games, context can be shifted and altered to encourage wildly differing 'positive' behaviours game to game. For instance, in the video game Grand Theft Auto - a crime simulator set in a fictional city - players are encouraged to commit specific crimes fitting the story and are also encouraged to attract police attention in order to outrun and/or fight authorities (in the single player the computer controls all other characters). These are different behaviours than the ones encouraged in a game like Roller Coaster Tycoon which is a business simulator where the aim is to make money off of customers (by selling cheap drinks to increase sales then charging for toilet use for instance). Two human players can engage competitively in each game, in a zero-sum environment where winning causes the other player to lose. However, when these games are played with two human players cooperatively the specific behaviours may remain the same (e.g., killing targeted opponents/manipulating customers) but the aspect of teamwork for mutual benefit creates a prosocial positive-sum opportunity. This is not limited to two players exclusively either.

Games now allow for multiple players to engage cooperatively to defeat either enemies controlled by the computer or rival teams of human players. Teams can grow into the thousands and populate fictional cities and countries. The social communities found in many games actually become an integral part of the game, so much so that many games now remain popular (or manage to survive) due in large part to the social experience and the integrated social game elements players encounter (Burns, 2018; Fan-Chen, Han-Chung & Ching-I, 2015; Pollock, 2015). This increase in cooperation within the digital landscape leads to questions of whether video game exposure can lead to cooperation outside of the digital landscape.

Why might cooperative games increase cooperation in non-game environments? Many cooperative video games combine both cooperative goal structures and leisure activities, both of which have been found to result in greater helping behaviours post game (Deutsch, 1993; Durkin & Barber, 2002; Greitemeyer & Osswald, 2010). Moreover, research suggests that players experience heightened arousal and greater self-reported enjoyment when playing video games with friends or family (Kubey & Larson 1990). Additionally, playing in a team has been found to reduce bias toward outgroup members even for violent games when played cooperatively (Adachi, Hodson, Willoughby, & Zanette, 2014). Doing the same activity together has been shown (via functional near-infrared spectroscopy hyperscanning) to increase prosociality (Hu, Hu, Li, Pan, & Cheng, 2017) with these effects also observed during cooperating on playing building games (Lui et al., 2015) flying games (Astolfi et al., 2012) and even Jenga (Lui et al., 2016).

It has also been found that communication across players in games (both video games and social dilemmas) has been found to promote reciprocity (Kooman & Herrmann, 2018) with reciprocity promoting cooperation (Romano & Balliet, 2017). This cycle of reinforcement builds and it has been theorised that feelings of cohesion and trust are necessary precursors toward cooperative behaviour and cooperative expectations (Greitemeyer, Traut-Mattausch, & Osswalt, 2012). Expectation and familiarity seem also to be important factors; it’s not just that one acts cooperatively but one also expects cooperation from others and this expectation increases with

more positive interactions (Bloom, 2013; van Lange, Joireman, Parks, & Van Dijk, 2012). Thus, one might expect that engaging in cooperative gameplay within video games might result in real world replication of these actions and expectations. This study aimed to investigate this precise issue - whether cooperation within a video game may potentially result in increased real world cooperation efforts.

The General Learning Model

The GLM is a theoretical model which posits that exposure to various kinds of stimuli (say a video game) will prime thoughts and emotive responses in line with said stimuli (Buckley & Anderson, 2006). Subsequent successful and rewarded behavioural responses will in turn increase the likelihood of repetition in line with operant conditioning (Ferster & Skinner, 1957; Gentile et al., 2009). Over time, repeated exposure to media and the continued rewarded reactions to it will result in the creation of cognitive scripts. According to the GLM, cognitive scripts are a kind of wrote learned cognition similar to a schema and are preferential responses learned and engaged to solve specific problems. Scripts are forms of heuristics and are engaged implicitly. Implicit preferences and scripts are not immutable but can be modified by situational variables. This means that the individual is not often aware of such changes taking place. These scripts are theorised to become stronger with each use becoming both more likely to be enacted and also generalised to similar situations over time, especially when variations of particular scripts are utilised (Barlett & Anderson, 2013; Gentile, Groves, & Gentile, 2014).

The GLM was created as an extension of the GAM proposed by Anderson and Bushman (2002). The GAM posits that exposure to specifically aggressive stimuli (with a focus on media) may instigate aggressive behaviour in real world situations (Greitemeyer, Traut-Mattausch, & Osswalt, 2012). Much of the historical research on video games has been framed through the GAM (Gentile, et al., 2009). However, as the GAM was restricted to effects of an aggressive nature the scope of the

theory was limited. As such the GLM was developed in order to account for non-aggression effects (Buckley & Anderson, 2006; Greitemeyer, Osswald, & Brauer, 2010).

The GLM proposes the same mechanisms of learning that are found in the GAM; those of person and situational factors contributing to cognitions, affective responses and attitudes - thereby creating scripts (Barlett, Anderson, & Swing, 2009). The GLM combines the influences of biological factors with social learning, classical conditioning, discrimination learning, and behavioural theories (Gentile, Groves, & Gentile, 2014). The theory posits that humans within an environment experience situations in a way that interacts with their past experiences, cognitions, affect, and biology. The environments themselves (this can include other people) are also important by producing reciprocal effects and it is in tandem with these bidirectional interactions that results in learning and behavioural expression occur (Jin & Li, 2017). The GLM attempts to explain, through a multiple domain approach, how learning occurs across domains in whatever form it manifests. For media exposure this allows researchers to look beyond passive media exposure like films to active media such as games (Gentile, Groves, & Gentile, 2014: Greenberg et al., 2010).

According to the GLM, games teach behaviours through a cycle of reinforcement. Due to the nature of how video games promote mastery (through repetition, consistent reinforcement, and active problem solving) they are considered to be particularly powerful and have become the core focus of GLM studies. The GLM proposes that learning occurs from the connection of cognitive ‘nodes’. These nodes are small observations of effect or actions like ‘press button’. These nodes then become connected to other observations such as ‘door opens’ if a door opens when the button is pressed. As behaviours are repeated, and the actions are deemed successful, the predictive utility of these linked nodes becomes reliable and the node associations provide predictive function. This is where established and result-positive connections become cognitive scripts. These scripts can also grow and get more complex as more and more nodes are added with branching variations. One can begin with simple associations and actions such as ‘press green button – door opens’ and expand on the ‘green button-door script’ by adding perhaps the number of button presses needed to open the

door. These scripts are also strengthened as more rehearsals of them occur (Buckley & Anderson, 2006). If a script is consistently successful then the likelihood that an individual will try this script as a solution to a similar but different problem increases.

This is where the situation of digital worlds, within the GLM, becomes important as it is thought that video game players form stronger scripts in games because of players' active and repetitive application of them. Scripts for players not only are repeated but they are actively expanded as problems build in complexity from episode to episode. Through their repetition and consistent success in a variety of game worlds/levels these scripts purportedly become both accessible and perceived as appropriate in real world situations and environments with similar stimuli (Gentile, Groves, & Gentile, 2014). It is important to distinguish also that with passive observation media, such as film and television, the learning effects are theorised not to be as strong (Greitemeyer & Osswald, 2010).

It should be noted that game research has become a 'hot topic' with GAM/GLM studies steering policy discussions around access, control, response, and the harm/benefits of video games worldwide (American Psychological Association, 2015; Copenhaver & Ferguson, 2018). However, it has also been argued that these theories are underdeveloped (Adachi & Willoughby, 2012; Ferguson & Dyke, 2012; Markey & Ferguson, 2011). It is therefore important to test the GLM to determine whether modelling pro-social behaviours in game is associated with increased likelihood of pro-social behaviours post-game. As the GLM proposes that there is a high probability of developing behavioural scripts when playing video games, one implication of the GLM is that games may act as potential training tools to develop positive behaviours.

It has been proposed that video games, like any stimuli, have both short term and long term effects (Rothmund, Gollwitzer, Bender, & Klimmt, 2011). As such the GLM has long and short term models to help explain and identify the process of learning (Buckley & Anderson, 2006). According to the GLM playing a video game for a short period will expose a player to numerous potential learning episodes and learning can occur very quickly (Gentile, Groves, & Gentile, 2014). The short term

effects of learning are also integral to the long term GLM model; where repeated exposure to an experience increases script strength, access, associations, conditioned emotion, and results in the creation of emotional constructs (Barlett & Anderson, 2013). However, as script building is proposed to occur at the short term level, this study examined the psychological effects of short term exposure to a cooperative video game.

The three core elements to the GLM are; personal variables, situation variables, and one's internal state. Personal variables include factors such as genetics, gender, prior learning, beliefs, and attitudes, whilst the situational factors account for environmental context and other actors/influences in each scenario (Jin & Li, 2017). When playing a video game the digital environment is influential as is the space that the person actually plays in. According to the GLM these factors all influence one's present internal state which consists of a combination of cognitions, physiological arousal, and affect (Barlett, Anderson, & Swing, 2009). It is this present state, combined with the task or learning opportunity at hand, that is responsible for the behavioural response. See Figure 1.

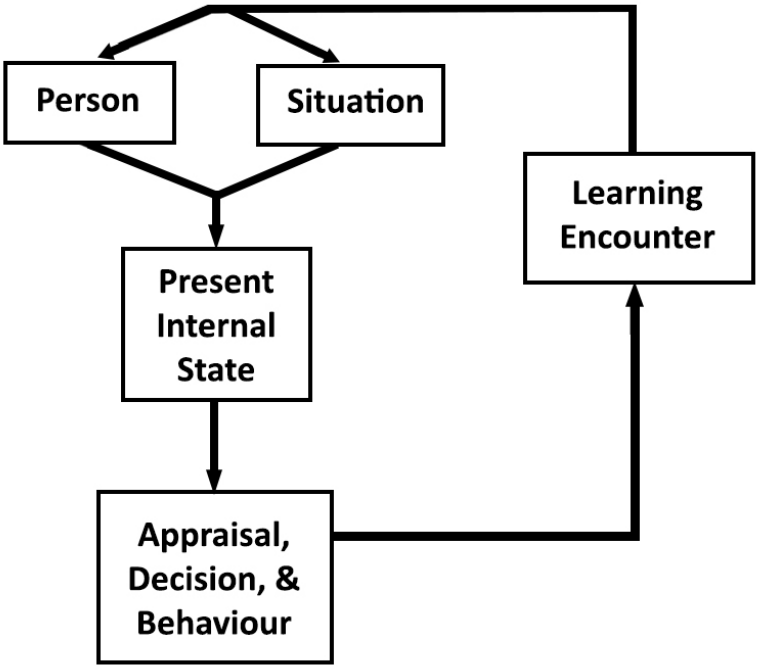

Figure 1. The GLM short term learning model. Adapted from Buckley and Anderson (2006, p. 370).

The GLM posits that we can often act impulsively and automatically without planning or thought and in such cases opportunities to learn are often lost. Although there are automatic pathways to learning contained within the GLM, the GLM views learning to primarily be an explicit cognitive process (Gentile, Groves & Gentile, 2014). The GLM states that a learning opportunity arises when one is faced with a decision that takes or demands time and thoughtful appraisal (Buckley & Anderson, 2006; Gentile, Groves, & Gentile, 2014). For instance, if the goal in a game is to shoot a duck flying away and a split second 'twitch' response is all that is needed, then the automatic firing at the poor pixelated avian is a very general response. Such a response would occur without the need for planning or re-appraisal. However if one was faced with a non-time dependent puzzle to solve, for example a locked box where one needs to arrange cogs to activate the unlocking mechanism - a puzzle and solution that one is not familiar with- then one cannot act automatically in a generalised way and a thoughtful action is then required.

Thoughtful actions occur after an appraisal or reappraisal opportunity, where one must gauge whether; 1) one could accomplish the goal with the resources one has and 2) whether or not the goal is worth accomplishing (Gentile, Groves, & Gentile, 2014). These thoughtful actions as described by the GLM are the processes that build scripts – a thoughtful action results in a novel creative solution and if that solution results in success then that cognitive script (the blueprint of the creative solution) can be applied to similar situations in the future. The more often a script is used the stronger it becomes until the cognitive script – a specific response to a specific problem – becomes an automatic response (Buckley & Anderson, 2006). It is also thought that scripts, especially in gaming (where environments change but tasks remain the same), are relatively unrefined and thus more likely to generalise due to a lack of discrimination and habituation (Gentile, Groves, & Gentile, 2014). This is also assisted through a feedback mechanism where each action taken filters back into the personal and situational factors (resulting in cognitive and physiological changes) strengthening similar future choice (Harrington & O'Connell, 2016). See Figure 2.

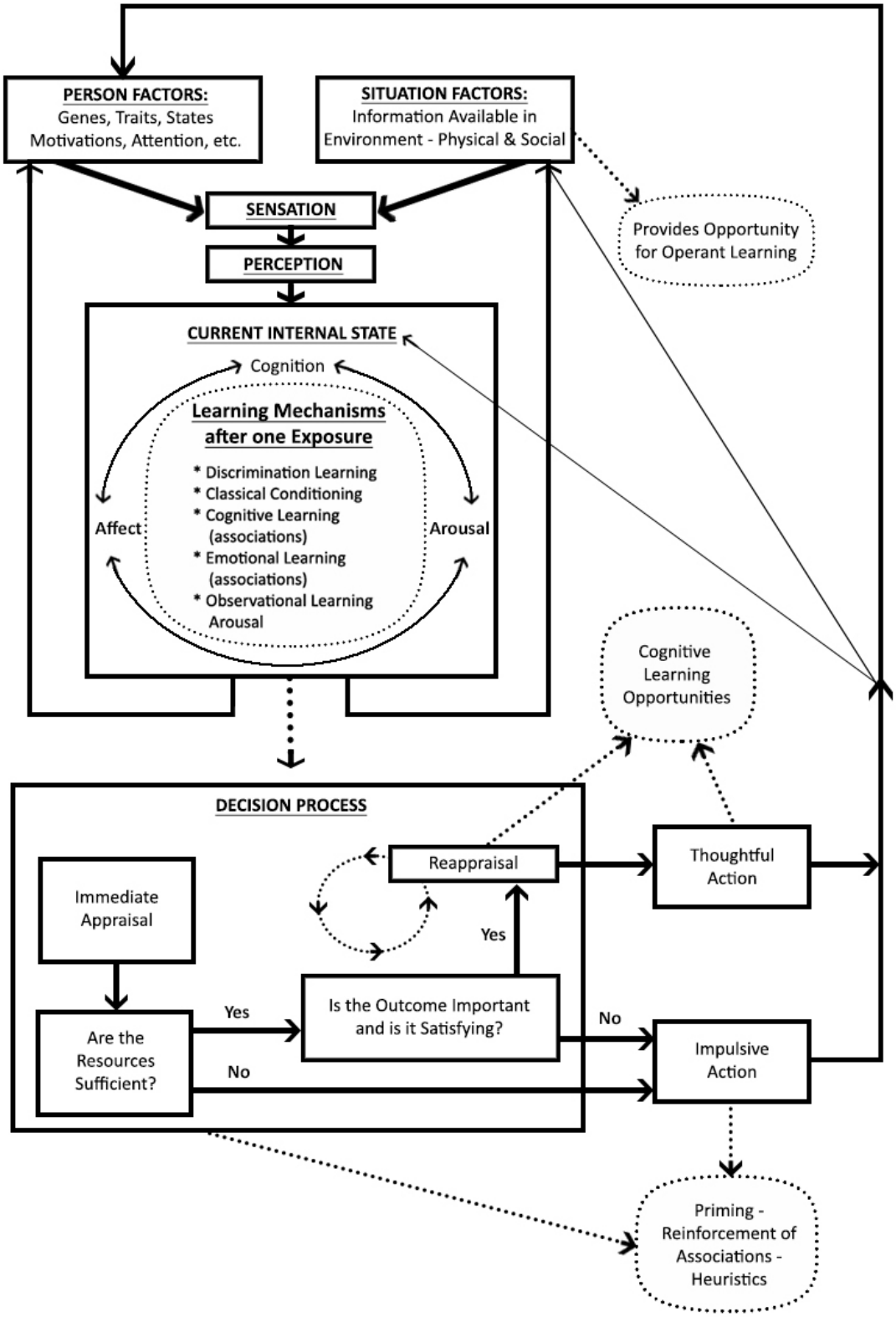

Figure 2. An expanded short term model of the GLM incorporating assessment, decision choice, and feedback loop. Adapted from Gentile, Groves, and Gentile (2014, p. 130).

