Simulated Social Worlds:

The Effects of Fiction on Theory of Mind

By

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Abstract

One of the greatest human features is the ability to estimate what others are thinking and feeling, and being able to respond to those estimations accordingly. It allows parents to know when their child is feeling happy, lovers to know when they are being reciprocated, and teachers to know when they have inspired their students. It is no wonder then that recent studies have started exploring ways in which these skills can be fostered. In this regard, a promising line of research shows that reading high quality fiction can boost these abilities, but are these effects unique to written literature?

This thesis proposes that these effects may also be found when fiction is presented through video games and virtual reality films. To test this proposal, one correlational and two experimental studies were conducted. Study 1 shows that lifelong exposure to fiction in the form of written fiction and video games, without distinctions of quality and content, is not associated with the ability to infer accurately others' cognitions and emotions and only partially with being able to experience them oneself after inferring them. Study 2 shows no differences in people's ability to infer others' experience when comparing participants who read high quality short stories, who played high quality narrative video games, or that played puzzle video games. Study 3 shows that reading high quality short stories, high quality narrative video games, and watching high quality virtual reality films boosts peoples' ability to infer others' experience.

Overall, the central conclusion of this thesis is that the ability to infer others' cognitions and emotions can be boosted for brief periods of time after being exposed to fiction in the form of literary fiction, narrative video games and virtual reality films. These boosts occurred in response to high quality fiction depicting social interactions which suggests that high quality and social contents may be necessary preconditions for these effects to occur. Nevertheless, further research is suggested in order to explore if these effects are exclusive to high-quality fiction depicting social interactions, or they can be found in a wider range of fictional content and quality.

Acknowledgments

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Chapter 1:

Introduction and Thesis Overview

Video games have become one of the most important industries in the field of entertainment, with recent developments allowing creators to tell complex and engaging stories comparable to the ones that can be found in traditional written fiction, but adding a layer of agency and interactivity. In a similar line, virtual reality is often recognized as a particularly immersive media for complex storytelling, allowing users to assume the perspective of characters inside a virtual world with varying levels of agency.

These distinctive elements of video games and virtual reality have inspired researchers to explore potential uses of these media in non-clinical training settings for cognitive, emotional, and social skills training; and in therapeutic settings for symptom amelioration of anxiety, depression, in exposure-based treatment of phobias, and for motor and cognitive rehabilitation. Overall, findings show relative success in terms of training and therapeutic outcomes and treatment adherence, suggesting that these media may be useful tools in these settings. Furthermore, studies have explored the use of these media to support the development of social cognition and behavioural skills, such as altruistic intentions, reduction of implicit racial bias, and reduced aggressive

behaviour in offenders of domestic abuse, suggesting that video games and virtual reality may be used as tools to support social cognition interventions.

Despite the distinctive elements of video games and virtual reality, their narrative forms share a partial overlap with written literature, thus looking at what research has been done in written fiction may inform how these new media could be used as supporting tools in training and therapeutic settings for social cognition interventions. In this regard, studies exploring the effects of written fiction have found an association between reading high quality literature with enhanced understanding of others' intentions, knowledge and emotions.

Explanations for abovementioned effects include fiction enriching readers' knowledge about social interactions, and readers projecting themselves into the fictional social scenarios serving as simulations of real world scenarios. Other authors have suggested that the levels of immersion into the narrative and the ability to assume the perspective of characters inside fictional stories may explain the extent to which fiction can boost the understanding of others. Complementing this last explanation, authors have proposed that people with different dispositional traits, such as imagery ability and need for cognition, may experience different levels of immersion when fiction is presented through different media. More precisely, they propose that people with high need for cognition and imagery ability may feel more immersed when stories are presented in written form, while people with low need for cognition and imagery ability may feel more immersed when stories are presented through film. Overall, these proposals suggest that peoples' dispositional traits make them feel immersed when narratives are presented on certain media, which in turn impacts enhancements in the understanding of others' intentions, knowledge and emotions.

Lastly, it is worth mentioning that despite the initial research being conducted on the effects of written fiction, recent studies suggest that social-cognitive boosts may not be specific to the written medium. Furthermore, considering the partial overlap between the narrative forms of video games and virtual reality with written fiction, this thesis proposes that enhancements in the understanding of others' intentions, knowledge and emotions, may too be produced by fiction presented in these media. To test this proposal, this thesis explores to what extent being exposed to fiction through written literature, video games, and virtual reality can foster the social-cognitive abilities of accurately estimating others' cognitions and emotions (i.e., theory of mind)

and of accurately matching the emotional estates of others (i.e., empathy). The main purpose of this thesis is to conceptually replicate previous research suggesting that reading high quality fiction enhances peoples' theory of mind and empathy and to explore if these enhancements are also present when fiction is delivered through modern media, such as video games, and virtual reality films.

One of the main contributions of this thesis is the exploration of ways through which the understanding of others can be fostered through modern media. This has potential applications in therapeutic settings for clinical populations with deficits in theory of mind and empathy (e.g., individuals with autism spectrum disorders), as well as for non-clinical populations in educational and professional training settings (e.g., training of health-care professionals). Additionally, this thesis contributes to the research suggesting that high quality and social contents of fiction are essential factors for the stimulation of social-cognitive skills. This thesis also contributes to the relatively recent trend in the scientific literature of exploring the potential benefits of video games, which until recently focused mainly on the negative effects of gaming. Lastly, this thesis contributes to the exploration of possible beneficial effects of virtual reality, highlighting the psychological potential of this relatively new technology.

Regarding the structure of this thesis, Chapter 2 outlines the theoretical background and rationale at the base of this thesis. This chapter provides a general review of the history and reach of the video games and virtual reality media, the scientific research regarding their beneficial effects in training and therapy settings, as well as the scientific literature regarding the effects of written fiction on social cognitive skills for understanding others' knowledge, intentions and emotions. This chapter also provides an overview of empathy and theory of mind as social-cognitive skills that are essential to the understanding of others and the successful navigation of social situations. Lastly, this chapter provides a brief overview of the scientific literature that informed the theoretical approach and methodological rationale of the empirical studies within the thesis.

The following three chapters report empirical studies examining the aims of this thesis. Chapter 3 reports a survey study that explores whether reading literary fiction and playing video games are associated with empathy and theory of mind. This study also explores the influence that different video game genre may have on empathy and theory of mind.

Chapter 4 describes an experimental study comparing the effects that reading fiction, playing high quality narrative video games, and playing non-narrative video games may have on theory of mind. The study also explores the extent to which transportation into the narrative and experience-taking explain the effect that exposure to fiction may have over theory of mind enhancements. This study also explores if the relationships between exposure to fiction with transportation into the narrative and experience-taking vary depending on people's imagery ability and need for cognition and on the media in which fiction is presented. Lastly, the study explores the effect that exposure to fiction may have on prosocial behaviour, as a measure that was estimated would better reflect the possible benefits of fiction exposure on everyday behaviour.