Video games have unique frameworks called *cycles of expertise* that combine rewards and challenges but are created in a way to ensure repetition with increasing difficultly as soon as mastery of a particular skill is reached (Gee, 2003). Due to this, thoughtful actions that become scripts in the early stages of the game for instance then become part of the solutions in the later stages. Those parts of the solutions that players have encountered before can become automatic in order for the player to take thoughtful action on aspects of the puzzle that are new. In this way the GLM attempts to explain, especially for short term exposures, how learning occurs during video game play and how video games may be highly efficient at maximising priming and/or script development and learning (Geitemeyer & Osswalt, 2010). However, while the above covers how skills are used and implemented within video games the aspect of generalisation and automatic script response in real world situations poses a unique concern for the proposed effect video games may have on players.

If people are required to act aggressively to resolve a given situation in a game, then, according to the GLM, this would mean that outside of the game those aggressive scripts would be more accessible, especially as it is argued that people who play violent video games will also perceive more conflict and aggression in the world around them (Buckley & Anderson, 2006). In contrast, the theory also proposes that after exposure to prosocial behaviours in the game world the accessibility and frequency of prosocial scripts and behaviour will increase in the real world (Gentile et al., 2009). This should be true not just of long term and repeated exposures, but also for stimuli an individual is exposed to only for a short duration (Gentile, Groves, & Gentile, 2014)

The GLM and prosocial video games.

The evidence on whether enacting cooperation in video games transfers to real-life cooperation is mixed. While much of the research on video games has historically examined aggression by proposing theory (Buckley & Anderson, 2006; Dewall, Anderson, & Bushman, 2011), using meta analyses (Anderson et al., 2010; Ferguson, 2015; Hilgard, Engelhardt, & Rouder, 2017) and by providing reviews of existing studies (Boxer, Groves, & Docherty, 2015), a growing body of

experiments have been conducted looking at learning and prosocial behaviours using the GLM. As previously outlined, the GLM predicts that playing a video game prosocially would result in prosocial script formation, those prosocial scripts rehearsed in the game would then result in higher prosocial behaviours in the real world outside of the video game itself (Barlett & Anderson, 2013; Gentile, Groves, & Gentile, 2014).

Gentile et al. (2009) had participants list their three favourite games and asked them to estimate the amount of time they played them each week. The prosocial and violent content in each game was multiplied by the amount of time played. This data was then correlated with several prosocial measures including the Prosocial Orientation Questionnaire and the Personal Strengths Inventory. It was found that participants prosociality increased after playing prosocial games in accordance with GLM predictions. In the same paper, short term exposure to game content was tested with participants playing either a violent, neutral, or prosocial game. Directly after playing, participants chose for another participant to solve 10 puzzles or varying difficulty. It was found that those who played a prosocial game chose less difficult puzzles for the other participants (Gentile et al., 2009).

Another study by Ballard and Lineberger (1999) had participants play 15 minutes of either a violent fighting game (Mortal Kombat) or a competitive sports game (NBA Jam). After playing the game, participants tested an ostensibly real second participant (who was actually a confederate) using memory cards and word games. The participant could reward the confederate with jellybeans (a measure of prosocial behaviour) or punish them for incorrect answers by putting their hand into a bowl of ice-cold water (a cold pressor test; a measure of aggressive behaviour). The participants could choose how many jellybeans to reward the other player with or how long the other participants hand went into the water. It was found that those who played Mortal Kombat gave fewer jellybeans to the confederate, demonstrating reduced prosocial behaviours. However, the differences in punishment -as measured by seconds of the cold pressor test- inflicted on the confederate were not significantly different.

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Greitemeyer and Osswalt (2010) found evidence in two experiments to support GLM predictions that increased prosocial video game play would be associated with increased altruism. Specifically, participants who played prosocial video games would be more likely to behave prosocailly. In Experiment 1, participants were split into three video game groups; prosocial, neutral, or aggressive. After playing a game for 10 minutes the experimenters found that participants in the prosocial game group picked up a greater number of dropped pencils on average when the experimenter knocked over a cup of pencils at the end of the session that those in the neutral or aggressive groups. In Experiment 2, participants were randomly assigned to one of two conditions; playing a prosocial game or neutral game. They found that participants were more likely to offer their time (and more of it) for further research after playing the prosocial game than the neutral one. In Experiment 3, participants again played either a prosocial or neutral video game (different games from experiment 2) and found that participants who had played the prosocial game were nearly three times as likely to intervene in a post-game, staged, harassment situation.

It is often assumed that increased aggression is a negative behaviour and thus represents a form of decreased prosociality (Tear & Neilson, 2014), as such the reported effects of violent games on aggressive behaviour are cited as further evidence that violent games should decrease prosociality (Anderson et al., 2010). There are many results using the GAM that are often cited alongside GLM work, however it is important to note that the pathways towards prosocial and antisocial behaviour learning and expression are not necessarily identical (Markey & Ferguson, 2017). Context is important; if someone stands up for another person who is being harassed (e.g., as in the Greitemeyer and Osswalt, 2010 study) this could be seen as both an aggressive and prosocial act. In sports and teamwork there is often imprecision in the distinction between aggression and competitiveness (Rowe, 1998). This is exemplified by the famous Robbers Cave study, which found newly grouped teams of boys increased their in-group prosociality while simultaneously increasing their out-group aggression (Sherif, Harvey, White, Hood, & Sherif, 1961).

It has also been argued that transfer of learning is a key concept especially when talking about video games and behaviours attributed to them (Markey & Ferguson, 2017). It is argued that game situations are actually very different to real life ones and this difference prevents generalisation. For games like Grand Theft Auto the context of being a mob hitman is very different to being a 13 year old at home, as such, this drastic difference may prevent or reduce the likelihood of generalising game-behaviours in the real world. Additional criticisms of the GLM and GAM have included the lack of differentiation between reality and fantasy (Drummond, Sauer, & Garea, 2018; Ferguson & Dyck, 2012). Do players discriminate between fantasy and real-world contexts when considering the appropriateness of enacting particular learning scripts? Although the GLM suggests that such scripts are generalised, some researchers argue that children learn to differentiate between real and fantasy concepts at an early age (Drummond, Sauer, & Garea, 2018; Ferguson & Dyck, 2012).

Moreover, not all research has confirmed all of the predictions of the GLM theory: Harrington and O'Connell (2016) used a large sample of over 500 children from schools across Ireland and found differing results for particular prosocial behaviours post prosocial-game exposure. They found positive correlations between video game use and cooperation and empathy but not in specific helping and altruistic behaviours. Their findings agreed with research outlining the potential for games as teaching tools (due to the motivational and ease of access factors). Their research also highlighted that games themselves contain many factors that differ game to game, behaviour to behaviour, in such a way that it can be difficult to be sure precisely what each game is teaching at any point which will potentially confound analyses.

Research undertaken by Tear and Neilson (2013 & 2014) also challenges the GLM. Tear and Neilson (2013) conducted three experiments using a combination of violent and neutral video games where participants were assigned to a condition in which they played one type of game then completed questionnaires and/or witnessed the experimenter 'accidentally' knock over a cup of pens (to see if the participant would assist picking them up). The researchers found no effects of

game type on post-game pro-social behaviours as measured by the number of pens picked up by participants in each group. Similarly in their 2014 study Tear and Neilson found that irrespective of video game type played (violent, neutral, or ultra-violent), participants showed no marked response differences in post-game questionnaires, Tangram puzzles (assessing both helping and hurting behaviours), and charitable donations.

Criticisms could also be made regarding the social acceptability of behaviours and the GLM not accounting for them. Specifically, people may be more likely replicate a positive behaviour when it is positively welcomed in the real world or permission is given to perform it. Whilst behavioural mimicry is said to increase after observation of behaviours being modelled, the acceptability and/or repercussions of these behaviours are also important factors that need to be considered (Bandura, Ross, & Ross, 1961; Bandura, 1971). This would conform with predictions of Social Learning Theory, which hold that the likelihood of re-enacting a behaviour is dependent upon the context in which that action occurs (Bandura & Walters, 1977). As Social Learning Theory is a core theory upon which the GLM expands, social context is technically outlined in the GLM (it could be considered a situational factor) but it is an unweighted variable –in that it's importance is something that is left up to the discretion of the researcher doing an analysis. As such its impact is something that may be often forgotten when having experimenters provide the means and situational-acceptability for a participant to administer hot sauce to another participant or determine how long to put someone's hand into a cold ice bucket (non-normative actions). Such environments outline a potential obedience to authority effect (Milgram, 1963) and/or presents ecological validity concerns.

Markey and Ferguson (2017) also posit that the actual performing of behaviours in a video game is very different to the performing of behaviours in the real world. For instance, punching someone in a video game requires only a button press but to punch someone in real life one must physically form a fist and throw it. Thus differences in play and reality make it unlikely that behavioural transfer will occur. Nonetheless, whilst there are potential problems with the GLM theory, the GLM remains a widely used theoretical framework globally to measure media and video

game effects. Contained within the GLM is a multitude of variables, such as social context, genetics, gender and environmental factors. However, how all of these factors interact presents a difficult task for researchers to define.

Little is known about what factors might actually influence the transfer of pro-social behaviours from video games to the real world. Some research also has shown that context (Sauer, Drummond, & Nova, 2015) and personality factors (Engelhardt, Bartholow, & Saults, 2011; Giumetti & Markey, 2007) are important moderating factors in the transfer of aggression from violent games to the real world. Thus, as a secondary consideration, the present study aimed to extend the understanding of factors which may influence the effects of cooperative games on real-world cooperation by examining whether one particular personality factor (social dominance orientation) might moderate the relationship between in-game and post-game cooperation. Social Dominance Orientations will be discussed later in this thesis in the section entitled “Social value orientations”.

This study aimed to test predictions of the GLM to establish whether playing a cooperative game, short term, would result in a measurable and significant increase in cooperative behaviour post game as the theory predicts. In order to investigate post game behaviours the present project employed the use of a social dilemma to measure potential dependent variable data.

Social Dilemmas

One way of examining prosocial behaviours is to use social dilemmas. Social dilemmas are situations where people can act selfishly at the cost of the group or they can act to benefit the group at personal cost highlighting differences in cooperation and competition (Leibo et al., 2017; Pinker, 2011). Social dilemma research looks at a host of real-world problems from areas such as commuting, to resource management, moral response research, and behavioural economics (van Lange, Joireman, Parks, & van Dijk, 2012). As such, dilemma research is becoming more prevalent in areas relating to organisational and state policy decisions.

Types of social dilemmas vary; there are social trap dilemmas which we encounter everyday such as overeating or smoking where we face short term gains but much more impactful long term losses (Gifford & Gifford, 2000). There are common pool resource dilemmas (CPR) such as overfishing or deforestation. Here, a common good exists in limited supply, and short term selfishness benefits the individual to the detriment of everyone else and the resource in question. This is also known as the "tragedy of the commons"; that there is an almost inevitability that selfish behaviours occur at the expense of the community when dealing with limited resources (Gifford & Gifford, 2000). Games which assess human behaviour in such dilemmas are based on Game and Behavioural Economic theory, mimicking types of behavioural transactions in the social world (Crump, 2001). The games look at individual and collective rationality, trust, and moral decision making with the data from studies, applying to - and being applied, across society from parenting recommendations through to international relations (Crump, 2001; Kostyuk, 2013; Holdony, 2016; Law & Pan, 2009).

Tragedy of the commons and CPRs.

A 'commons' dilemma is when one must face either reducing one's potential harvest in order for the group resource to be sustainable or to take as much as possible to the detriment of the group but gain of the self (Gifford & Gifford, 2000). This was essentially outlined in Hardin's 'Tragedy of the Commons' which looked at overgrazing on communal (commons) land in a small town (Hardin, 1968). As Hardin outlined people generally want to maximise their own gain, but the cooperative or communal option is the only one that will guarantee that common resources remain in the long term. The 'tragedy' is that this is not how people often operate, nor are incentivised. People will often choose to benefit themselves at the cost of others (McCarter, Budescu, & Scheffran, 2008). But these are not the only types of common or popular social dilemmas.

Prisoner's dilemmas.

Another well-known form of social dilemma is the Prisoners Dilemma. This highlights a situation in which two people would be better off if both acted cooperatively with each other but often in reality act in a selfish way to their own detriment (Kuhn, 2019). The classic example offered by Tucker (Kostyak, 2013) highlights sentences and plea deals with two participants. Imagine both players are under arrest and that the detectives are asking for information. Both players, in different rooms, are told that if they blame the other person and the other stays silent then they will go home free and the police will charge the other for, say, a three year sentence. If both parties blame each other, then both will be charged for two year sentences each and if neither party says anything then both will receive a minor one year sentence.

Because 'defecting' or blaming the other player results in a better or equal outcome with the other player it is most often chosen, even though cooperation (staying silent) is in fact the best case for both parties. See Table 1.

Table 1
Tuckers Prisoners Dilemma outlining options and outcomes

		Prisoner 2	
		Stays silent (cooperates)	*Betrays (defects)*
Prisoner 1	*Stays silent (cooperates)*	Prisoner 1: 1 year Prisoner 2: 1 year	Prisoner 1: 3 years Prisoner 2: goes free
	Betrays (defects)	Prisoner 1: goes free Prisoner 2: 3 years	Prisoner 2: 2 years Prisoner 2: 2 years

Note. Adapted from Kostyuk (2013)

Other games such as the Dictator or Ultimatum games are similar but offer some distinct differences. The Dictator game, instead of a binary choice of whether to cooperate or defect, allows one player (the proposer) to choose how much of a resource to offer the other player (the recipient) out of their 100% share. In this, the recipient is passive and must accept what is offered (Bloom, 2013; Tan & Forgas, 2010). The game provides potential responses on a scale between narrow self-interest and altruism (Koch & Normann, 2008) and offers no benefits to the proposer (and no opportunity for the recipient) for cooperation; rational proposers should keep all their resources as there is no benefit to giving. As such the Dictator game was not deemed appropriate for this study.

The Ultimatum game is similar to the Dictator game but with the added caveat that the other recipient can reject the offer and if they do reject it then both players get nothing (Bloom, 2013). Rationally the proposer should offer a small amount of resources and the recipient should accept them - as a small offer is still better than getting nothing (Bloom, 2013; Nowak, Page, & Sigmund, 2000). However, in practice this rarely occurs as low offers are often rejected (Bloom, 2013; Pinker, 2011). This results in proposers giving higher offers due to fear of retaliation (fear of the irrationality of the other player), and offers are considered around concepts to fairness - in spite of potential gain (Bloom, 2013). These dynamics seem ill suited for cooperation research where mutual benefit is sought (conciliation and cooperation differ) as such the Ultimatum game was not chosen for this study.

The give some dilemma.

The give-some dilemma is an adaptation of common pool and prisoner dilemma games. Where CPR games revolve around the management of shared resources and the Prisoners Dilemma is based on a binary decision, the give-some was best suited for this study as it is; a) a continuous measure – that is, it is more sensitive to differences in the degree to which people want to cooperate, and b) it involves the management of individual resources for mutual benefit which is more cooperative than taking resources from a common pool and also should elicit more

cooperation than take-some dilemmas (van Lange & Kuhlman, 1994). Leibo et al. (2017) highlights some key aspects in social dilemmas which relate to the give-some particularly. They are as follows:

1. Mutual cooperation is preferred to mutual selfishness.

2. Mutual cooperation is preferred to cooperation on one's own part but selfishness on the other.

3. Exploiting the other player and being selfish oneself will be personally beneficial but at the expense of the other.

In a give-some dilemma there are typically two players and each are given a set number of coins. These coins are worth a set amount of money to the player and double this amount to the other player. The game assesses, without real-time communication or planning with the other party, how many coins one player gives the other player. The best mutual outcome for both parties would be to give all their coins away meaning each person ends up with double than what they started with (because the other players donated coins are worth twice what they are worth if kept). This would represent perfect cooperation. However, one could also keep all of one's own coins and hope the other player gives away all of theirs which would result in both the highest possible coin accumulation for the player keeping and receiving the coins, but also the lowest for the one giving them all away, representing perfect selfishness (De Hooge, Zeelenberg, & Breugelmans, 2007).

The give-some dilemma has been successfully conducted in multiple experiments demonstrating its validity as a measure of cooperation under a variety of conditions: In the first give-some task developed originally by van Lange and Kuhlman (1994) they gave 4 chips to each participant. The experimenters were examining the cooperative behaviour of participants against factors such as participant's intelligence, honesty, and social value orientations (prosocial-individualists-competitors). They found that those that scored high on prosociality and honesty questionnaires had the highest cooperation/coin scores overall.