Chapter 5 reports an experimental study comparing the effect that reading fiction, playing narrative video games and watching virtual reality films may have on theory of mind. This study also aimed to test if virtual reality films elicit greater immersion into the narrative and if it produces greater boosts in theory of mind, when compared to written fiction and video games.

The final chapter of the thesis, Chapter 6, summarizes the findings of the three empirical studies, describing general conclusions and implications of these findings. Finally, limitations of the current studies are addressed as well as proposals for future studies.

Chapter 2:
Fictional Worlds and Social Cognition

Video Games

Video games are a relatively recent technological innovation. Major consensus establishes Atari's Pong (1972) as the first successful arcade video game that led to the popularization of the medium (Stanton, 2015). Since then, video games have evolved from simple graphics and sound cues to more meaningful ways of storytelling which, along with the professionalization of the industry, more powerful gaming devices, the globalization of the economy, and rapid growth of the Internet, have turned video games into a multibillion dollar industry. The first section of this chapter explores the increasing reach, quality, and diversity of this media, its suitability for complex story-telling, and the scientific literature regarding video games' effects on players' behaviour and its uses in therapeutic settings.

This exploration of video games is made in the context of the scientific literature suggesting that reading high quality literature can boost people's ability to estimate the affective and cognitive states of others, as well as the ability to match those states accurately (i.e., theory of mind and empathy). Therefore, this section argues that similar effects could be found when playing certain video games.

Video games as a form of art

Nowadays, video games are becoming an increasingly important part of many people's lives as a leisure activity. Newzoo (2018a) estimates that solely in the UK there are 37.3 million people who play video games to some extent, that is 55% of the population in this country. A similar picture is portrayed in China and in the United States, ranked first and second in terms of industry revenues, with 619.5 and 178.7 million video game players, or 43.7% and 54.5% of their respective populations (Newzoo, 2018b; 2018c) Also, video games are consolidating themselves as a relevant economic activity in the leisure and entertainment sector which can be seen when comparing its expected global revenues for 2018 of 137.9 billion dollars (Newzoo, 2018d) versus the 136 billion dollars in revenues for the global movie production and distribution industry for the same year (IBISWorld, 2018).

An explanation for the growth of this media and its economic success can be found in the depth that video games developers are putting into their work which has led some authors to consider this young media as a new art form (Gee, 2006). Gee's article, published in the first issue of the journal Games and Culture, states that video games have evolved from simple graphics and sound to more complex ways of storytelling which enables the assignment of meaning by the players in a unique interactive experience, different from any other forms of entertainment or art.

In Gee´s proposal, the assignment of meaning comes from three different sources, the first being the different shapes, movement, sound, and combinations of these provided by the game that helps determine what the players should look for in the game. This helps create an ambience, mood and feeling in which the players immerse but is only an abstract rule system. The second source of meaning comes from the human need to interpret things that happens as part of one coherent story. This need takes the story elements mentioned earlier and assigns them a narrative sense even in the absence of a whole and finished narrative. The third and final source comes from the inseparable relationship between the rules and story elements provided by the game which allows different stories to exist in the same game, one being the story provided by the game and the other the story that each player reconstructs in her or his mind during the play through. As Gee (2006) eloquently states, "This proactive production by players of story elements, a visual-motoric-auditory- decision-making symphony,

and a unique real-virtual story produces a new form of performance art coproduced by players and game designers" (p. 61).

A complementary explanation for the success of video games comes from the professionalization of the industry which allowed the creation of video games that also have the specific intention of satisfying basic psychological needs and with it, to reinforce the video game playing activity. In this regard, Przybylski, Rigby, and Ryan (2010) propose an adaptation of *self-determination theory* (SDT), a macro-theory of human motivation that is principally concerned with the potential of social contexts to provide experiences that satisfy universal human needs. This adaptation points out that video games were originally tailored to meet competence need through balancing difficulty with the players´ skills. Over time, partially thanks to technology innovations, developers broadened the game experience and in-game environments to better meet the autonomy need with flexible progression, goals, strategies, and gameplay. Finally, developers have managed to integrate the satisfaction of need for relatedness, by facilitating interactions with video game communities, both on- and offline, while also incorporating competitive and cooperative multiplayer aspects in video games. This proposal explains the enjoyment coming from the interaction with video games and the different motivations that players may have.

As stated earlier, video games have been considered as a new art form by some authors. A supporting argument for this is the notion that, nowadays, video game developers aim to integrate pleasure, learning, reflection, and expanded living, in a similar manner to traditional forms of art (Gee, 2006). In this regard, Smethurst and Craps (2015), argue that creators of video games operate in a similar manner as traditional artists do in the sense of taking advantage of the particular features of the medium they work on, in order to communicate and emphasize their message, which in the case of video games, involve using both ludic and aesthetic elements (Smethurst & Craps, 2015).

Complementary to the proposal that video games may be considered a new art form, there is a recent movement in video games that advocates for the recognition of "art games" as a genre on its own. This movement seeks to answer the criticism that not all video games possess artistic merit in a similar way that not all music, films and television programs are considered art pieces. Sharp (2012) argues that in video games of this newly proposed genre, both their experiential and formal characteristics (e.g.,

objectives, game mechanics, rules) and their aesthetic elements, are capable of expressing complex ideas to the players. Sharp's argument is resonant of the concept of "procedural rhetoric" (Bogost, 2007), a form of communication that takes advantage of video games' capabilities of manipulating the virtual world while interacting with the players. As Bogost, Sharp, and Gee show, video game developers have a notable set of tools available for the creation of complex storytelling.

Nowadays, video games are able to address complex topics such as suicide (e.g., Pinchbeck, 2008), morality and construction of identity (e.g., Green, 2016) and psychological trauma (e.g., Smethurst & Craps, 2015). In this regard, Smethurst and Craps (2015), argue that video games deal with psychological trauma, and probably with other sensitive topics, in ways that are unprecedented in other media through three interlinked facets: inter(re)activity, the way video games elicit empathy, and how they make the player complicit with in-game events.

When comparing video games to other media, interactivity emerges as one of the most, if not the most, distinctive characteristics. In this sense, interactivity refers to the notion that video games require an active engagement from the player, usually in the form of manual input and/or puzzle-solving abilities, which is required for the game to function properly and to keep advancing the game and its story (Smethurst & Craps, 2015). The authors offer a comparison between video games and films, where the latter require just the act of watching, and with books where the reader is required to merely turn a page to keep advancing the story. But the authors themselves mention a counterpoint to this notion since the act of reading a book or watching a film already constitute an interactive process in the sense that the reader/viewer must actively interpret the text in order to make sense of it. On this same subject, Rousse (2012) suggests that the notion of interactivity should be extended to include the reciprocal process of the audience interpreting the book or film, and the creator trying to anticipate those interpretations. Rousse also proposes that reactivity, and not interactivity, is what makes video games different. According to Rousse´s proposal, reactivity is defined as the procedural responses, that is, the manipulability of the virtual world and the way it adapts to the players' behaviour, that are characteristic of the majority of video games (Rousse, 2012 in Smethurst & Craps, 2015). Finally, considering that both the player and game react to one another in a feedback loop, Smethurst and Craps (2015) propose the merging of interactivity and reactivity into the term interreactivity which,

considering the heterogeneity of video games, should be considered as a continuum in the sense that there are video games that are more or less interactive than others, hence varying the amount of interpretative interaction from the player while also varying the effort that is required from the player for the game to work.

The second difference between video games and other media comes from how they elicit empathy in the player. Smethurst and Craps do not argue that empathy elicitation is exclusive to video games because, as it will be reviewed later in the text, there is evidence that empathy can be fostered through reading literary fiction (e.g., Black & Barnes, 2015b; Kidd & Castano, 2013; Pino & Mazza, 2016) and watching award-winning television series (e.g., Black & Barnes, 2015a). Instead, Smethurst and Craps propose that what is special about empathy in video games is how is elicited, its nature, and extent. According to the authors, there are two schools of thought in regards of the link between empathy and video games. The first one draws definitions of empathy that are characteristic of the fields of cognitive psychology, neuroscience, and literary analysis, and applies them to video games, while the other observes the users' behaviour while playing and examines if they empathize with characters (Smethurst & Craps, 2015). Taken together, these schools of thought propose that video games may foster empathy in the player depending on two different processes.

Firstly, video games foster empathy while the video game players try to understand another person´s (or character's) cognitive or affective state of mind. In this regard, Belman and Flannagan (2010) proposed the concept of empathetic play, a mode of playing characterized by players actively trying estimate the cognitive and affective states of individuals or groups presented in the game as characters (cognitive empathy) and/or preparing themselves for an emotional response (emotional empathy). This way of fostering empathy, although interesting, is not exclusive to video games considering that it could be easily mapped into other media.

On the contrary, the second process refers to how players stop empathizing with the characters once they assume the control of their actions in the game. According to Newman (2002), when players assume the control of the characters in a video game, the character as such (who they are and what are they feeling) ceases to exist entirely since they now serve the primary function of embodying the player's actions, who is now focused on what the character can and cannot do. In sum, Smethurst and Craps argue that these two processes of empathy elicitation are characteristic to video games:

the player must switch, even several times in the course of a few minutes, between actively trying to understand the thoughts and feelings of people and groups presented in the video game and suspend that search for understanding in order to focus on the actions that the he or she must accomplish in order for the game to progress.

The third aspect that is characteristic to video games, and how they deal with complex subjects, is complicity. According to Smethurst and Craps, complicity is elicited in video games thanks to a combination of previous processes: interreactivity and empathy. More precisely, given the unique ways in which players interact with and react to video games and how they try to understand the characters' intentions and emotions is that they feel as if they are complicit with what occurs inside the video game. In this proposal, the interreactivity of the video games foster the sense that players are responsible for what happens inside the video game (since players are responsible for what happens to the protagonist) while the game exploits the empathic link that the players establish with the characters. The empathic link is reinforced through intermittent periods of time where the player loses agency of the character, usually during cut-scenes, where the story advances through a character's decision or a quest is accepted and then the player must enact that decision or accomplish the quest through game play. This gives the player time to reflect on the choices they made and experiences they underwent, through controlling the character, providing context and filling them with meaning. In this example, even though the player didn't have a choice to take the decision or quest, she or he must act on it in order to advance the story, making him/her an accomplice of what happens in the video game.

Although Smethurst and Craps focus their analysis of video games on the portrayal of trauma, their proposal may be applied to other sensitive topics that are also present in complex storytelling such as individual sacrifice, the search for the greater good, and human nature in environments of adversity. As complex topics often require a deep understanding of the characters immersed in those narratives, the combination of interreactivity, empathy and complicity that is characteristic to video games, may be especially helpful to promote that understanding.

In sum, despite the recent history of video games, this media has grown to become one of the most important industries in entertainment, reaching millions of people around the globe. This success can be explained partially by the effort that video game designers put into creating more compelling storytelling and unique interactive

experiences which leads to the assignation of deeper meaning while engaging with this media, as long as people are motivated to engage with said stories. There is also the potential that video games have to satisfy basic psychological needs such as competence, autonomy and relatedness (Przybylski et al., 2010), which reinforce the video game playing activity, and finally there is the potential that video games have to tell complex stories and deal with sensitive subjects.

Potential benefits of gaming

Considering the rapid growth of video games and its appeal to younger audiences, there has been interest in this medium from the scientific community although its focus has been mostly concern-driven with the majority of research studies aimed at identifying the potential negative effects of gaming. Examples of this are the research studies that link video games to aggression, addiction, depression, social isolation, and overuse (e.g., Anderson & Bushman, 2001; Anderson et al., 2010; Ferguson, 2013; Grüsser, Thalemann, & Griffiths, 2007; Lemola et al., 2011). Despite the fact that results of these studies contribute valuable information to the subject, a complete analysis of the effects that video games may have on players should consider both negative and positive effects. With this in consideration, there has been a shift in the focus of research on the effects of video games in the last decade or so.

In 2014, Granic, Lobel and Engels published a paper compiling the benefits of playing video games that had been found so far in the scientific literature. The article organized the studies according to cognitive, motivational, emotional and social benefits reported. Cognitive benefits included: faster and more accurate attention allocation; higher spatial resolution in visual processing, and mental rotation abilities (for a review, see Green & Bavelier, 2012); problem solving skills (Prensky, 2012), and creativity (Jackson et al., 2012). Motivational benefits included how long a participant would persistently attempt to solve difficult anagrams outside of a gaming context (Ventura, Shute, & Zhao, 2013). Emotional benefits included improved moods, promotion of relaxation, and blocking anxiety (Russoniello, O'Brien, & Parks, 2009); the experience of *fiero* (McGonigal, 2011), which is an intense pride experienced when success follows great adversity; *flow* or *transportation* (Sherry, 2004), which is a positive emotional experience that occurs when a person is immersed in an intrinsically rewarding activity that elicits a high sense of control while simultaneously evoking a loss of self-consciousness, and has been linked to commitment and achievement (e.g.,

Nakamura & Csikszentmihalyi, 2002); higher self-esteem, and less anxiety (Csikszentmihalyi, Rathunde, & Whalen, 1993). Also, it has been suggested that video game use may promote the ability to flexibly and efficiently reappraise emotional experiences, teaching players the benefits of dealing with frustration and anxiety in adaptive ways, although this remains as speculation (Granic et al., 2014).