Drouvelis, Metcalfe, and Powdthavee (2015) ran a 20 token give some dilemma; each token was worth 50c to the participant or $1 to the public good. Participants were initially paid $5 at the

beginning of the session for filling out a questionnaire then they were primed via either neutral or cooperative word searches. Following this they began the give-some with the instructions that the 20 tokens represented the initial $5 they earned at the beginning of the session, they were then asked to offer what they wanted to for the common good. Results were that those primed with cooperative words gave more tokens than those primed with neutral words.

The give-some dilemma has also been used in studying the effects of video games. Greitemeyer, Traut-Mattausch, and Osswalt (2012) used the give-some dilemma to examine whether cooperative video game play ameliorated the purported negative effects of violent game content. This study had participants play either a cooperative or single player video game before engaging in the give-some dilemma with the same partner (for those in the cooperative condition). It was found that participants who played the cooperative games left more coins for the other players in the give-some than those that played single player games. However it should be noted that this study outlined that cooperation post game will increase when interacting again with the same partner (with whom one had already cooperated). The study did not investigate if this increased cooperation could be found when interacting, post cooperation condition with others more generally.

Jin and Li (2017) also examined the effects of cooperation in video games. Participants were split across four conditions playing either violent video games (Warface and Call of Duty) or neutral video games (QQ Dazzle Dance and Portal 2) in single or cooperative conditions. After playing in one of these conditions participants then played the give-some dilemma. Results found that those who played the neutral video games gave more coins in the cooperative condition than the single player. For the violent condition the cooperative pairings scored higher than the single player, showing that regardless of game type (violent or neutral) participants were more likely to be cooperative post game if they had played cooperatively prior.

However the Jin and Li study (2017) has some limitations that are important to address. Differences in each cooperative session, including differing partners experimental session to session,

could produce confounding elements that were poorly controlled, increasing statistical noise. Additionally, with the games used in the Jin and Li study, the features and tasks therein differed greatly game to game and condition to condition (e.g., for the neutral condition the tasks of QQ Dazzle Dance differ greatly to the tasks in Portal 2). This makes it difficult to be sure that the cooperative elements in some of the games were the actual features causing or influencing cooperation. This is compounded that even within one game, for instance Portal 2, the differences between the standard single player, and standard cooperative modes included differing characters, different levels, different puzzles, and a different narrative between these modes.

As such, the present study aimed to replicate the core findings of Jin and Li's work (2017). However, to increase the validity of the experimental manipulation, stricter experimental controls were implemented and an additional, secondary measure of cooperation was added; the validated self-report questionnaire 'Everyday Cooperation Scale'. This scale has been used prior as a dependent measure to identify short-term cooperation and general cooperation tendencies (De Hooge, Zeelenberg, & Breugelmans 2007). Additionally, this study also aimed to extend our understanding of factors which may influence the likelihood of cooperation following cooperative gameplay, and therefore included an investigation to see whether one personality variable – social dominance orientation - mediated or moderated potential cooperation effects.

As situation variables are theorised to be important for potential learning outcomes (according to the GLM), it was decided to limit the stimuli to a single non-violent game. A non-violent game was chosen to counteract any potential increases in aggression from violent content. Additionally, by limiting the study to one game type in the study this would reduce the (digital) environmental differences between conditions. Finally by using custom built levels -across both single and cooperative conditions- tighter experimental control could be gained. One video game that could meet all of these requirements was identified for the present study: Portal 2.

Portal 2

One video game which contains the ability to include extensive aspects of cooperation is Portal 2. Portal 2 is an extremely popular first-person puzzle game. The game, since its release in 2011, has sold over 4million units (Caoili, May, 2012; Dutton, May, 2012a). The concept of the game is that the player is a subject in a science laboratory – a laboratory that requires participants to escape a chamber by solving puzzles. The puzzles consist of a combination of obstacles including water, large drops, inaccessibility, and laser walls, among others. These obstacles all need to be overcome through the activation of buttons, the continued depressing of activation buttons through the use of well-placed boxes, and the use of the key tool; the portal gun.

The portal gun utilises the core mechanic, and namesake of the game - portals. The gun is not an offensive weapon, but a tool that fires two portals. These portals join two separated spaces together. For instance, a player is able to shoot a portal on a wall in front of them, then another on a wall behind them, and thus be able to walk into one and then directly out of the other.

The use of gravity and physics is also is also built into the problem solving in the game. While portals can help one reach otherwise inaccessible areas, players need to be creative to fully traverse the environment. So players may use the portals to utilise the momentum of falling to propel oneself onto a hard to reach platform. For instance, a player could fall a long distance into a portal that is placed on the ground and by having the other portal set up so that falling momentum carries one through to the desired location like a catapult (See Figure 3). Escape in each level is often accomplished through the combination of all problem solving elements encountered prior with each level building in difficulty as new novel problems are added.

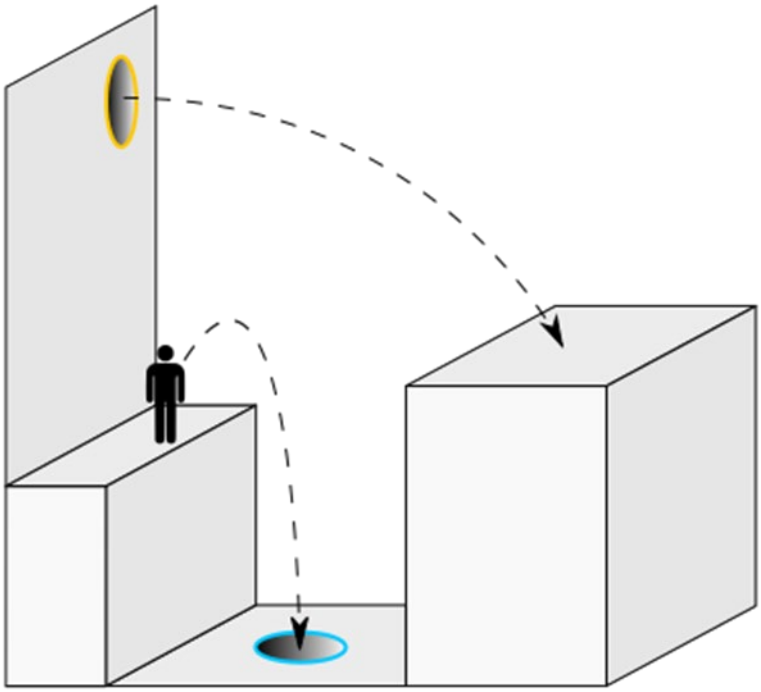

Figure 3. Portal and gravity mechanics in Portal 2. Outlines the use of gravity and momentum combined with portal placement. Taken from the Valve Software Developer Community website https://developer.valvesoftware.com/wiki/Game_Mechanics_(Portal_2)

Portal 2 has been shown to provide greater improvement to cognitive abilities and problem solving than commercial 'brain training' games (Shute, Venture, & Ke, 2015; Shute & Wang, 2015). Portal 2 also assists players with the understanding of physics, mathematics, and relies on applied reasoning so extensively that the game has been used in schools and training courses to teach these concepts resulting in over 2500 teachers using the 'Teach with Portals' programme worldwide (Salen, 2012). This programme allows for students and teachers to explore, but also manipulate the levels themselves by utilising another feature of Portal 2 that makes it useful for research; the puzzle editor (Dutton, 2012b; Pittman, 2013).

The Portal 2 puzzle editor (aka "puzzle maker") allows users to build and design their own levels, puzzles, and also allows the sharing of these levels with the community (Valve Software, 2012). The editor itself takes the basic features and mechanics of the game and permits creators to build levels of almost any size or complexity. Accordingly the editor allows players and researchers to produce unique and specifically designed levels featuring specific mechanics for testing, to

introduce variables or remove them in settings with an extremely high degree of experimental control. The ability to use the level editor to match the experiences between single player and cooperative levels, as much as possible, allows for the elimination of confounds (e.g., storyline, puzzle elements) making it ideal for experimental research.

Portal 2 can be played solo or cooperatively. For cooperative play, problems in each level are organised in a way that makes success contingent upon cooperation. For example, a door may need synchronous button activation from two switches at once to open. This type of inescapable cooperation means that when playing a two player mode cooperation is guaranteed to have occurred if any progress was made. Not all cooperative modes in games ensure that cooperation occurs – many popular shooting games (such as Call of Duty, Fortnite, Battlefield etc.) permit team play, but do not actively discourage freeloading. For Portal 2 however, cooperation is often necessary to progress through the cooperative mode (and always necessary if levels are custom designed as in the present study). It is for this reason that Portal 2 was chosen as the stimulus game for this study. The game also has high ecological validity as something that people would, and do play, for fun (Foroughi et al., 2016).

Social Value Orientations

Social value orientations are reliable preferences regarding outcome and power distributions between oneself and others (van Lange & Kuhlman, 1994). These preferences and patterns have been identified as important individual factors to consider when dealing with how participants act and react around social and prosocial behaviour (van Lange, Joireman, Parks, & van Dijk, 2012; Murphy & Ackermann, 2013). How these orientations affect decisions differ according to their conceptualisation but consistent effects have been found. Kahan et al. (2012) found that more individualistic people rated climate change to be significantly less concerning than egalitarian-communitarians. Using public transport as a focus, researchers looked at the inconvenience of taking buses versus personal transport and unsurprisingly discovered that prosocials - i.e., community

oriented/co-operators - were happier to take public transport due to the reduced impact on the environment than proselves/individualists (Van Vugt, Meerterns, & van Lange, 1995). Looking at economic behaviours Hilbig and Zettler (2009) used the dictator and ultimatum games and found that participants scoring highly as prosocials on the Honesty-Humility category allocated fairer amounts of resources in both games, whereas those who scored as proselves were more selfish in the dictator game but increased to an equal split for the ultimatum game.

Pratto, Sidanius, Stallworth, and Malle (1994) investigated dominance orientation – that is, the belief that it was legitimate for people with power to dominate over their lesser. Using a dominance hierarchy, the researchers found that strong social dominance orientation results showed high levels of sexism, racism, and nationalism and this could be correlated with potential resistance to group rights, environmentalism, and law and order policies promoting LGBT issues. The hierarchy itself consisted of what Pratto, Sidanius, Stallworth, and Malle (1994) called 'legitimizing myths'. These myths were ideologies that either supported or rejected social inequality concepts, including concepts of gender, nationalism, elitism, meritocracy, and civil rights.

As outlined also in the give-some section, social value orientations have been identified as important when measuring and understanding data around social behaviour. As such the present study included the 16 item Social Dominance Orientation (SDO) scale by Pratto, Sidanius, Stallworth, and Malle (1994) to determine whether SDO mediated or moderated the effect of cooperation in video games on post-game cooperation. See Figure 4.

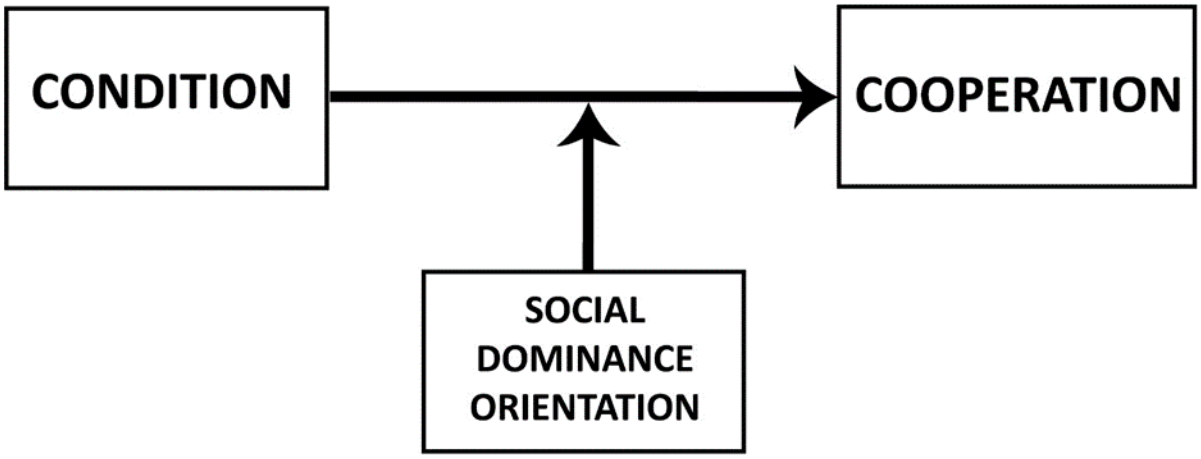

Figure 4. Outlining the potential moderation effect of social dominance orientation on cooperation.

As SDO results have been found to be negatively correlated with empathy, communality, and altruism whilst positively correlated with economic conservatism, individualism, nationalism and elitism (Pratto, Sidanius, Stallworth, & Malle, 1994); the implications of social dominance regarding social roles, the allocation of funding, and institutional discrimination are well established. In regards to the GLM and the importance it places on person specific variables for learning, not much is actually known about what these variables are and how they might function. It is possible that high SDO people, who are typically less cooperative generally, may find that cooperative gameplay behaviours (specific to progress in the game) do not encourage or facilitate cooperation post game due to a participant's strong pre-existing individualism. The SDO thus would be able to provide some information on moderation or mediation effects.

Research Questions and Hypotheses

This study aimed to test the effects of cooperative video games on post-game cooperation with a novel partner. Specifically, can exposure to video games that make instrumental progress contingent on social co-operation increase post-game co-operation levels? Moreover, the study explored whether a personality variable - social dominance orientation - might moderate or mediate the relationship between exposure to cooperative gameplay and post-game cooperation.

The give-some dilemma has also been used in studying the effect of video games. Based upon previous research (Greitemeyer, Traut-Mattausch, & Osswalt , 2012; Jin & Li, 2017), it was predicted that cooperation, as measured by the number of coins offered by the participant to another (ostensibly real) participant, on the 'ten-coin give some dilemma game' would be higher after playing Portal 2 cooperatively than after playing Portal 2 individually. Specifically, participants would offer more coins on average in the ten-coin give some dilemma game after playing Portal 2 cooperatively than when playing Portal 2 individually. It was also predicted that participants would have higher average everyday cooperation scale scores (De Hooge, Zeelenberg, & Breugelmans, 2007) after playing Portal 2 cooperatively than after playing Portal 2 individually.

A secondary prediction of the study was that SDO would moderate the effect of in-game cooperation on post-game cooperation. Specifically, it was predicted that high SDO participants would show similar levels of cooperation in the give-some dilemma and everyday cooperation scale irrespective of whether they played the single player or cooperative game. In contrast, participants with low-SDO scores would show greater cooperation as measured by the give-some dilemma and everyday cooperation scale after playing a cooperative game than when they played a single player game.

The study, it's hypotheses and methods, was pre-registered with AsPredicted (see Appendix A) and is available at http://aspredicted.org/blind.php?x=cj5x6a

Method

Participants

Sixty participants were recruited for the present study. Simmons, Nelson, and Simonsohn (2011) recommended a minimum of 20 participants per cell (or condition) for experimental research as samples smaller than this may not be powerful enough to detect most effects. Balancing the time-commitments of experimental data collection, 60 participants were used for the present study across two conditions, slightly more than the recommended minimum. Doing a power calculation for the 30 participant per condition limit of this study showed that an effect size of 0.74 could be reliably detected. Previous research using video games looking at video game effects incorporating both Portal 2 and the give-some dilemma found an average effect size of d = 1.44 (Jin & Li, 2015) implying that the present study should have enough power to detect a similarly sized cooperation effect.

Participants were recruited predominantly from Massey University and through social media postings on Facebook. Physical posters were placed on campus and throughout Auckland communities. The posters outlined a study looking at the effects of video games – no additional information about the specifics of the activities were provided on these sheets (see Appendix B). A $10 voucher was offered to participants as a thank you for participation and a contact email for the study was provided through which contact could be made.

When participants emailed their interest they were provided a screening questionnaire which could be filled out digitally and sent back (See Appendix C) – this was to ensure participants were of the approved age to participate (aged 18 or over) and would not suffer any discomfort or undue risk by playing a video game (screened for conditions such as epilepsy). The sample consisted of 40 males and 20 females with a mean age of 30 years. This experiment was approved by the Massey University Human Ethics Committee (NOR 18/05 - Video Games and Cooperation) – See Appendix D.

Materials and Measures

Portal 2 (cooperation manipulation).