Concerning the social benefits of playing video games, Ewoldsen et al. (2012) argue that players seem to acquire important social skills required to cooperate, support and help others. In this regard, one study summarized international evidence from correlational, longitudinal, and experimental studies showing that playing prosocial video games consistently relates to, or predicts, prosocial behaviours (Gentile et al., 2009, Prot et al., 2014) and reduced aggression (Greitemeyer, Agthe, Turner, & Gschwendtner, 2012). Similarly, cooperative game modes decrease aggression (Velez, Greitemeyer, Whitaker, Ewoldsen, & Bushman, 2016) and increase cooperative behaviour (Greitemeyer & Cox, 2013). Another study showed that adolescents who played games with civic experiences were more likely to be engaged in social and civic movements in their everyday lives (Lenhart et al., 2008). In sum, the scientific literature suggests that video games have the potential to foster certain social skills, such as helping and cooperative behaviour, reduced aggression, with the possibility of having an impact that transfers to everyday life.

Possible explanations for how video games affect people´s behaviour can be found in Bormann and Greitemeyer's (2015) General Learning Model (GLM). GLM, which was adapted from the General Aggression Model (e.g., Anderson & Bushman, 2002), proposes that individual difference variables, such as trait aggression, and situational variables, such as video game exposure, may affect a person's internal state, consisting of cognition, affect, and arousal, which in turn influences how the person perceives and interprets an event and how he or she will behave in a social encounter.

It is important to notice that the GLM suggests that the content of the video game determines whether negative or positive effects are to be expected. The issue of the content of video games is backed by Greitemeyer and Mügge's (2014) meta-analysis which shows that whereas violent video game play increases aggression and decreases prosocial outcomes, prosocial video game play has the opposite effects. Similarly, playing a video game cooperatively in a team, as opposed to playing the same video game alone, decreases aggression and increases prosocial outcomes (e.g.,

Greitemeyer, 2013; Greitemeyer et al., 2012; Velez et al., 2016). This suggests that video game exposure may harm or benefit social relations depending on the content of the game and the context in which is played.

Regarding the issue of content in video games, Bormann and Greitemeyer (2015) propose that in-game storytelling might promote the mental simulation and abstraction of social experience, through stimulating players to explore digitally simulated social worlds, although it should be noticed that in-game storytelling may also worsen the negative effects of video game play. Happ, Melzer, and Steffgen (2015) showed that empathy in a video game context can promote prosocial as well as antisocial outcomes, depending on game content and focus. More precisely, the study showed that both playing prosocial video games and increasing empathy for victim characters in antisocial games makes prosocial behaviour more likely, thus defying the conventional categorization of prosocial and antisocial media content and its simplistic division into "good/beneficial" or "bad/harmful."

In conclusion, despite the scientific literature focusing on the potential negative effects of gaming, there is a relatively recent push in science to explore the possible beneficial effects of gaming. According to the literature, benefits of gaming have been reported in cognition (e.g., faster and more accurate attention allocation), motivation (e.g., longer persistence in problem solving behaviour), emotion (e.g., relaxation and anxiety blocking), and in social skills (e.g., increased prosocial behaviour, and reduced aggression). Possible explanations for these effects come from the proposal that exposure to video games affects people's cognitions, affects and arousal, which in turn influence how they perceive and interpret the world around them. This explanation can be applied to explain both harmful and beneficial effects of video games, thus highlighting the importance of the contents of video games and their possible effects on people's behaviour.

Using video games for training purposes

Partially inspired by the abovementioned benefits of playing video games, researchers have started exploring the possible uses of video games in training and therapy settings. Studies in this field have explored the use of commercial video games for training or therapy, as well as the use of "serious" video games (i.e., games

developed specifically for behavioural change) usually in educational, training and therapeutic settings (Zyda, 2005).

In this regard, Pallavicini, Ferrari, and Mantovani (2018) published a systematic review on the use of video games for cognitive and emotional training in healthy adult populations. In this systematic review, the authors identified 35 studies, most of which used commercial video games, mostly action games followed by puzzle games. Thirty studies explored the effects of video games on cognitive skills (i.e., processing and reaction times, memory, task-switching, and mental spatial rotation), with effect sizes (Cohen's *d*) ranging from 0.06 to 3.43. Five studies explored the effects of video games on emotional skills training (e.g.*,* enjoyment, changes in positive and negative effect, stress management), with effect sizes ranging from 0.20 to 3.01. Overall, the findings provide evidence for the benefits of using video games as training tools for cognitive and emotional skills in healthy adult populations.

The abovementioned findings are consistent with results of studies focusing on cognitive decline in senior adults. A meta-analysis by Toril, Reales, and Ballesteros (2014) examined 20 studies investigating the effects of playing video games in older adults, aiming to enhance their cognitive functioning. Results show an overall effect size of 0.37 (Cohen's *d*), and of 0.63 for reaction time, 0.37 for attention, 0.39 for memory, and 0.38 for global cognition. These results indicate overall positive effects on cognitive functions in populations of older adults suggesting that video games may be effective tools for training in populations beyond healthy young adults.

Video games have also been used in therapy settings, with relative levels of success to some degree. Llorens, Noé, Ferri, and Alcañiz (2015) explored the use of video games in group-based therapy programs for self-awareness and social skills training in patients with traumatic brain injury. Participants interacted with a video game that was like a board game and had been specially developed for training purposes, with results showing improvements for self-awareness of deficits, and social skills. Similarly, Fernandez-Aranda et al. (2015) explored the use of serious video games for emotion regulation and impulsivity control in bulimia nervosa patients. Results of this study showed that participants that received cognitive behavioural therapy (CBT) augmented with playing a serious video game, obtained better results in terms of reduction of symptoms, anxiety, anger, and risk of drop-out (i.e., treatment non-adherence) when compared to participants who only received CBT. These results

suggest that integrating serious video games into short term CBT could boost its effects in terms of improving emotion dysregulation as well as therapy adherence. Under a similar design, Tárrega et al. (2015) explored the use of a serious video game as a tool to support CBT interventions for severe gambling disorder patients, with results showing significant reductions in impulsivity, psychopathology distress, anger expression, novelty seeking and drop-out rates, with effect sizes ranging from 0.64 to 1.38. Overall, these results support the use of video games as tools in CBT interventions with clinical populations.

Moreover, other studies suggest that video games capacity to improve treatment adherence may not be exclusive to psychotherapy. Kato, Cole, Bradlyn and Pollock (2007) conducted a study consisting of a randomized trial with 375 patients who had an initial or relapse diagnosis of a malignancy (i.e., cancerous tumour) and currently undergoing treatment. Participants were randomly assigned to either a control or an intervention group, the intervention being a video game that addressed behavioural issues considered critical for cancer treatment. Results of this study show higher adherence rates for the intervention group, as well as higher self-efficacy and knowledge, when compared with the control group. Overall, these results provide further evidence that video game interventions could be a helpful tool to improve adherence to treatment in clinical settings beyond psychotherapy.

In sum, there is evidence in the scientific literature suggesting that video games may be a helpful tool to support training in therapy settings. In this regard, studies have explored the use of video games for cognitive and emotional training in non-clinical populations of adults, as well as for symptom amelioration in clinical populations with traumatic brain injury, bulimia nervosa patients, and severe gambling disorder patients. Overall results suggest that video games could be a helpful tool in training and in therapeutic settings for the amelioration of symptoms as well as for boosting treatment adherence. Arguably, it is plausible that these effects could also be found in other novel forms of delivery to support treatment, such as virtual reality and written fiction.

Virtual reality

Virtual reality (VR) development is a relatively young industry with commercially available VR headsets only becoming available in early 2016. Since

then, this technology has become accessible on a markedly bigger scale and budget. VR immerses its users in a virtual world by providing audio-visual stimulation, and by allowing them to assume the point of view of a fictional character inside a virtual world with varying levels of agency, thus simulating their physical presence in a virtual environment. VR's potential to elicit the illusion of being physically present in a virtual world with varying levels of agency, have inspired scientists to explore the possible uses of this technology as tools in therapeutic settings. This section explores the reach and complexity of this media, as well the scientific literature exploring training uses in therapeutic, educational and professional settings.

Virtual reality, a new media

Despite the concept of VR being present in popular culture for decades (see films Tron, [1982]; Johnny Mnemonic [1995]; Existenz, [1999]; and The Matrix trilogy, [1999-2003]) it can be argued that it is a relatively new media. This is considering that the mainstream VR headsets were made commercially available less than three years ago, with Oculus Rift, HTC Vive, and PlayStation VR, being launched in March, April, and October of 2016, respectively. During this time, VR media have found relative commercial success with global revenues for 2018 estimated at $3.6 billion, which was a 30% increase over the previous year (Horwitz, 2019).

A possible explanation for the relative success of the VR industry comes from its links to the video games industry. PlayStation VR, regarded as the most successful VR headset in terms of sales with an estimated 3 million units sold as of August 2018 (Minotti, 2018), is technically an accessory to the best-selling video games console of the current generation, the PlayStation 4. Similarly, HTC Vive, the fourth best-selling VR headset of 2018 (Horwitz, 2019), was developed by HTC in collaboration with Valve Corporation, the company behind Steam, currently the biggest online distribution platform for video games. It is estimated then, that sales of these two VR headsets may be partially explained by their appeal to the gaming community.

As for the future, it is estimated that the VR market will experience a boost in sales and revenues thanks to technological developments making headsets more convenient and affordable. An example of this is Oculus Go, the second best-selling headset of 2018 (Horwitz, 2019), a standalone version of the Oculus Rift which although stripped down from some of the functionalities of its predecessor, is

significantly less expensive. Overall, this trend of companies developing less expensive standalone headsets (e.g., Google's Daydream, HTC's Vive Focus and the upcoming Oculus Quest, and HTC's Vive Focus Plus) sets a shift in their target markets toward a more mainstream audience that may not be willing to pay the high prices that characterized the launch of the Oculus Rift and PlayStation VR in 2016.

As for what types of content can be accessed through VR, there is a wide range of experiences that users may get in terms of format (e.g., 3D rendered graphics, filmed), levels of interactivity (e.g., video games, scripted films), purpose, (e.g., entertain, educate), and contents and genre (e.g., science fiction, horror, drama). In this regard, there is a clear connection between the VR and video games industries with fully-fledged 3D rendered video games being released for both VR and non-VR ("*traditional*") gaming settings (e.g., *Resident Evil 7* [2017], *The Elder Scrolls V: Skyrim VR* [2017]*)*, as well as some recent video games being developed exclusively for VR platforms to take advantage of this technology's capabilities (e.g., *Lone Echo* [2017]). These video games allow users to virtually assume the role of a character from the first-person perspective in a variety of interactive settings such as horror, medieval fantasy, or science fiction. There are also VR experiences that resemble more that of an immersive film or documentary such as *Robert Rodriguez's The Limit* (2018), a scripted action/sci-fi film, or *Clouds Over Sidra* (2015), a documentary about the refugee crisis narrating the life of a twelve year old in a refugee camp in Jordan. Other experiences resemble that of content creation software, such as *Tilt Brush* (2016) and *Paint VR* (2017), allowing users to paint and animate in a 3D canvas, while other experiences resemble interactive art installations such as *Notes on Blindness* (2016), where the user listens to the audio notes of John M. Hull narrating his experience of going blind, while the user also interacts with a virtual world designed to represent and evoke that experience. Overall, this wide variety of experiences that can be found in VR means that this media has the potential to entertain, educate, inspire, and awe its users, with varying levels of interactivity, that echo and mix the complexities of traditional film and video games.

In sum, VR is a relatively new media which, within its three years of commercial life, has accumulated relative success in terms of hardware and software sales. This success is partially explained by the links between this and the video games industry, while technological innovations set a promising future for this industry by

making headsets more affordable and convenient, thus, potentially, reaching a wider audience. Lastly, the vast range of experiences users may get through VR, showcase the potential that this media has to significantly engage with audiences, in a similar way as video games and films do.

Virtual reality in therapeutic settings

As already mentioned, VR as a media shares some characteristics with video games and films but its main distinctive feature is the level of immersion that can be achieved with it, which has led scientists to explore its possible uses for training and therapeutic purposes. In this regard it has been proposed that VR may be a promising tool in therapeutic settings, given its potential to elicit the illusion of being physically present in a controlled, virtual world, with some degree of agency, which comes from this technology eliciting high levels of immersion in its users, allowing them to adopt the point of view of a character in a virtual setting, while being sensorially and physically immersed in it (Krijn, Emmelkamp, Olafsson, & Biemond, 2004). In a similar line, Tieri, Morone, Paolucci and Iosa (2018) proposed that VR's ability to elicit strong feelings of "being physically present" in a virtual environment, can elicit reactions as if the subject was physically situated in a real place. Additionally, VR seems particularly useful to induce the feeling of agency over a virtual body (Tieri et al., 2018), which is estimated may help boost users' feelings of immersion and with it their engagement with the VR experience. In sum, VR's potential to elicit high levels of immersion and the illusion of "being physically present" in a virtual world, as well as the feeling of agency that users experience while using this technology, suggest that this technology may be particularly useful in therapeutic settings.

In this regard, researchers started investigating possible uses of this technology in therapeutic settings. Fodor et al. (2018) conducted a meta-analysis exploring the use of VR interventions for anxiety and depression in 39 trials, where VR therapies were proven to be more effective than control groups with moderate to large effect sizes (0.79 and 0.73 for anxiety and depression, respectively), but not more effective than other active interventions (i.e., CBT, imaginal exposure, *in-vivo* exposure). Some examples of these studies include explorations of VR as a tool in clinical psychology settings for exposure-based treatments of fear of flying (e.g., Rus-Calafell, Gutierrez-Maldonado, Botella, & Baños, 2013), and dental phobia (e.g., Gujjar, van Wijk, Sharma, & De Jongh, 2018), with overall results supporting the idea that VR may be

used as a tool in therapy settings for the amelioration of symptoms such as stress and behavioural avoidance.