Portal 2 was selected for use in this study. The game was presented to participants on the PC platform with a wireless Playstation 4 controller to navigate. A set of 15 levels were created via the Portal 2 level editor for the cooperation mode. These levels were adapted from a 15 level single player battery from a previous study investigating fluid intelligence (Foroughi, Serraino, Parasuraman, & Boehm-Davis, 2016).

Levels for the cooperation condition were constructed to be aesthetically identical with alteration only to ensure that puzzle elements became contingent upon cooperation. For instance, in the single player chambers a solitary button press may have been required, whereas in co-operative play, two buttons were required to be pressed simultaneously by each player. Similarly where an important item might have been accessible to the single player by retrieving it from a difficult location - the cooperative scenario may make its retrieval by one person impossible and require a player to hand said item to the other player in order to complete the task. Several different techniques were utilised but all focused on ensuring that level completion was co-operation contingent.

Levels in each condition became progressively harder as new elements were introduced and puzzles became more complex. This allowed players to learn the game elements gradually, ensuring that the game was accessible to veterans and amateurs alike. Levels introduced no time limits, there were no enemies in the game, and anytime a player died (through falling or walking into a laser) they were instantly respawned and they could continue from the entrance of the chamber without penalty in both conditions. The single player test battery can be found here: https://steamcommunity.com/id/chameleonism/myworkshopfiles/?appid=620&p=1&numperpage=30 and the cooperative player test battery can be found here: https://steamcommunity.com/sharedfiles/filedetails/?id=1362816001 , both are public and free to use. Depending on the condition, participants would either play single player alone in a small room

or with the experimenter in the same room via a split screen option. See Figure 5 for a breakdown of the element and action differences in the first 5 levels.

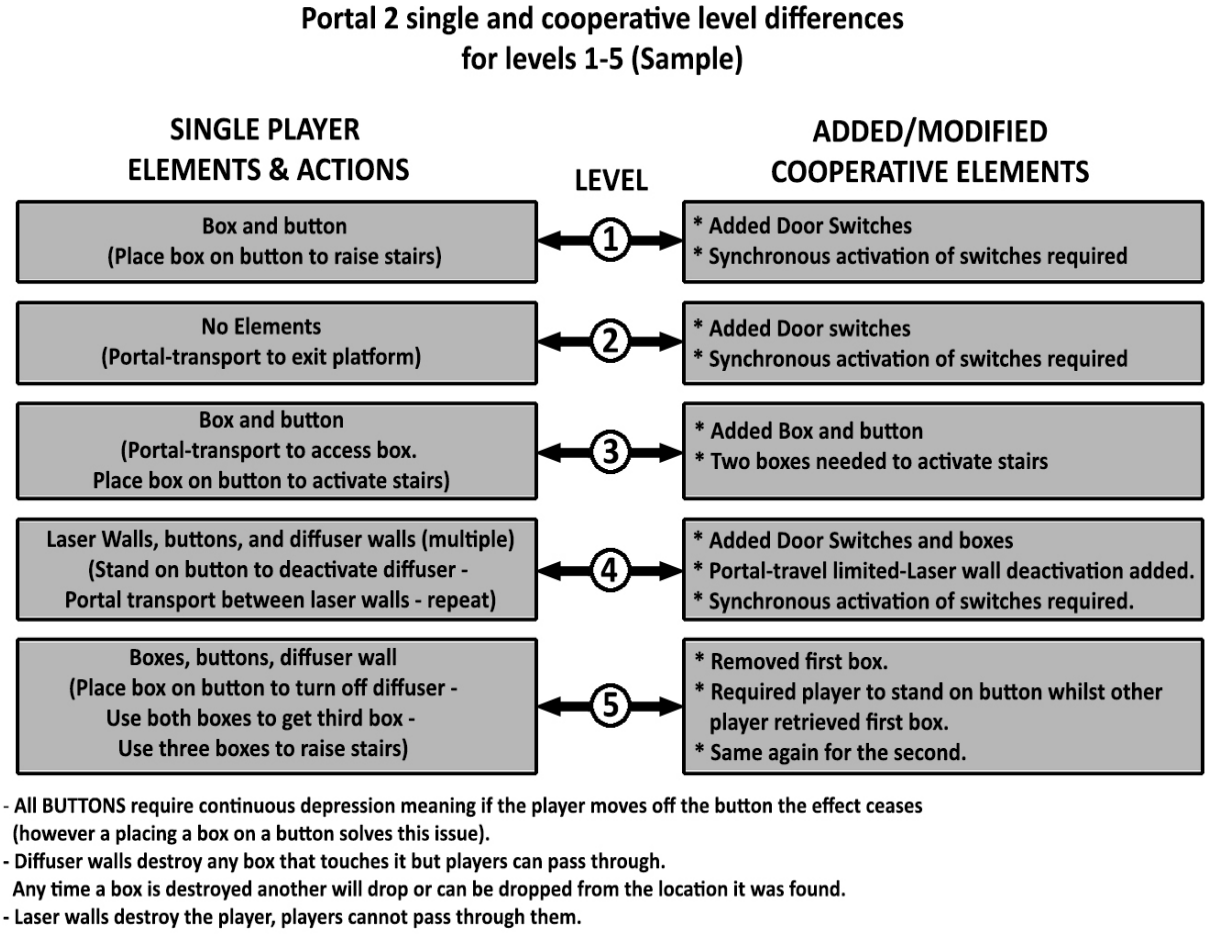

Figure 5. Portal 2 level elements and action breakdown for both single and cooperative levels showing the differences between conditions (sample of levels 1-5).

Dependent Measures.

Give-some dilemma.

The primary measure of behavioural cooperation used was the give-some dilemma developed by van Lange and Kuhlman (1994). Previous research using Portal 2 has been teamed prior with the give-some dilemma to measure cooperation (Jin & Yi, 2017). By adopting the same task it allowed for direct comparison.

This give-some coin dilemma was specifically developed for this study as a web browser game and was accessed by participants via web browser in the lab. The game involves the player playing against an ostensibly real opponent in a different physical location whom is actually a set of preprogramed routines. Participants were told that the amount of reimbursement they would receive at the end of the study would be dependent upon how much money they won during the give some coin dilemma. This deception allowed for tight experimental control, and to examine cooperation for participants who believed it would have real-world financial consequences.

Via web browser a brief message screen preceded the dilemma instructions, this asked for the participant to send a message to the other player with the understanding that the 2nd player would be doing the same. The participant was also told that each player would only see the others message after both had been sent (See Figures 6 & 7). This communication was added to enhance the participant's belief they were playing with a real opponent.

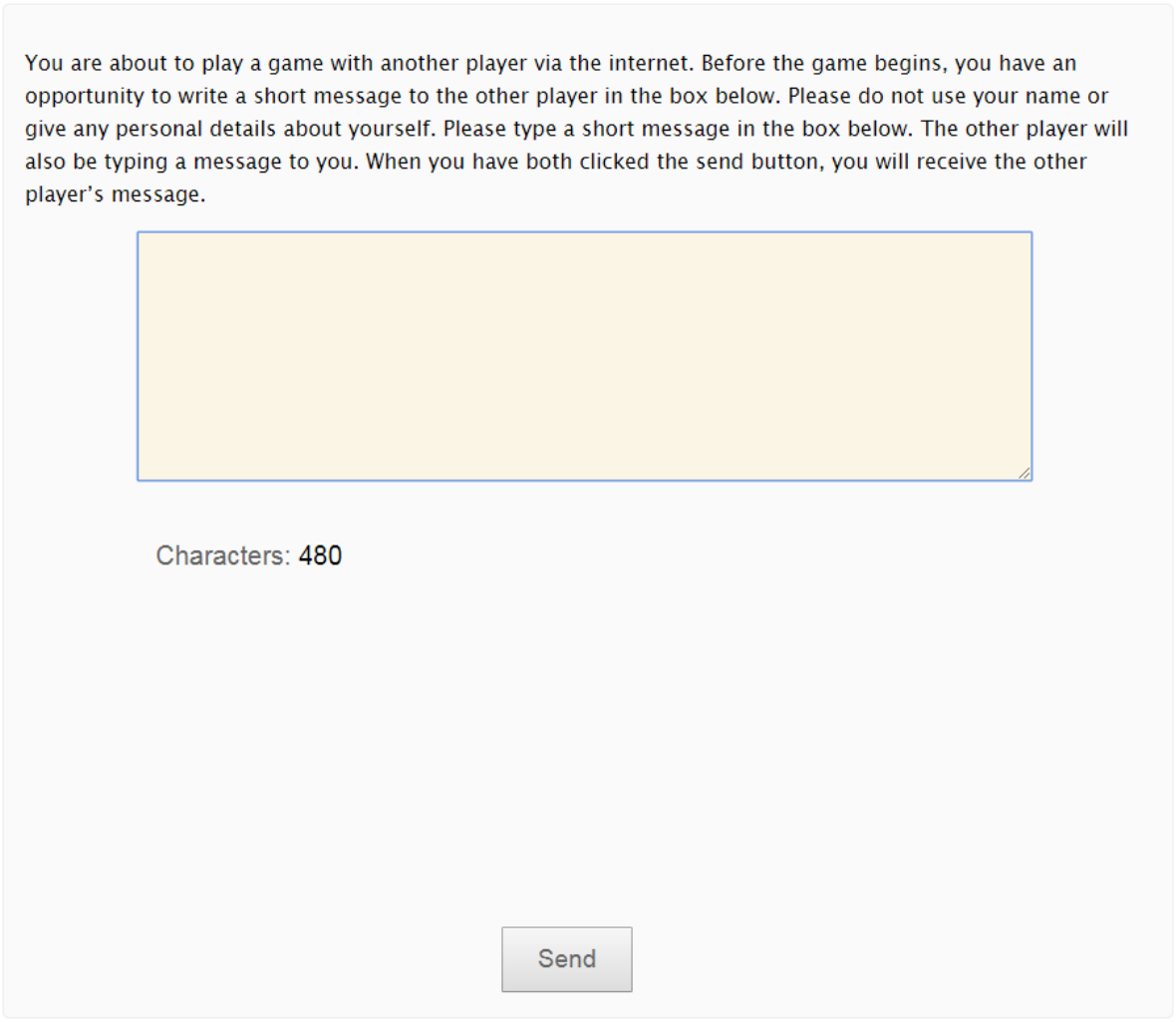

Figure 6. A screen from the give-some dilemma showing the message instructions given to participants before beginning the give some dilemma.

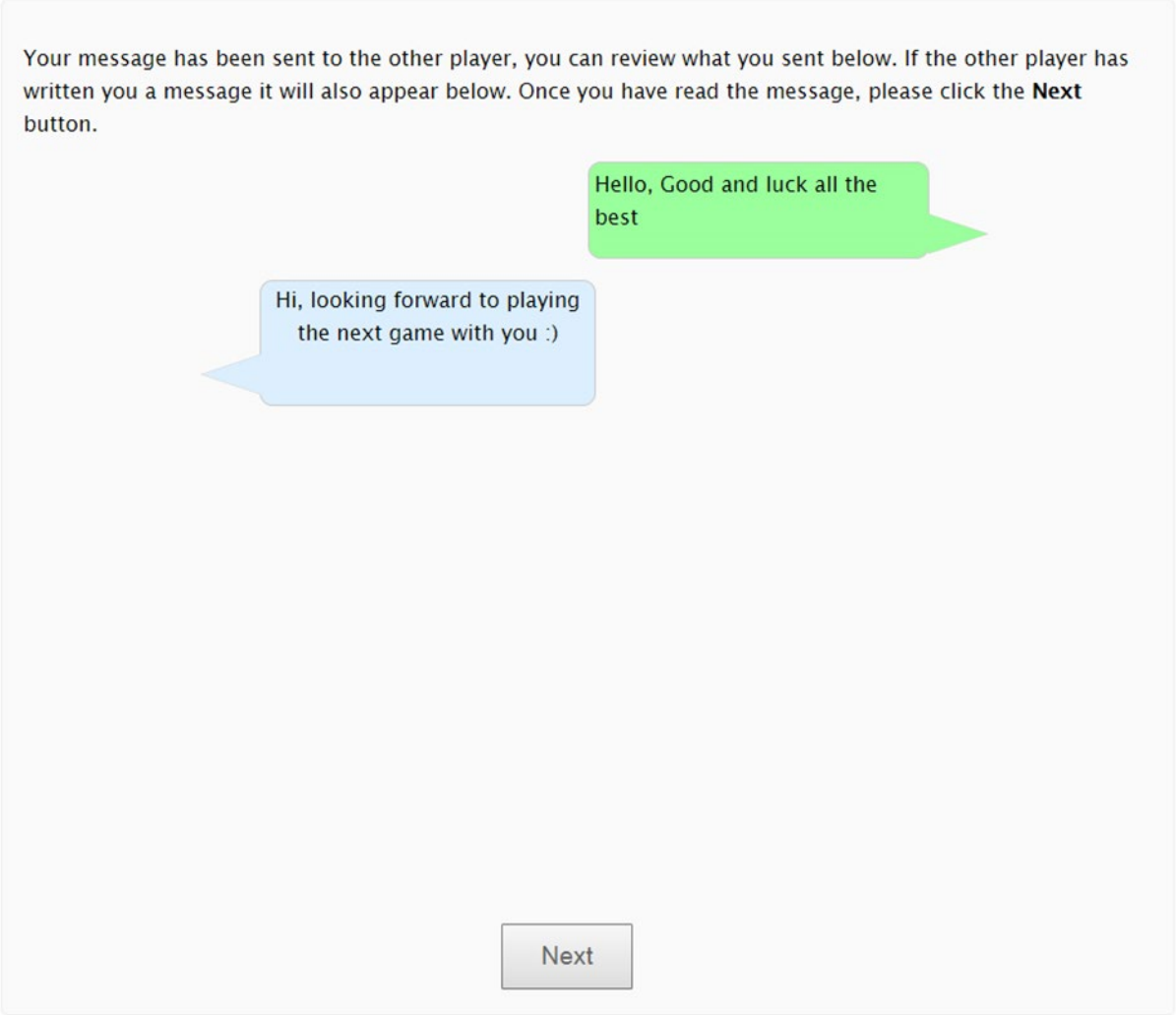

Figure 7. A screen from the give-some dilemma showing both participant messages. The message in green (on the right) was preprogramed.

Each participant was then given 10 digital coins. Participants were told that each coin was worth 25c to themselves or 50c to the other player. Players could click on a coin to send that coin to the top of the screen in the other players 'half' or hold on to the coin in their own (See Figure 8). If players decided to return one of the coins they had given they could click on it to do so. When participants had made their final decision they clicked the 'finished' button.