Other studies have explored the use for VR in therapy settings for eating disorders. Clus, Larsen, Lemey, and Berrouiguet (2018) conducted a systematic review of clinical studies using VR in therapy settings for patients with eating disorders. Twenty-six studies were analysed, with studies using VR headsets to work on patients' body image, and on exposure to virtual food stimuli. Overall, using VR in addition to CBT showed greater efficacy when compared to control groups, and to CBT alone, suggesting that VR is an acceptable and effective therapeutic tool in the treatment of eating disorders. Nevertheless, these results should be taken cautiously considering certain limitations of the studies this review was based on (e.g., relatively small sample sizes, the lack of controlled randomized clinical trials).

There is also evidence suggesting that VR could be used for cognitive and motor rehabilitation. In this regard, Massetti et al. (2018) offered an overview of said studies in their systematic review of 41 manuscripts that explored the use of VR as a rehabilitation tool in clinical populations with stroke, cerebral palsy, and spinal cord injury, among other diseases. Benefits found in these studies include improvements in motor function (e.g., balance and gait, strength and fitness), increased participation in both domestic and community environments, as well as improved patient adherence to treatment.

Lastly, there have been studies exploring the effects that VR may have on social cognition skills, which in the long term, could be used in training settings with clinical populations. Recently, studies have examined the use of VR for increasing altruistic intentions (Rosenberg, Baughman, & Bailenson, 2013), reducing short-term implicit racial bias (Banakou, Hanumanthu, & Slater, 2016), and reducing aggressive behaviour in domestic abuse offenders (Seinfeld et al., 2018). Overall, results of these studies show promising results in regards of VR being capable of fostering empathy by allowing users to virtually assume the position of another.

Complementing the scientific literature regarding the use of VR in therapeutic settings, is the literature exploring the uses of this technology for training purposes in non-clinical populations. In this regard, a recent review on the use of VR for educational and training purposes (Jensen & Konradsen, 2017) suggest that this

technology can be useful in the training of cognitive skills (e.g., remembering and understanding spatial and visual information and knowledge), psychomotor skills related to head-movement (e.g., visual scanning, observational skills), and affective skills (e.g., controlling emotional responses to stressful situations). Regarding the training of affective skills, studies include stress management in the military (Pallavicini, Argenton, Toniazzi, Aceti, & Mantovani, 2016), and more recently doctors' social skills to break bad news (Ochs et al., 2019). These studies suggest that VR could be used a training tool for educational and training purposes outside therapeutic settings.

To sum up, given VR's potential to elicit high levels of immersion, researchers have started exploring uses of this technology for training in therapeutic settings. More precisely, authors have explored the use of VR as a supporting tool in the treatment of anxiety, depression, in exposure-based treatments for phobias, eating disorders, and for motor and cognitive rehabilitation. Overall studies show promising results in regards using VR in as tools for therapeutic settings. Additionally, studies have explored the use of VR to support the development of social cognition and behavioural skills such as altruistic intentions, reduction of implicit racial bias, and reduced aggressive behaviour in offenders of domestic abuse. Overall, these results suggest that VR may not only be used for entertainment or artistic purposes, but also as tools to support social cognition interventions.

Social Cognitive Skills for Understanding Others

As has been mentioned in the previous sections, there is a wide range of experiences that people may get from playing video games and using VR, from pure entertainment to engaging in meaningful stories, similar to those that can be encountered in high-quality literature and in films. It has also been mentioned that there has been a high interest in exploring possible uses of these media as tools in training and therapeutic settings with promising results for both video games and VR. In the case of video games, their beneficial effects for players' cognition, emotion, motivation, and social skills have also been investigated. Nevertheless, one issue that remains relatively unexplored is if playing video games and using VR in everyday-life scenarios (i.e., non-therapy settings) may benefit people's abilities to estimate the

cognitive and emotional states of others and to match those emotional states themselves, i.e., theory of mind and empathy.

Theory of mind is broadly defined as the ability to accurately infer others' cognitive (e.g., intention, knowledge), and affective states (e.g., feeling happy). On the other hand, empathy is often defined as a two-stage process, the first one being theory of mind or some variation of it (depending on the author), and the second stage being the ability to match the mental state of another (more detail about theory of mind and empathy will be provided in later sections of this chapter).

The interest in researching theory of mind and empathy comes from the widely accepted idea that being able to infer and respond to others' affective and cognitive states, plays an important role in facilitating adjusted social functioning (Spreng, McKinnon, Mar & Levine, 2009). There is evidence that associates empathy to prosocial behaviour (e.g., Eisenberg & Miller, 1987; Eisenberg, Eggum, & Giunta, 2010; Geng, Xia, & Qin, 2012; Hoffman, 2000), positive interpersonal attitudes and reduced prejudice (e.g., Galinsky, Ku, & Wang, 2005; Johnson, 2013) and reduced aggression (e.g., Batanova & Loukas, 2016; Espelage, Mebane, & Adams, 2004; Lovett & Sheffield, 2007). In a similar way, deficits in theory of mind have been associated with psychopathologies marked by interpersonal difficulties (Baron-Cohen, Wheelwright, Hill, Raste, & Plumb, 2001; Shamay-Tsoory & Aharon-Peretz, 2007; Shamay-Tsoory, Harari, Aharon-Peretz, & Levkovitz, 2010, in Kidd & Castano, 2013). Even when the ability to understand others is intact, disengagement of theory of mind has been linked to the breakdown of positive interpersonal and intergroup relationships (Castano, 2012). Considering the impact that empathy and theory of mind can have on people's lives, researchers have investigated if these abilities can be fostered through everyday life activities such as reading fiction.

Written Fiction and Social Cognition

Written fiction is often recognized as one of the greatest human achievements because being able to tell stories in a compelling way affects how readers think and feel and offers them a space to experience worlds that otherwise they may not be able to experience. Written fiction is one of the more traditional forms of art, with a significant body of research which includes investigating how reading fiction may boost peoples' understanding of others. Despite the distinctive elements of video games

and VR, their narrative forms involve storytelling elements that can also be found in written fiction, with a considerable overlap between these different forms of communicating fiction. Therefore, learning what has been done and what has been found in research on written fiction can inform research on newer media. This section explores the scientific literature investigating the effects of fiction on social cognition, more precisely on empathy and theory of mind, and the explanations that research offers as to how these effects come to be.

In this regard, there is evidence that suggests that reading literary fiction (i.e., high quality literature) as opposed to nonfiction and popular fiction, improves people's theory of mind (e.g., Kidd & Castano, 2013), and empathy (e.g., Mar, Oatley, Hirsh, dela Paz, & Peterson, 2006). In detail, Kidd and Castano (2013) report results from 5 experiments which explored the extent to which reading literary fiction boosts people's affective and cognitive theory of mind (i.e., ability to understand other's mental states). Participants of the studies were randomly assigned to either read short extracts of literary fiction (experiments 1 to 5), non-fiction (experiment 1), popular fiction (experiments 2 to 5), or nothing at all (experiments 2 to 5). Overall, results showed that reading literary fiction enhances people's theory of mind for short periods, but not when reading popular fiction, nor nonfiction pieces. These differences have been explained by literary fiction tending to be more challenging, engaging and relatable than popular fiction (Mar et al., 2006) due to its use of phonological, grammatical and semantic stylistic devices that defamiliarize its readers (Miall & Kuiken, 1999), unsettle their expectations and challenge their thinking (Barthes, 1974).