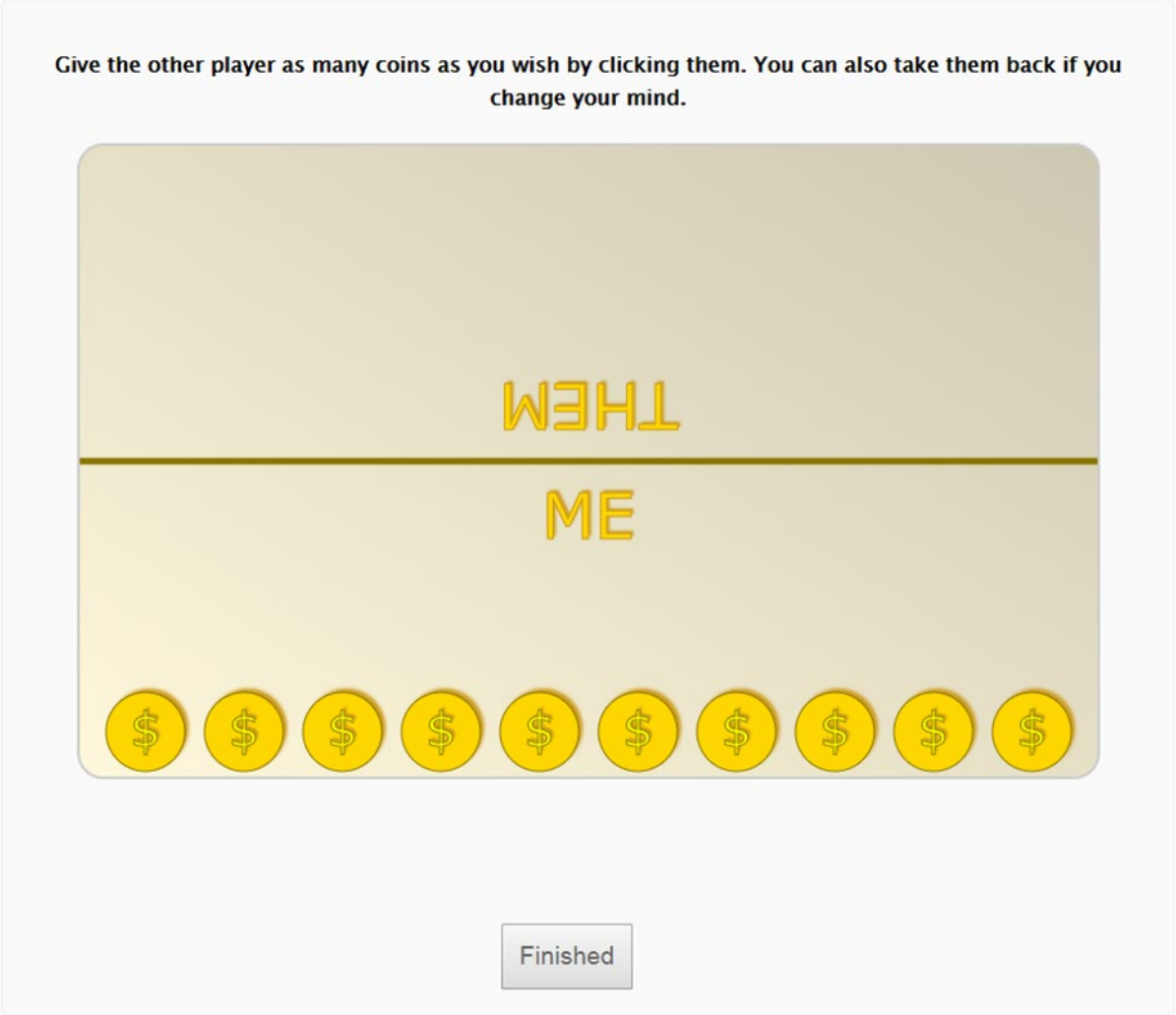

Figure 8. The give-some dilemma programme showing the 10-coins on the participants half of the screen.

Participants were told that they would not know what the other player had chosen and vice versa until both had also pressed the finished button. This allowed for anonymity during the decision making process; that is, participants were not prompted into decisions by seeing what the other player was about to offer.

At this point players could a) keep all their coins which maximised their own profit or b) give all their coins away maximising both players profit assuming the other player also gave all their coins away or c) some coins could be retained/given for a mixed result. The greater the number of coins given away by the participant the more they were considered to have cooperated with their partner.

One round of this 2-player game was chosen for each participant as repeated 'rounds' of CPR games have been found to decrease the potential effects and make it more difficult to identify causality by introducing extraneous variables such as the results of previous rounds (Drouvells, Metcalfe, & Powdthavee, 2015).

Upon submission of their choice, a thankyou message appeared alongside the results of the game which stated how many coins the participant shared themselves teamed with what coins they received from the other player (this was always 10). The programme calculated the total monetary result and yield for the players gift voucher. Responses within the 'ten coin dilemma' game were all recorded digitally and automatically linked with participant numbers.

Everyday cooperation scale.

The second measure of cooperation was the validated self-report questionnaire the Everyday Cooperation Scale created by De Hooge et al. (2007). All 9 items on the scale were responded to using an 11-point Likert-type scale with the anchors "Not at all" to "Very much". Examples of items included: "At this moment I would like to help an unknown other" and "At this moment I would like to support a person who is emotionally distressed". For the full questionnaire, see Appendix E.

Social dominance scale.

Previous research has shown that participants' social dominance orientation can influence the amount of resources allocated in cooperation tasks, with individualist orientations resulting in less cooperative results (van Lange, Joireman, Parks, & Van Dijk, 2012; Leibo et al., 2017). As such the implementation of a social orientation measure – the 16 item SDO from Pratto, Sidanius, Stallworth, and Malle (1994) - was added to see if any mediation or moderation effects could be found in the main results. The aim of this addition was to investigate whether the cooperation manipulation may influence one type of person more than others. The SDO asks participants to

respond to statements around group dominance and equality. The questions were presented on a Likert scale of 1-7 ranging from “Very negative” to “Very positive”. Examples of items included: “We would have fewer problems if we treated people more equally”, and “Sometimes other groups must be kept in their place”. For the full questionnaire, see Appendix F.

Additional single-item measures.

Three single-item measure were also introduced. A frustration measure was added along with a game difficulty and a difficulty-to-control measure. All items were presented on a 7 point Likert-type scale. The items were: “How difficult did you find it to control the game?”, “How frustrated do you feel after this experience?”, and “How difficult did you find the game?”. The scales were set with poles of “Not at all” (1) and “Extremely Difficult” (7), “Not at all” (1) and “Extremely Frustrated” (7), and “Not at all” (1) and “Extremely Difficult” (7) respectively. For the items as presented with the scale see Appendix G.

Procedure

Upon arrival at the laboratory, participants were given an information sheet (Appendix H) and the opportunity to ask questions. The study was explained to participants, without reference to the give-some coin dilemma or participant deception. A consent sheet was then presented to participants. All participants signed the consent sheet, zero participants decided not to proceed.

Participants were assigned a participant number (P1-P60) so that their data was de-identified and then they filled out a basic questionnaire outlining their age, ethnicity, and how often they played video games of any type (See Appendix I).

Each participant was randomly allocated into one of two conditions; single player Portal 2 or cooperative player Portal 2 resulting in 30 participants in each group. Delegation to particular conditions was done randomly through a digital coin-toss (http://www.virtualcointoss.com/). This

was done until one condition had reached 30 participants. When this occurred all subsequent participants were automatically assigned to the other condition.

Participants were stepped through an orientation of Portal 2's core mechanics and game controls (see Appendix J). Participants then watched a short 2 minute video explaining these mechanics again (this video was edited for this study and featured game play, Valve Software Portal orientation videos, and additional text descriptions). For this video see: https://www.youtube.com/watch?v=SUBXBFlRLj8. Upon completion of the video, participants then began playing Portal 2 using the Playstation 4 wireless controller.

For participants in the single player condition, participants were loaded into the Portal 2 custom maps mode where they began playing from level 1 of the Portal Test Battery created by Fouroigi et al. (2016). As soon as the level started and all functions of the controller were confirmed with participants the experimenter left the room and closed the door. Participants were left for 20 minutes at which time the experimenter re-entered the room and stated that the Portal 2 session was over and then exited the game.

For participants in the cooperative player condition, participants were loaded into the Portal 2 custom maps editor mode where they began playing from level 1 of the Portal Test Cooperative Battery created for this study. The experimenter was the other player in this condition and played in the same room. The game displayed as a split screen with the participants view on the left and the experimenter on the right of the same screen.

For the cooperative condition a series of prompts were utilised by the experimenter to both aid the participant when facing difficulty and to also assist the cooperative process. As experimenters would no doubt be aware of the levels and the solutions to puzzles beforehand, it could be seen as non-cooperative by participants for the experimenters to leave solutions completely up to participants. Because of this, if participants were not able to identify the next step in solving the puzzle or had missed some information in the environment, the experimenter would after a 15 second delay, direct the participant to the needed components and/or discuss the next

step of the puzzle with verbal cues like: “Why don’t you go have a look over there and I will look over here”. After another 10 seconds the experimenter would ask again if there was anything of note to investigate. If there was no progress still the experimenter would direct the participant to the next step in the puzzle with the ‘direct attention’ action. This in game action outlines a game element in the player’s heads up display (point of view). In this way the act of exploration and problem solving was not circumvented and still allowed for co-operative problem solving and task completion (See Figure 9 for an example of this).

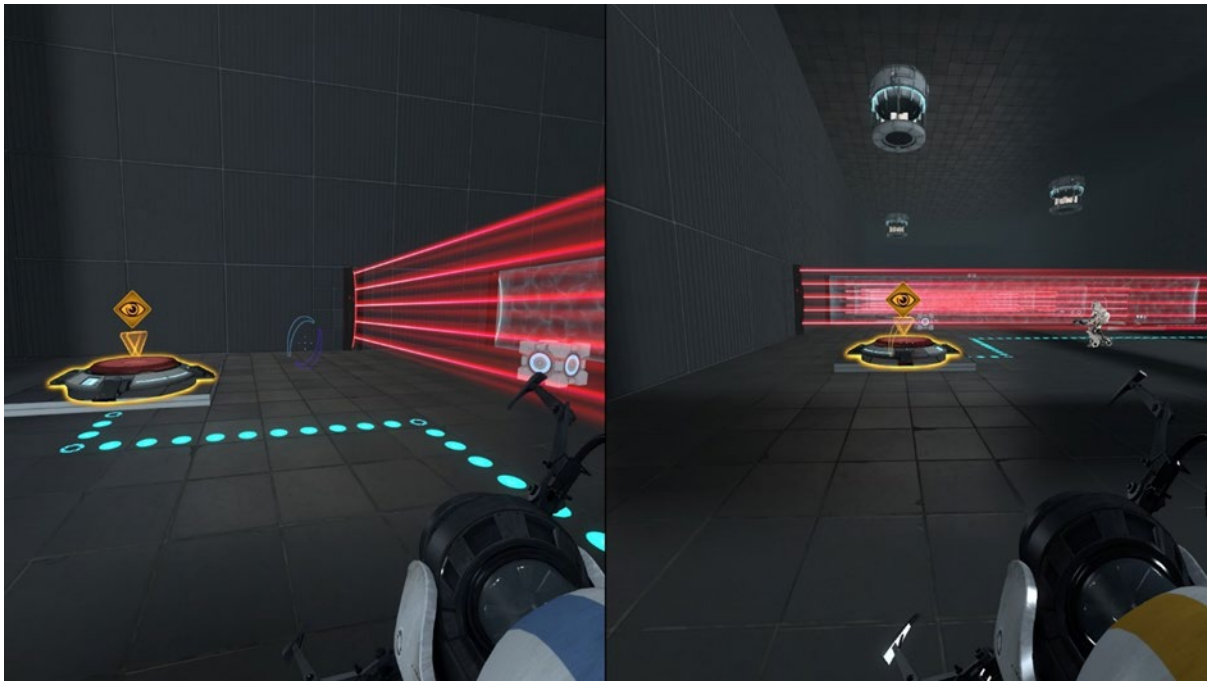

Figure 9. Shows the screen display for Portal 2 in the cooperative condition. This is a view of an activation button from two angles. The button that needs activation has been highlighted by one player to draw attention to it in game for the other player (signified by the orange highlighting and eye symbol).

Participants played alongside the experimenter for 20 minutes at which time the experimenter then stated the Portal 2 session was over and exited the game. Participants in both conditions then filled out the Everyday Cooperation Scale questionnaire, the three single item measures, and then the Social Dominance scale in that order. These were administered on paper via clipboard.

Debrief.

All participants were fully debriefed at the end of the experiment. Using a funnelled debrief approach participants were asked if they had any questions related to feedback about the experiment, the games and questionnaires. Then they were asked if they were aware of, or thought they were aware of, what the experiment was specifically looking at. They were then asked if they found anything suspicious during the session.

After this participants were made aware of the deceptions in the session. Specifically, participants were informed that in the coin dilemma there was no second player and the message they received at the start was pre-written. They were told that the second deception was that they would receive a final amount of money dependent on the results of the coin game but this was not the case; they would be given the full $10 gift voucher regardless of their performance in the give some dilemma game. Participants were given their vouchers, asked again if there were any questions and then were thanked again before leaving. See Figure 10 for a flowchart of the procedure.

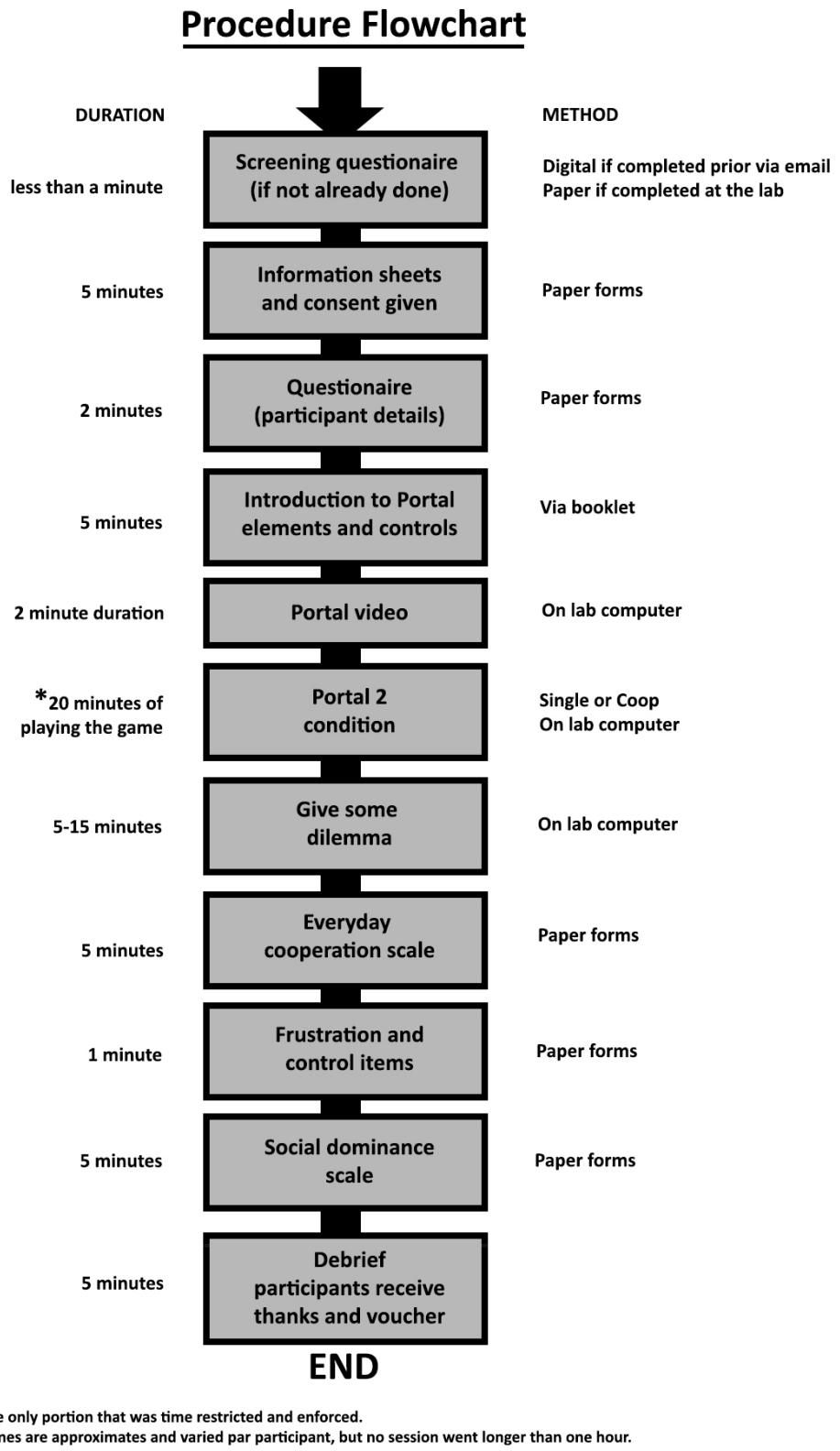

Figure 10. Flowchart of the experiment showing process order, time per section, and method of application. All times outlined are approximate apart from the Portal 2 condition which was timed and enforced.

Results

All participant responses were recorded and used. No participant declined to complete (or inappropriately responded to) any task or vital item and no participant guessed or suspected the aim of the study. Data was analysed using the statistical software; JASP, version 0.9.1. There were no outliers found on either of the dependent measures using the Mean +/- 3.29SDs method (Tabachnick, Fidel, & Ullman, 2007). Thus all analyses included the full 60 participants. For all analyses an alpha of .05 was used as the standard for determining statistical significance.

Confirmatory Analyses

Give-some task.

For the give-some dilemma the number of coins given by each participant was recorded by computer program. On average, participants gave approximately 5.75 coins (SD = 2.8) across both conditions. There was evidence that participants used the full scale of potential responses in the give-some coin game, with participants giving a minimum of 0 and maximum of 10 coins.

An independent t-test was conducted on give-some dilemma results by condition. The effect of condition on number of coins given was not significant, $t(58) = 1.44$, $p = .15$, Cohens $d = .37$. Participants who played the single player condition did not give significantly fewerer coins (M = 5.23, SD = 2.88) than participants who played in the cooperative condition (M = 6.27, SD = 2.66). See Figure 11 below.

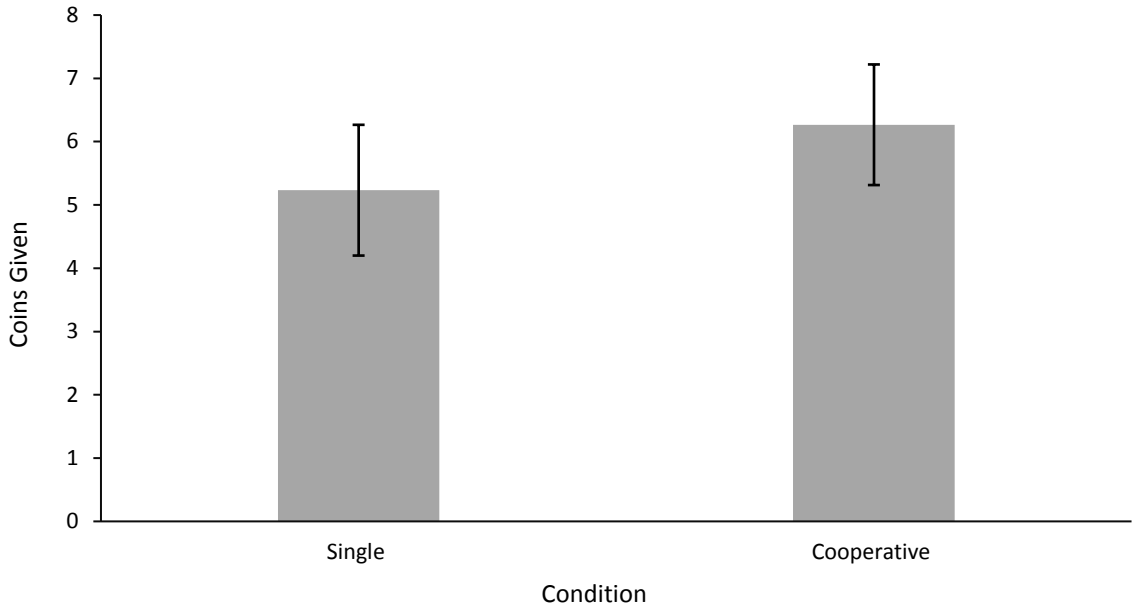

Figure 11. Mean totals by condition of coins given by participants. Error bars represent 95% Confidence Intervals.

Everyday cooperation scale.

Responses to the ECS items were totalled and were calculated based on item value within the scale. Responses were provided on paper and then digitally recorded after the sessions end. On average, participants score was 52.87 (SD = 19.88) across both conditions. There was evidence that participants used the full scale of potential responses in the ECS, with participants providing responses across each point on the scale.

Independent samples t-test's were conducted on the ECS results by condition. No significant effects were found, $t(58) = 0.33$, $p = .74$, $d = .09$. Participants who played the single player game had similar ECS scores (M = 53.79, SD = 20.29) to participants who played in the cooperative condition (M = 52, SD = 19.77). See Figure 12 below.

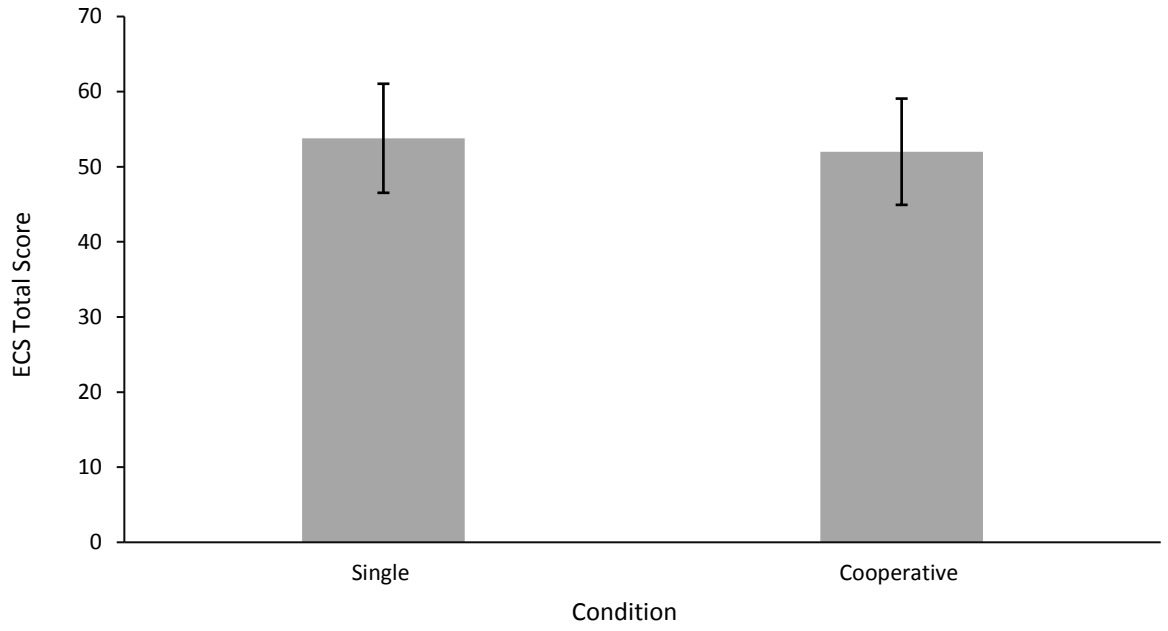

Figure 12. Mean totals by condition of ECS participant scores. Error bars represent 95% Confidence Intervals.

Social Dominance Orientation

Responses to the SDO were totalled by condition, responses were calculated based on item value within the scale (with reverse coding for questions 9-16). Responses were provided on paper and then entered after the sessions end. On average, participants score was 44.13 (SD = 15.33) across both conditions. There was evidence that participants used the full scale of potential responses, with participants providing responses across each point on the scale. Mediation and moderation investigations were conducted to measure for potential effects:

Mediation.

For the mediation investigation the cooperation condition itself, however unlikely, may have altered participants social dominance orientation which in turn may have resulted in increased cooperation. However as outlined above, condition didn't predict coins given or ECS results. Condition also did not predict SDO results, $t(58) = 0.43$, $p = .66$. Thus, SDO as a mediator -leading to

give some or ESC final scores- was not a plausible mediation pathway. As such no further investigation of mediator effects was undertaken.

Moderation on coins-given.

For the moderation investigation a linear regression analysis was used on potential moderating effects of the SDO on the give-some dilemma results. The analysis contained the predictor terms of condition, SDO, and the interaction term (between condition and SDO). Condition did not affect coins given, $B = 15.76$, $t(56) = 1.02$, $p = .31$. SDO did not affect coins given, $B = 0.11$, $t(56) = 1.28$, $p = .20$. No moderation effect was found from the SDO on the give-some coin results; $B = 0.05$, $t(56) = 1.10$, $p = .27$.

Moderation on ECS scores.

For the moderation investigation a linear regression analyses was used on potential moderating effects of the SDO on the ECS. Condition did not influence ECS scores, B = 1.31, t(56) = .58, p = .57. SDO also did not affect ECS Scores, B = 0.16, t(56) = .28, p = .78. There was also no moderation effect found from the SDO on the ECS; B = 0.38, t(56) = 1.15, p = .26.

Exploratory Analyses

Independent samples t-tests were also undertaken on each of the three single item questions; Q1 (difficulty controlling game), Q2 (frustration) & Q3 (difficulty of the game itself) via condition. Results showed that participants who played the single player game did not find the game more difficult to control (M = 3.1, SD = 1.37) than participants who played the cooperative game (M = 2.83, SD = 1.55), $t(58) = 0.70$, $p = .48$. Participants who played the single player game also did not report higher frustration levels (M = 1.87, SD = 0.97) than participants who played the cooperative game (M = 1.83, SD = 1.37), $t(58) = 0.11$, $p = .91$. Finally, participants who played the single player game did not find the find the game difficulty more challenging (M = 2.97, SD = 1.35) than

participants who played the cooperative game (M = 2.6, SD = 1.13), $t(58) = 1.14$, $p = .26$. Across all three items and conditions, no significant effects were found.

Discussion

This study investigated the effects of cooperative gaming on real world cooperation through the framework of the GLM. Participants played the video game Portal 2 in either single player or cooperative modes. In the cooperative condition participants played alongside the experimenter. Participants then completed a behavioural measure of cooperation in the form of the give-some dilemma -a digitised coin sharing programme- and a self-report measure of cooperation; the Everyday Cooperation Scale (ECS) self-report.

The core findings indicate that cooperative gaming short term does not elicit a marked increase in cooperative behaviours in the real world as measured by the give-some dilemma. The results showed a non-significant trend, however, this effect was small and failed to reach statistical significance. No evidence was found of a large cooperation effect as was found in previous research (Jin & Li, 2017). Moreover, participants ratings on the ECS were comparable across conditions. As such the hypothesis that cooperative game play would lead to a cooperation increase post game was not confirmed.

A secondary purpose of this study was to investigate whether the personality factor of SDO would mediate or moderate potential cooperation effects. This factor was measured via the self-report SDO scale after both the give-some and ECS were completed. Results showed no SDO moderation effect. SDO did not alter the relationship of in-game cooperation with post-game cooperation; high and low SDO individuals were not differentially affected by the cooperation manipulation. Additionally – there was no evidence for mediation.

Exploratory analyses were conducted of game difficulty, control, and potential frustration. Again, no significant differences between conditions were found. As cooperation did not influence participant's perception of difficulty, frustration, and ease of control, these factors can be dismissed as potential factors influencing the effect of in-game cooperation on post-game cooperation.

The lack of a cooperation effect in this study seem to be inconsistent with GLM predictions. The present study appears to meet all the necessary conditions for learning according to those

outlined in the short-term model of the GLM (Gentile, Groves & Gentile, 2014). For instance, levels of cooperation across conditions in the present study matched in content as much as possible; cooperative levels were designed to feature cooperation contingent solutions but the levels themselves remained as similar as possible to the solo battery of 15 levels taken from the study by Foroughi et al. (2016). Additionally, while levels matched across conditions, the removal of narrative and of enemies to encounter reduced or eliminated many variables that could influence responses. An additional dependent measure of cooperation was added (the ECS) in comparison to the Jin and Li (2017) study looking at cooperation and Portal 2. These tighter experimental controls therefore produced a more reliable manipulation. As such, the results of the present study imply that video games, short term, do not produce substantial cooperation effects.

The core results of this study offer serious challenges to a number of studies, most notably Jin and Li (2017) who found large differences in post-game cooperation after Portal 2 cooperative play in comparison to when participants played single player. Similarly, Greitmeyer (2013) in tests of empathetic concern found that after playing Portal 2 cooperatively, participants were more likely to be empathetic to generalised others. Moreover, many studies using games other than Portal 2 have also found that cooperative video games increase cooperation and/or prosociality (Adachi, Hodson, Willoughby, & Zanette, 2014; Ewoldsen et al., 2012; Harrington & O'Connell, 2016; Greitemeyer, Osswald, & Brauer, 2010). That we were unable to replicate such a pro-sociality effect suggests that these effects are not as large and/or robust as previously suggested.

This study joins a growing number of studies which suggest that prosocial video game content does not increase prosociality (Chambers & Ascione, 2012; Sarmet & Pilati, 2017; Tear & Neilsen, 2014). This study also joins the wider growing number of studies that suggest video game effects (both negative and positive) are not as large or robust as previously suggested (Ferguson, 2015; 2007; Tear & Neilsen, 2013; Unsworth, Devilly, & Ward, 2007; Valadez & Ferguson, 2012). This presents a potential challenge to the predominant attitudes within the field. Where detailed theories exist (including the GLM) that outline and explain the mechanics of learning, if those

theories are not predictive - regardless of how popular they may be - such results call for their potential reassessment (Sarmet & Pilati, 2016).

One reason for the lack of effect may have been the presence of the experimenter as the second player in the cooperative conditions. While the GLM does not suggest that cooperating with an experimenter would affect responses, the presence of an experimenter has been shown in research to distract participants from the tasks that they are performing (Belletier & Camos, 2018; Wuhr & Heustegge, 2010). Thus, it is possible that having the experimenter in the same room during the cooperation manipulation may have resulted in a distraction that interfered with the potential effects of cooperation. Additionally, reactivity and participants' changing of behaviours to match perceived expectations is also an identified phenomenon; in relation to dependent measures it has been found that being watched will increase participant contributions in public good dilemmas (Burnham & Hare, 2007) while demand characteristics can form from observing experimenters (Nicols & Maner, 2008). As such, it is possible that participant reactivity or distraction (or both) contributed to the cooperative conditions (and accordingly the results) of the present study.

Whilst games are often criticised for their negative effects (Anderson et al., 2010; Ferguson, 2015; Wilkinson, Ang, & Goh, 2008) they are also often praised for their positive effects and promoted as unique tools for positive change (Gentile, Groves, & Gentile, 2014; Granic, Lobel, & Engles, 2014; Buckley & Anderson, 2006). With these claims in mind this study was conducted with the consideration of the potential positive use of video games in areas of education, training, rehabilitation, and therapy. As such the non-significant results found here suggest caution should be exercised when considering video games as tools for positive change in these areas.

The results of this study add to the increasing number of findings presenting the negligible effects of video games (Ferguson, 2015a; Hilgard, Engelhardt, Rouder, Segert, & Bartholow, 2019; Kühn, et al., 2018; Nakamuro, Inui, Senoh, & Hiromatsu, 2015). However, while more and more studies with non-significant results are being published, the existing issue of publication bias known as the 'file drawer problem' (Rosenthal, 1979) remains prevalent (Powers, Brooks, Aldrich, Palladino,

& Alfieri, 2013). The file drawer problem identifies that studies with significant results are often rewarded with attention and publication in journals over null/non-significant result studies (that are left in the metaphorical filing draw). This then provides incentives for researchers to reach significance and also produces a skewing of available research, giving the impression of consensus in the field (Ferguson, 2007). The failure of the present study to find an effect as large as previous research in this area casts doubts on the size of any effect of in-game cooperation on post-game behaviours.

Regarding the secondary hypothesis, the results of this study showed that in-game cooperation does not differentially effect high and low SDO people. In relation to the GLM, SDO seems not be a personality factor of influence when considering the effects of in-game cooperation. Practically, this means that SDO does not change how people are affected by in-game cooperation. This implies that cooperation in video games cannot be utilised to any substantial effect to increase cooperation amongst people with high social dominance, who typically cooperate at a lower level than people who are less socially dominant. The mediation hypothesis was also rejected as the Portal 2 condition did not influence either SDO ratings or cooperation. These finding suggest that in-game cooperation does not alter a person's SDO and is not a plausible mechanism by which cooperation might be influenced.

Limitations

Whilst no large effects were found for either dependent measure in this study, there was a small non-significant trend found in the results of the give-some dilemma whereby those in the cooperative condition gave slightly more coins in the give some dilemma than those in the single player condition. Based on previous research it was expected that a moderate to large effect would be detected. The sample size of this study provided adequate power for the detection of a moderate to large effect. However, a much smaller non-significant trend was actually detected. Thus it is possible that an effect exists but it is smaller than previously thought. As such the present study is

potentially underpowered to detect an effect if the true effect size is smaller than suggested by previous research (Maxwell, 2004). Accordingly, replication with a larger sample size is required to determine if a true, small, cooperation effect size exists.

Another limitation of this study was that the sample predominantly consisted of University students. As such, there may have been context specific factors shared across the participants that shaped responses and thus, the data may not be generalizable to the broader population (Hanel & Vione, 2016). Regarding student populations in psychology studies; giving and taking percentages in common good experiments and ultimatum/dictator games have been reported to be significantly affected by personal characteristics such as gender, nationality, political affiliation, and what subject a student may be studying (Bloom, 2013; Drouvells, Metcalfe, & Powdthavee, 2015). For instance economic students have been reported to expect rational co-players in dilemmas, thus acting in specific and predicable ways, despite the fact that not all humans act rationally in such tasks (Bloom, 2013). Additionally, in the United States it has been found that more university students identify as liberal over conservative (Stolzenberg et al., 2019), with this difference being exaggerated for female students (Egan et al., 2017). As such, samples consisting predominantly from students should take such information into consideration, especially as research has found that political orientation can be a predictor of associated behaviour (van Lange, Bekkers, Chirumbolo, & Leone, 2011). Accordingly, future studies continuing cooperation investigations – particularly when using single round dependent measures - should attempt to expand and increase sample diversity, ensuring that a wider sampling of the general public occurs so as not to rely predominantly on university-student responses.