It is worth noting that despite some studies being been unable to replicate the abovementioned findings in regards of literary fiction boosting theory of mind (Panero et al., 2016; Samur, Tops, & Koole, 2018), a recent meta-analysis provides strong evidence supporting the idea that reading fiction has a small positive impact on social-cognitive performance. More precisely, Dodell-Feder and Tamir (2018) conducted a meta-analysis of 53 effect sizes from 14 experimental studies, focusing on the effects that reading fiction versus nonfiction may have on different social-cognitive measures (e.g., theory of mind, empathy, social reasoning). It is worth noting that authors of this meta-analysis focused on the fiction versus nonfiction comparison due to the lack of precision when differentiating literary versus popular fiction (Kidd, Ongis, & Castano, 2016), and only data from literary fiction was included when studies included both

conditions. Results of this meta-analysis showed that fiction readers outperformed nonfiction readers and non-readers on social-cognitive tasks, with a small and statistically significant effect size ($g = .15$), and with similar results after reestimating the model including unpublished data sets ($g = .16$). These results suggest that reading fiction boosts social-cognitive performance for short periods of time, when compared to nonfiction or no reading.

In a similar line, other research has provided experimental evidence that enhancements in theory of mind can also be found after exposure to other forms of fiction such as television shows and video games. Black and Barnes (2015a) studied the effect of watching television shows on theory of mind, with results showing enhancements in theory of mind performance for participants who watched award-winning television dramas, when compared to participants who watched documentaries. Similarly, another study (Bormann & Greitemeyer, 2015) found enhancements in theory of mind in people who played narrative video games, relative to participants who played the same narrative video game but were first asked to ignore its narrative elements, and to participants who played a non-narrative video game. These results support the abovementioned claims in regards of fiction boosting social-cognitive performance while suggesting that these effects may not be exclusive to the written medium.

Lastly, familiarity with fiction, self-reported empathy, and performance on an advanced affective theory of mind test have been found to be significantly correlated (Mar et al., 2006; Mar, Oatley, & Peterson, 2009), and experimental evidence suggests that reading fiction increases self-reported empathy (Djikic, Oatley, & Moldoveanu, 2013; Bal & Veltkamp, 2013). Thus supporting the notion that fiction exposure boosts people's social-cognitive performance, while also suggesting that these effects may translate into long-lasting improvements when exposure to fiction is frequent.

It is worth mentioning that, overall, studies investigating the effects of fiction on empathy and theory of mind assume that these social cognitive skills are malleable constructs that can vary depending on the environment and relatively short interventions, e.g. reading a single short story (Djikic, et al., 2013; Bal & Veltkamp, 2013; Kidd and Castano, 2013). However, studies exploring the effects of familiarity with fiction and general exposure to fiction propose that long-term exposure to fiction

may lead to stable improvements in theory of mind and empathy (e.g. Mar et al., 2006; Mar, Oatley, & Peterson, 2009, Kidd and Castano, 2013).

In sum, there is experimental evidence suggesting that reading high quality literature, as opposed to popular fiction and nonfiction, boost people's abilities to estimate the mental states of others. Results from experimental studies show that these effects are present shortly after reading fiction, while correlational studies measuring lifelong exposure to fiction suggest that these effects may be long-lasting when reading fiction is frequent. A recent meta-analysis concluded that exposure to fiction boosted social-cognitive abilities with a small but statistically significant effect size (g= .15 to .16). Lastly, evidence provided by experimental studies suggests that these effects may also be found in other forms of fiction, such as in television series and video games. Nevertheless, the mechanisms explaining these effects remain mostly speculative.

Underlying mechanisms connecting fiction to social cognition

Regarding the underlying mechanisms explaining how fiction boosts peoples' social-cognitive skills, it has been proposed that fiction expands readers' knowledge of others' lives, thus helping them recognize similarities between themselves and others (Mar et al., 2006; Mar et al., 2009; Schiappa, Gregg, & Hewes, 2005). Kidd and Castano (2013) propose a complementary explanation: that literary fiction affects theory of mind processes by forcing the readers to engage in mind-reading and character construction. This explanation echoes Nussbaum's (1995) and Vitz's (1990) proposals that when individuals read fiction, they try to take the perspective of the characters presented, eliciting the mental simulation of social interactions that in turn produce improvements in empathy. Considering these complementary explanations, two ways in which fiction boosts people's social cognition skills can be identified: knowledge, and simulation.

A systematization of the abovementioned explanations has been proposed by Mar (2015). According to the author, there are two routes through which fiction improves social cognition. In the *process* route, readers experience simulations of social situations, thus strengthening their own social-cognitive skills by vicariously experiencing social interactions of fictional characters. Complementing this, in the *content* route, readers learn concrete knowledge about human psychology and social interactions, thus enriching their understanding about how social interactions could and

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should work. Overall fiction facilitates the mental simulation of social interactions while also providing specific knowledge on how social interactions work, thus strengthening the readers' social skills.

Another explanation for how fiction boost peoples' social-cognitive skills relates to the distinction that some authors make in regards of literary and popular fiction (Kidd & Castano, 2013; Pino & Mazza, 2016) with the former focusing on character development and the latter on plot development (Kidd et al., 2016). The focus on characters and character development makes literary fiction particularly evocative of emotional responses in readers (Mar, Oatley, Djikic, & Mullin, 2011; Oatley, 1995), allowing them to assume the perspective of the characters inside the fictional stories and with it, new worldviews and characteristics (Fong, Mullin, & Mar, 2015).

It is worth noting that studies that compared the effects of literary fiction, popular fiction and nonfiction on social-cognitive performance (Kidd & Castano, 2013; Pino & Mazza, 2016) used the criteria of awards and nominations to discriminate between pieces of literary and popular fiction. More precisely, pieces of literary fiction that were chosen had either been nominated or received an award for their literary merit (e.g., O. Henry Award, National Book Award). This operationalization of the *literariness* of written fiction focuses on the consensual subjective evaluation of expert raters (i.e., literary prize jurors) regarding the quality and literary merit of the pieces. Nevertheless, the issue of the distinction between popular and literary fiction is still contested, with authors suggesting that both categories share a partial overlap and thus, a clear-cut distinction may not be possible (Kidd & Castano, 2013; Kidd et al., 2016).