Additionally, this use of split-screen gaming, chosen in part due to resource limits, may produce a different effect than online cooperative play. As prior studies have shown, physical proximity to another person can affect ones behaviour and performance on tasks both in positive and negative ways (Markus, 1978; Pessin, 1933; Platania & Moran, 2001). Whilst the physical presence of others has been highlighted as a contributor to performance it has also been suggested

that the physical presence of another is not enough; it has been proposed that for presence effects to occur participants must feel evaluated, thereby creating an audience effect (Alevy, Jefferies, & Yu, 2014; Cottrell, Sekerak, Wack, & Rittle, 1968). An audience effect may have occurred in in the cooperative conditions of this study as participants were aware that their game partner, playing in the same room with them, was the researcher. As such, changes to future research in this area could look at online cooperation, this would be both more ecologically valid (as more gamers play cooperatively online) and also would remove potential audience effects due to there being no need for the researcher to be in close physical proximity during cooperation condition play.

Another potential limitation of the present study was the use of Portal 2. Whilst matching all the key requirements of the study both according to the experiment itself and fitting GLM short term model requirements; it is possible that it may not be generalizable to other games. Whilst existing studies have used both Portal 2 and Portal 2 alongside other games finding positive prosocial effects it is possible that confounding variables within the game design affect results and that other games may produce stronger cooperation effects. For instance in the present study, the avatars for players in the Portal 2 conditions were not human; this may have led to lack of identification. This could be important as identification has been found prior to be a predictor of imitation and learning (Bachen, Hernandez-Ramos, Raphael, & Waldron, 2016; Cohen, 2001; Ryan, Rigby, & Przybylski, 2006). Also, environments are similar level to level in Portal 2 which may not allow for the potential generalisation of scripts, as generalisation - as argued by Gentile, Groves, and Gentile (2014) - is facilitated by the same solutions being useful in widely differing digital environments. As such cooperation investigations with other games using the give-some as a dependent measure is recommended.

Future Research Considerations

Due to the varied nature of video game types (and that this present study only looked at one – a neutral puzzle game) one future avenue for research is to test differing game types in replication

studies to examine potential differences in outcomes. The content of a game and its central conceit provides players with particular goals and behavioural requirements. For instance, NBA Jam, a basketball game, is a competitive sports simulation where players can play singly against the computer, against other players, or cooperatively with other players against either the computer or other people. For sports and especially team based sports, which in the real world provide personal and social benefits to their players (Wankel & Berger, 1990), one would expect sports video games to show higher potential cooperation effects than single player violent games. To elaborate; if people learn behaviours from a combination of performing them and of being rewarded for doing so then by playing a team sport it would be reasonable to assume that teamwork would be learnt and prosociality would increase. Accordingly if one performs violent and aggressive acts and is rewarded for this then one would reasonably expect antisociality to increase. As such, measuring cooperation effects across different game styles is recommended. Furthermore, if results do not correspond to the assumptions as above, then this may further challenge the GLM.

Additionally, a criticism of GLM/GAM theories is that no distinctions between clearly fantastic actions and more realistic actions are made (Ferguson & Dyck, 2012; Markey & Ferguson, 2017). However, research has found that higher levels of post-game aggression is linked to the level of realism presented to players in game (Krcmar & Farrar, 2009). In relation to cooperation it is possible that higher levels of post-game cooperation could be generated through in-game behaviours that more closely resemble real-world cooperation. As Portal 2 is a science fiction game, the content (of robots and portals) is not realistic. Accordingly, for future cooperation studies it is suggested that a focus on realistic video games (context of situation and location) and cooperative behaviours with ecological validity (both in action and result) are made.

An additional avenue for future research is virtual reality, which is an area of increasing interest for researchers. Virtual reality, while an incredible step forward in technology may increase plausible pathways for the replication of in-game behaviours in the real world. Accordingly, virtual reality results in the physical merging of digital and real world physical actions (if one plays tennis in

game one is also psychically performing the actions in one's living room). This direct input of physical behaviour as game action is not presently considered in the GLM, and would make behavioural investigations particularly interesting. For instance if a VR experience was designed asking players to cooperate on tasks together by building a castle out of blocks (one person must hold blocks in place while the other cements them together for instance), this would allow participants to not only perform cooperative behaviours in a digital world they would also be performing those same behaviours physically. This would provide researchers with an opportunity to run two conditions, that of a VR experience and one on a computer with traditional controller. Such an experiment may provide information on whether traditional game play rehearsal of a behaviour (by pressing buttons) has any differing effects on post-game cooperation than VR rehearsal (physically mimicking an action).

Lastly, further testing of the GLM within the traditional scope of media exposure seems appropriate. The present study found that levels of in-game cooperation on post-game cooperation were much smaller than predicted (possibly nil). As such, going forward, testing the GLM's long term model using similar methods to the present study but with a series of Portal 2 game sessions over time may find an effect of cooperation that this study did not short-term. As such it is important that further claims, from the GLM, of long term learning and exposure effects are also tested.

Conclusion

Due to the prevalence of video games in society and their growing integration in people's lives it is becoming more and more important to know about the psychological effects of engaging with video games. Whilst the predominance of video game studies have focused on aggression and violence (often finding divergent results) it is important to also examine whether this ubiquitous technology could be used for potential positive effects. The use of video game technologies already exist in hospitals, schoolrooms, and therapist centers assisting with rehabilitation, education, and exposure therapy (Colder Carras, et al., 2017; 2012, October, John Hopkins Medicine; Pittman,

2013). Extending research into the social arena is a natural next step, thus the question of whether video games could be used to promote specific prosocial behaviours – namely cooperation – was tested.

The study found no significant effect of in-game cooperation on post-game cooperation. These results suggest either that a) the effect of in-game cooperation on post-game cooperation was much smaller than suggested by previous research, b) the effect does not exist, or c) the effect exists but is influenced by yet-unknown factors (such as the person participants are cooperating with in-game). Accordingly, further large-scale replications should be conducted in order to examine the reliability and true effect size of any in-game cooperation effect on post-game cooperation.

Social Dominance Orientation was not found to be an important personality factor contributing to the effect of in-game cooperation on post-game cooperative behaviour. That is, participants scoring high or low on the SDO showed no differential effects on the strength of a cooperation effect post-game. This highlights that SDO is not a factor or person variable of consideration in relation to the GLM. Additionally, no effect from game difficulty, control difficulty, or frustration affected cooperation results. As such these factors were discounted as possible variables in these results.

Further research recommendations from this study proposed 1) the involving of differing game types (eg: Sports games, action games), 2) focusing on whether realism in-game results in heightened post game responses, 3) the incorporation of VR and how the physical replication of behaviours in-game affects learning, and also 4) extending replication research of potential cooperation effects to long term exposures in order to investigate GLM long term model claims.

Video games are often perceived publically as having a strong influence on both prosocial and antisocial behaviours (Duggan, December 2015; Hall, Day, & Hall, 2007; Markey & Ferguson, 2017). However, this study found no significant effects and only a small non-significant trend toward increased cooperation following cooperative gameplay. In order to ensure that statements, legislation, and the public perception of video game effects are in line with actual scientific findings,

replication studies and challenges to dominant theories in the field should be conducted. As such, all established theories and positions should be treated as fair game and all results given fair play. Video games are played by two-thirds of the western world and this fraction will inevitably increase as game technologies are introduced to children at younger and younger ages while also being integrated into the daily routines of adults. Accurately understanding the effects that video games have is important both to ensure that they aren't unduly regulated or inappropriately used as a panacea for training positive prosocial behaviours.

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Appendix A

Pre-registration with AsPredicted

CONFIDENTIAL - FOR PEER-REVIEW ONLY

AsPredicted
Pre-Registration made easy

Gaming & Working Together: Can video games increase real world cooperation? (#9649)

Created: 04/05/2018 04:45 PM (PT)
Shared: 04/29/2018 05:25 PM (PT)

This pre-registration is not yet public. This anonymized copy (without author names) was created by the author(s) to use during peer-review. A non-anonymized version (containing author names) will become publicly available only if an author makes it public. Until that happens the contents of this pre-registration are confidential.

1) Have any data been collected for this study already?
No, no data have been collected for this study yet.

2) What's the main question being asked or hypothesis being tested in this study?
Question: Can exposure to video games that make instrumental progress contingent on social co-operation increase post-game co-operation levels? Hypothesis: It is predicted that cooperation, as measured by the number of coins offered by the participant to another (ostensibly real) participant on the 'ten-coin give some dilemma game' (De Hooge, Zeelenberg & Breugelmans, 2007) will be higher after playing Portal 2 cooperatively than after playing Portal 2 individually.
It is predicted that cooperation, as measured by the everyday cooperation scale (De Hooge, Zeelenberg & Breugelmans, 2007) will be higher after playing Portal 2 cooperatively than after playing Portal 2 individually.

3) Describe the key dependent variable(s) specifying how they will be measured.
Dependent: Co-operation as measured by the number of coins offered by participants in the 'ten-coin give-some dilemma game' - recorded via computer programme. Dependent: Co-operation levels, measured by the results of the 'Everyday Cooperation Scale'.

4) How many and which conditions will participants be assigned to?
There will be two, 30 participant conditions. One where participants play the game Portal2 on their own (control) and the other where participants will play Portal2 with another person (cooperative).
Participants will be assigned at random until one condition meets its 30 participant quota, then all proceeding participants will be assigned to the other until quotas for both conditions are met.

5) Specify exactly which analyses you will conduct to examine the main question/hypothesis.
We will conduct an independent samples t-test on the number of coins players offer in the 'ten-coin give-some dilemma game'. Bayesian analyses will likely be used for publication given the relatively small sample size.
We will also conduct an independent samples t-test on the results from the 'Everyday Cooperation Scale'. Bayesian analyses will likely be used for publication given the relatively small sample size.
At the beginning of the experiment a demographic questionnaire will also be conducted identifying age, sex, and average game time (never-most days).
Will conduct secondary analyses using the Social Dominance Orientation Scale by Pratto, Sidanius, Stallworth &
Malle (1994; adjusted for NZ participants) to determine whether this mediates or moderates the effect of cooperation in the coin game.
Three additional one-item self-report measures will be conducted directly after the Portal2 condition: (1) A measure of frustration; (2) A measure of ease of control; (3) A measure looking at perceived game/puzzle difficulty (Portal 2).

6) Describe exactly how outliers will be defined and handled, and your precise rule(s) for excluding observations.
Data will be screened for outliers before analyses (outliers will be any score 3.29 SD away from the mean). Participants who exceed this cut-off will be excluded from that analysis, though all analyses will also be reported with outliers included as supplementary analyses.

7) How many observations will be collected or what will determine sample size? No need to justify decision, but be precise about exactly how the number will be determined.
Sample size will be 60 adults (two conditions of 30 participants).
Cut-off date for reaching this will be October 1st 2018. If we have not reached 60 adults, we will cease data collection at this time with whatever sample size has been reached.

8) Anything else you would like to pre-register? (e.g., secondary analyses, variables collected for exploratory purposes, unusual analyses planned?)
Recording of detailed gameplay in the video game Portal 2 will be done via the developer console for potential exploratory analysis looking at frustration scale results in tandem with the amount of time taken to complete a level &/or the amount of times a mechanic is utilised in game.

Verify authenticity:http://aspredicted.org/blind.php?x=cj5x6a
Version of AsPredicted Questions: 2.00

Shaun Garea
Student #

Appendix B

Experiment Poster

MASSEY UNIVERSITY
TE KUNENGA KI PŪREHUROA
UNIVERSITY OF NEW ZEALAND

Interested in taking part in a Psychology experiment?

Play video games & answer some questionnaires

$10 voucher as a thank you for your time!

If you are under 18, do not have normal or corrected-to-normal vision, you suffer from epilepsy or motion sickness, or you are unable to use a game controller then you do not meet the requirements for this experiment.

The experiment will take approximately 1 hour of your time

If you wish to participate or find out more information, please email us at:

MasseyVideoGameStudy@gmail.com

Thank you for your contribution

Concerns about this project may be raised with the primary investigator Shaun Garea by email at **shaun.garea.1@uni.massey.ac.nz**. This project has been evaluated by peer review and judged to be low risk. Consequently, it has not been reviewed by one of the University's Human Ethics Committees. The researcher named in this document is responsible for the ethical conduct of this research. If you have any concerns about the conduct of this research that you want to raise with someone other than the researcher(s), please contact Dr Brian Finch, Director (Research Ethics), email humanethics@massey.ac.nz.

Shaun Garea
Student #

Appendix C

Screening Questionnaire

To fill out digital PDF please click on any box that is appropriate for Q1-3 and type in any additional information in Q4. Please leave the Code box empty.

Screening Questionnaire **Code:**.....

This is a screening questionnaire simply used to determine the safety of you participating in aspects of this study.

Q1. My vision is:

- ☐ Normal
- ☐ Short-sighted
- ☐ Long-sighted

Q2. If short or long sighted then, do you wear?

- ☐ Glasses
- ☐ Contacts
- ☐ Neither

Q3. Do you have any of the following conditions? (Please select any boxes if appropriate)

- ☐ Epilepsy
- ☐ Motion Sickness
- ☐ Vertigo

Q4. Is there any other reason you may not be fit to play a computer game on a desktop computer?

.....

.....

Thank-you for completing this questionnaire

Don't forget to save your changes.

Appendix D

Ethics Approval

Date: 03 May 2018

Dear Shaun Garea

Re: Ethics Notification - **NOR 18/05** - **Video Games and Cooperation**

Thank you for the above application that was considered by the Massey University Human Ethics Committee: **Human Ethics Northern Committee** at their meeting held on **Thursday, 3 May,2018**.

On behalf of the Committee I am pleased to advise you that the ethics of your application are approved.

Approval is for three years. If this project has not been completed within three years from the date of this letter, reapproval must be requested.

If the nature, content, location, procedures or personnel of your approved application change, please advise the Secretary of the Committee.

Yours sincerely

Dr Brian Finch
Chair, Human Ethics Chairs' Committee and Director (Research Ethics)

Research Ethics Office, Research and Enterprise

Massey University, Private Bag 11 222, Palmerston North, 4442, New Zealand **T** 06 350 5573; 06 350 5575 **F** 06 355 7973

E humanethics@massey.ac.nz **W** http://humanethics.massey.ac.nz

Shaun Garea
Student #

Appendix E

Questionnaire 2 – Everyday Cooperation Scale

QUESTIONNAIRE 2 **CODE:…….**

For each question below, please circle the relevant number:

1.
At this moment I would like to help an unknown other

NOT AT ALL **VERY MUCH**

[0] [1] [2] [3] [4] [5] [6] [7] [8] [9] [10]

2.
At this moment I would like to help a person while others are looking at me

NOT AT ALL **VERY MUCH**

[0] [1] [2] [3] [4] [5] [6] [7] [8] [9] [10]

3.
At this moment I would like to comfort someone who is emotionally very upset

NOT AT ALL **VERY MUCH**

[0] [1] [2] [3] [4] [5] [6] [7] [8] [9] [10]

4.
At this moment I would like to help a person when (s)he does not know who is helping

NOT AT ALL **VERY MUCH**

[0] [1] [2] [3] [4] [5] [6] [7] [8] [9] [10]

5.
At this moment I would like to help a person while I get in the spotlight as a consequence

NOT AT ALL **VERY MUCH**

[0] [1] [2] [3] [4] [5] [6] [7] [8] [9] [10]

Shaun Garea
Student #

6.
At this moment I would like to support a person who is emotionally distressed

NOT AT ALL **VERY MUCH**

[0] [1] [2] [3] [4] [5] [6] [7] [8] [9] [10]

7.
At this moment I would like to help a person without him/her knowing

NOT AT ALL **VERY MUCH**

[0] [1] [2] [3] [4] [5] [6] [7] [8] [9] [10]

8.
At this moment I would like to help a person while others are watching the way I do Everything

NOT AT ALL **VERY MUCH**

[0] [1] [2] [3] [4] [5] [6] [7] [8] [9] [10]

9.
At this moment I would like to help someone who hurt him/herself

NOT AT ALL **VERY MUCH**

[0] [1] [2] [3] [4] [5] [6] [7] [8] [9] [10]

Thank-you for completing this questionnaire.

Shaun Garea
Student #

Appendix F

Questionnaire 4 – Social Dominance Orientation

QUESTIONNAIRE 4 **CODE:……**

Which of the following objects or statements do you have a positive or negative feeling towards?

Beneath each object or statement, circle a number from' 1' to '7':

1. Some groups of people are simply inferior to other groups.

Very Negative **Very Positive**

[1] [2] [3] [4] [5] [6] [7]

2. In getting what you want, it is sometimes necessary to use force against other groups.

Very Negative **Very Positive**

[1] [2] [3] [4] [5] [6] [7]

3. It's OK if some groups have more of a chance in life than others.

Very Negative **Very Positive**

[1] [2] [3] [4] [5] [6] [7]

4. To get ahead in life, it is sometimes necessary to step on other groups.

Very Negative **Very Positive**

[1] [2] [3] [4] [5] [6] [7]

5. If certain groups stayed in their place, we would have fewer problems.

Very Negative **Very Positive**

[1] [2] [3] [4] [5] [6] [7]

Shaun Garea
Student #

6. It's probably a good thing that certain groups are at the top and other groups are at the bottom.

Very Negative **Very Positive**

[1] [2] [3] [4] [5] [6] [7]

7. Inferior groups should stay in their place.

Very Negative **Very Positive**

[1] [2] [3] [4] [5] [6] [7]

8. Sometimes other groups must be kept in their place.

Very Negative **Very Positive**

[1] [2] [3] [4] [5] [6] [7]

9. It would be good if groups could be equal.

Very Negative **Very Positive**

[1] [2] [3] [4] [5] [6] [7]

10. Group equality should be our ideal.

Very Negative **Very Positive**

[1] [2] [3] [4] [5] [6] [7]

11. All groups should be given an equal chance in life.

Very Negative **Very Positive**

[1] [2] [3] [4] [5] [6] [7]

Shaun Garea
Student #

12. We should do what we can to equalize conditions for different groups.

Very Negative						**Very Positive**
[1]	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**	**[7]**

13. Increased social equality.

Very Negative						**Very Positive**
[1]	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**	**[7]**

14. We would have fewer problems if we treated people more equally.

Very Negative						**Very Positive**
[1]	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**	**[7]**

15. We should strive to make incomes as equal as possible.

Very Negative						**Very Positive**
[1]	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**	**[7]**

16. No one group should dominate in society.

Very Negative						**Very Positive**
[1]	**[2]**	**[3]**	**[4]**	**[5]**	**[6]**	**[7]**

Thankyou for completing this questionnaire

Appendix G

Questionnaire 3 - Single Item Questions of Frustration and Difficulty

QUESTIONNAIRE 3 **Code:……..**

For each question below, please circle the relevant number:

Q1. How difficult did you find it to control the game?

1	2	3	4	5	6	7
Not at all						Extremely difficult

Q2. How frustrated do you feel after this experience?

1	2	3	4	5	6	7
Not at all						Extremely frustrated

Q3. How difficult did you find the game?

1	2	3	4	5	6	7
Not at all						Extremely difficult

Thank-you for completing this questionnaire.

Appendix H

Participant Information Sheet

MASSEY UNIVERSITY
COLLEGE OF HUMANITIES
AND SOCIAL SCIENCES
TE KURA PŪKENGA TANGATA

Massey University School of Psychology – Te Kura Hinengaro Tangata
Private Bag 11222, Palmerston North 4442 T +64 6 356 9099 extn 2040 F +64 6 350 5673 www.massey.ac.nz

Video Game Study

INFORMATION SHEET

Hello, my name is Shaun Garea and I am a student at Massey University doing postgraduate study in Psychology. This is an invitation to take part in a new psychology study as part of my thesis that is being conducted at Massey University Oteha Rohe campus. This sheet outlines the project and tasks therein.

If you decide to take part in this study you will be required to read and sign the consent form attached along with this document. An understanding of the project, the tasks that will be asked of you, and your consent to partake is very important so please read this document and talk to me (the researcher) or supervisors with any questions you may have (contact details in Project Contacts section).

Additionally, this information will be outlined for you again if you decide to join the study, at the single session you would attend.

Researcher Introduction

This research project will be conducted by me, Shaun Garea as part of the requirements for my Masters of Science (Psychology) degree.

This study is an experiment looking at videogame play across platforms and its effects Supervisors on this study are Dr. Aaron Drummond and Dr. Peter Cannon from the School of Psychology at Massey University.

Participant Identification and Recruitment

Participants in this study are being recruited from Massey University Campus and the greater Auckland area via physical and online posting.

- *All participants must be over 18 years of age*
- *We are looking for 60 participants for this study.*
- *Any individuals with epilepsy cannot participate in the study due to potential seizure triggers by video game exposure.*
- *Participants who suffer from motion sickness/vertigo to a degree that makes video game play uncomfortable cannot participate.*

Shaun Garea
Student #

- *Participants must have normal, or corrected to normal eyesight (glasses or contacts).*
- *Participants with dexterity issues, as such that they would be unable to use a game controller cannot participate.*
- *A gift voucher of $10 will be given at the conclusion of this study.*

Project Procedures

You will be asked to play several games on the computer either by yourself or with another person. Following this you will be asked to answer some questions about your experience with the game, yourself and your thoughts about a range of issues.

The study time should take around 45-60 minutes.

Psychology studies often require mild deception about the objectives of the study or withholding of information until the end of the experiment. For this reason it might not be possible for the researcher to explain all of the details to you until the end of your participation. At the end of your participation you will have the study objectives and procedure study explained in full and all deception or withheld information will be described. At this point you will be asked whether you are still happy for your data to be included in the study. This will be the final opportunity to withdraw your own data before it is de-identified and is no longer linked to you personally. Any additional questions you may have can be asked and will be answered at the conclusion of session.

Data Management

The information you provide will be confidential. No one apart from the research team (led by the Primary Investigator below) will have access to identifiable information that you provide. Your consent form will be kept separate from the observations collected during the course of the study. Consent forms will be securely stored for a five year period after which all personally identifiable information will be destroyed. Once the data is analysed a report of the aggregate findings will be submitted for publication and the de-identified data will be made publicly available for verification by other researchers. It will not be possible to identify any individuals from the public dataset. A summary of the results will be available from the Primary Investigator on request after July 31st, 2019.

- *Data will be digitized and remain on Massey secure servers for a period of seven years.*
- *A de-identified version of the data will also be stored securely on the Opens Science Framework (OSF) in accordance with best practice.*
- *Findings of the study will be emailed out to all participants at the conclusion of the project.*
- *No identifying data will be recorded about you (beyond your consent form) and all participants will be assigned numbers from which each individual's data will be linked.*

Participant's Rights

You are under no obligation to accept this invitation. If you decide to participate, you have the right to:

- *Decline to answer any particular question;*

- *Withdraw from the study at any time; if you withdraw before the completion of all tasks therein your data will not be used or stored.*
- *To withdraw from the study please contact either the researcher or supervisor/s of the study in person, email, or phone (see contact details below).*
- *Ask any questions about the study at any time during participation;*
- *Provide information on the understanding that your name will not be used unless you give permission to the researcher;*
- *Be given access to a summary of the project findings when it is concluded.*
- *Completion and return of the questionnaire implies consent.*
- *You have the right to decline to answer any particular question.*

Project Contacts

Participants are welcome to contact the researcher or supervisors with any questions or concerns about this study.

- *Researcher: Shaun Garea,- ph [redacted], email Shaun.Garea.1@uni.massey.ac.nz*
- *Supervisor: Dr. Aaron Drummond - ph +64 (06)3569099 ext.86238, email A.Drummond@massey.ac.nz*
- *Supervisor: Dr. Peter Cannon – ph +64 (09)4140800 ext. 43102, email P.R.Cannon@massey.ac.nz*

Compulsory Statements

1. MUHEC APPLICATIONS

Committee Approval Statement

Select the appropriate statement:

This project has been reviewed and approved by the Massey University Human Ethics Committee: Northern, Application NOR 18/05. If you have any concerns about the conduct of this research, please contact Associate Professor David Tappin (Chair), Massey University Human Ethics Committee: Northern, email humanethicsnorth@massey.ac.nz

Appendix I

Questionnaire 1 - Participant Information Questionnaire

QUESTIONNAIRE 1 **Code:……..**

Q1. What is your age (in years)? ……

For each question below, please tick the relevant box/ circle the relevant number:

Q2. What is your sex?

- ☐ Male
- ☐ Female
- ☐ Gender Diverse

Q3. What is your ethnicity?

- ☐ NZ European
- ☐ Maori
- ☐ Asian

  Please Specify ☐

- ☐ Polynesian
- ☐ Other

  Please Specify ☐

Q3. How often do you play video games?

- ☐ Never
- ☐ Hardly ever
- ☐ Once a month
- ☐ Once a week
- ☐ Most days

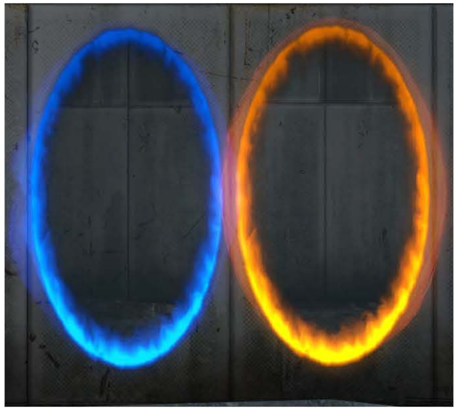
Thank-you for completing this questionnaire.

Appendix J

Portal 2 Introduction Booklet

Shaun Garea
Student #

The following are important elements to the game you are about to play. All elements will again be reintroduced to you while playing.

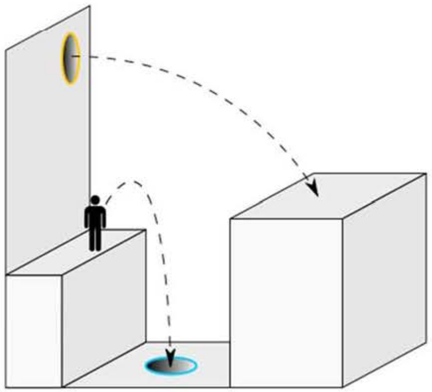


Portals

Interactive game mechanic that allows the player to create two portals from distance on white walls that the player and objects can travel between.

Portal Gun

This device allows the player to fire Portals. The device fires two types of portal and only two portals can be open at any time per device. Placing a third portal will remove one of the existing ones.

	**Portal Walls**	Only white walls are where portals can be placed. Not all surfaces can be used for portal placement (right hand side in image here).
	**Momentum (Fling)**	Game mechanic that allows a player to convert downward Kinetic energy from gravity into equal energy in any direction via portals.

B1

B2

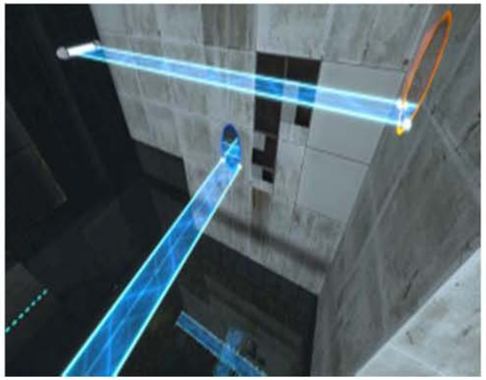
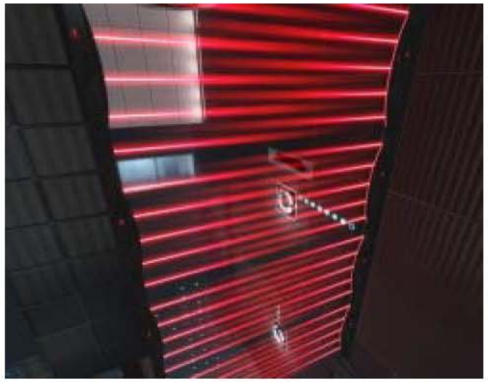
Buttons

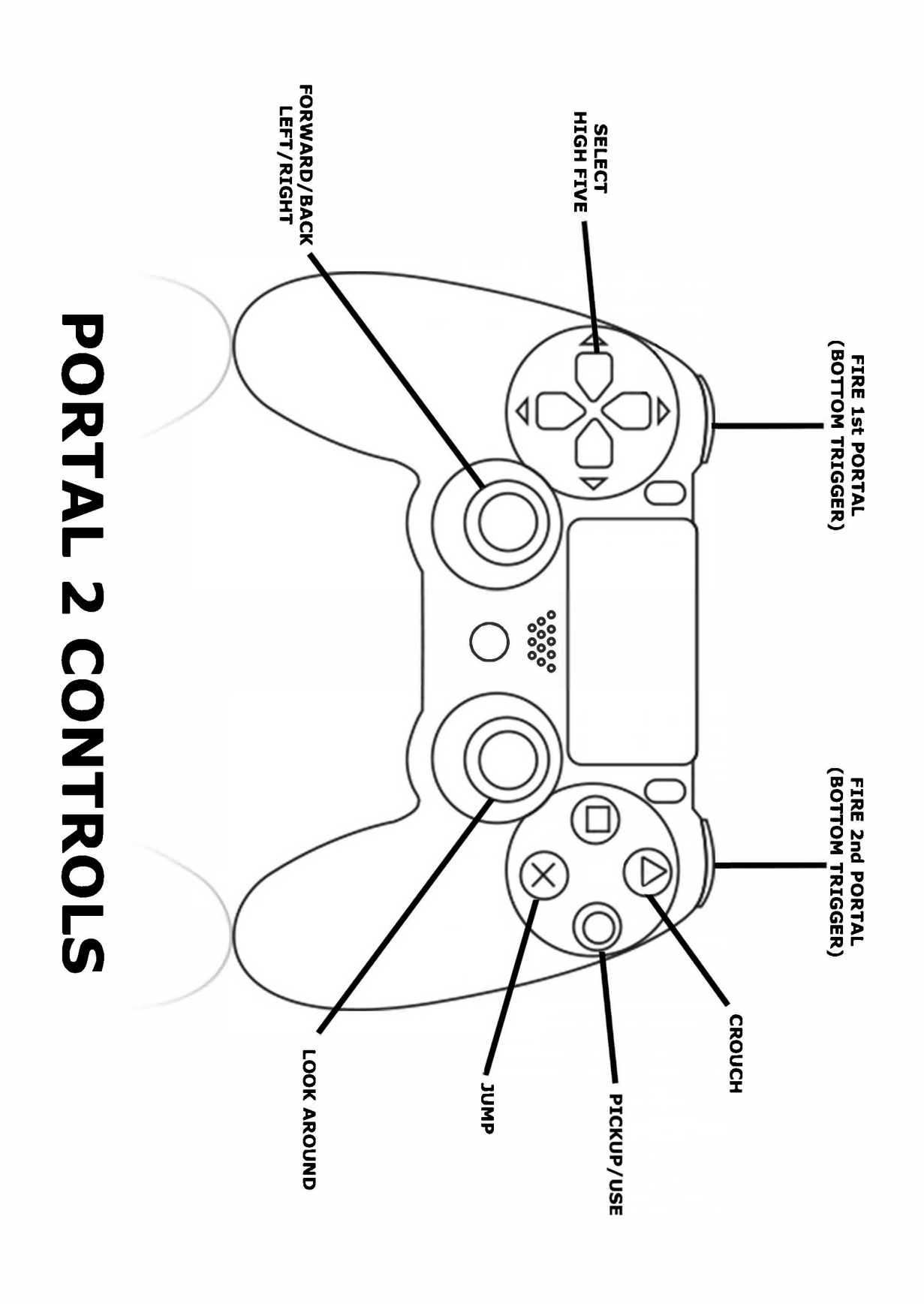
Interactive objects that can be used to activate or deactivate other game objects. B1 is a single press button. B2 is a stand-or-place-object button.

Cubes

Interactive object that can be moved by the player. One common use is placing a cube on a ground button to keep it activated.

	**Emancipation Grid (Fizzler Wall)**	A blue wall that the player can walk through but cannot take objects. Any cubes passing through an emancipation grid will disintegrate.
	**Excursion Funnel (Tractor Beam)**	An object that can create a funnel (i.e., tractor beam) that can move the player and/or objects across a level. Can be turned on or off via activation buttons.

	**Light Bridge**	A bridge that players can walk on and that objects can be placed. Can be turned on or off via activation buttons.
	**Red Laser Wall**	A wall that players cannot pass through. Attempting to pass will result in a restart of the level. Can be turned on or off via activation buttons.



Shaun Garea
Student #