Another complementary explanation of how reading literary fiction fosters empathy and theory of mind relates to how readers immerse themselves in the narrative. Oatley (1999, 2002) proposed that when readers feel transported into the narrative, they become emotionally involved with the story and connected with the characters, allowing them to change as a results of reading. Transportation into narrative worlds is defined as the state of cognitive, emotional and imaginal immersion in a text that enables the readers to regularly *lose themselves* into the narrative (Gerrig, 1993; Green & Brock, 2000). Evidence of this has been found in Green and Brock (2000), where readers that became transported into a story experienced a stronger change in their attitudes towards topics portrayed in the stories. Other studies (Appel, 2008; Appel and Richter, 2007, 2010) found that transportation into narratives is the main precursor of

changes in the individual, when reading fiction. More recently, Bal and Veltkamp (2013) found similar results when participants read a fictional story over a week: participants who experienced high transportation became more empathic while non-transported participants became less empathic.

Experience-taking is a concept similar to the one of transportation; it is defined as the imaginative process of spontaneously assuming the identity of a character in a narrative and simulating that character's thoughts, emotions, behaviour, goals, and traits as if they were the readers' own (Kaufman & Libby, 2012). Experimental evidence provided by the authors (Kaufman & Libby, 2012) shows that fictional stories written in a first-person narrative and in which the central character shares an in-group membership with readers (e.g., university affiliation), cause higher levels of experience-taking, which in turn leads participants to attribute relatively positive characteristics (e.g., extroversion) to themselves and to engage in prosocial behaviours (e.g., voting). This suggests that fictional stories eliciting the simulation of the experience of a fictional character may lead to meaningful behavioural changes in the readers.

Overall, the experimental evidence suggest that literary fiction has the potential to impact readers' behaviour as long as they feel cognitively and emotionally immersed in the narrative. Similarly, experimental evidence suggest that readers being able to assume the perspective of a character inside a fictional story can promote prosocial behaviour with potential applications for long-term attitudinal and behavioural change.

Complementary to the concept of transportation into the narrative and experience-taking as mediators in the relationship between fiction exposure and socio-cognitive performance, is the idea that individuals with different dispositional traits may benefit from different media. For example, Green et al. (2008) stated that individuals who have difficulty creating mental imagery may benefit from the fully vivid and concrete set of images provided by films; that is, films may be especially helpful to produce transportation for those low in imagery ability, which in turns affects their empathy. Although the original proposal by Green et al. (2008) referred to the comparison of books and films, it may be transferable to other media such as video games and VR, since they provide audio-visual stimulation similar to that of films in the sense that the provide a visual representation of the narrative that is often accompanied by sound and music cues that enhances the experience of storytelling.

Another dispositional variable that has been proven to play an important role in transportation into narrative is need for cognition. Need for cognition, defined as the tendency to enjoy and engage in effortful cognitive activity (Cacioppo & Petty, 1982), was proposed by Green et al. (2008) as an important moderator for transportation (see also Appel & Richter, 2007; Green & Brock, 2000). In this proposal, people who enjoy the mental exertion of reading tend to feel more transported when exposed to this medium, while people who do not enjoy the mental exertion of reading tend to feel more transported when exposed to the, arguably, less-demanding medium of film, video games or VR. Studies regarding imagery ability and need for cognition support the proposal that individuals with different dispositional traits may benefit from different media.

In sum, the scientific literature suggests that literary fiction can boost peoples' socio-cognitive performance, which can be explained by fiction providing knowledge about social situations and by eliciting the mental simulation of social interactions, thus enriching the readers' range of experiences and answers to real life social situations. Moreover, it has been proposed that literary fiction tends to be more emotionally engaging than popular fiction, thus allowing readers to project themselves inside novel situations and enhancing their social-cognitive skills. Similarly, authors have argued that feeling immersed in the narrative and being able to assume the perspective of a fictional character inside it, may be requisites to fiction producing behavioural changes. Lastly, it has been proposed that individuals with different dispositional traits such as imagery ability and need for cognition, may benefit from fiction presented through different media.

Empathy

In reviewing some of the most relevant research on the effects of fiction on social-cognitive skills, empathy emerged as an important outcome variable due to its role in adjusted social functioning. Research has found empathy to be associated with variables such as prosocial behaviour, positive interpersonal attitudes, reduced prejudice, and reduced aggression, thus highlighting its potential to positively impact the sphere of social relationships. Therefore, this section explores the definitions and measurements of empathy, as well as its associations with other variables.

Definitions of Empathy

According to Spreng, et al. (2009) "empathy" is derived from Titchener's (1909; Wispé, 1986) translation of the German word *Einfühlung*, meaning "feeling into" (Wispé, 1986). There seems to be a consensus in modern definitions of empathy that there is a distinction between a cognitive and an affective component. In this regard, Eisenberg and Fabes (1990) define empathy as the ability to share and understand others' thoughts and feelings, while Hoffman (2000) offers a similar definition of empathy "as the process where the attended perception of the object's state generates a state in the subject that is more applicable to the object's state or the situation than the subject's own prior state or situation". Similarly, Preston and de Waal (2002) define empathy as the consequence of perceiving the feeling state of another as well as the capacity to do so accurately. In all these cases, the definitions allude to a cognitive component, which involves being able to identify another person's emotional state, as well as an affective component, which involves being able to experience said emotional state after perceiving it in someone else.

The distinction between the cognitive and affective components of empathy has been further explored by other authors. Spreng et al. (2009) propose that emotional empathy refers to an emotional reaction to another's emotional response while the cognitive component refers to the intellectual or imaginative apprehension of another's emotional state. According to Spreng et al. (2009, p. 68), this two-dimensional structure of empathy finds support in monkey research and neuroimaging suggesting that despite both components being allocated in different parts of the brain, they are represented by the same process by viscero-motor mirror neurons, neurons that fire in response to executing as well as observing a goal-directed action or emotional experience of another (Gallese, 2003; Gallese, Keysers, & Rizzolatti, 2004; in Spreng et al., 2009).

Despite the relative consensus on the definition of empathy, the term is often confused and/or used interchangeably with others, hence the effort that some authors have put into distinguishing empathy from related concepts. In this regard, Soubhari and Kumar (2015) offer the distinction between empathy and emotional contagion, which involves the person matching the affective state of another, with sympathy which involves "feeling sorry" for the another (Preston & de Waal, 2002), and with perspective taking which refers to assuming another's cognitive and emotional states without one own's personal response (Rankin, Kramer & Miller, 2005). Also, it is

worth mentioning that the cognitive component of empathy is often described as overlapping with the construct of theory of mind and used interchangeably by some authors (Lawrence, Shaw, Baker, Baron-Cohen, & David, 2004).

An interesting proposal organizing some of these concepts comes from the self to other model of empathy (SOME; Bird & Viding, 2014). The model identifies the processes underlying the empathic response which have been linked to specific areas of the brain through neuroimaging studies of empathy. Under this model, an empathic response requires emotional contagion, or the matching of the affective state of another after being exposed to it, and theory of mind, or the cognitive representation of the mental states of others. This model then implies that theory of mind and emotional contagion are concepts related to one another and to empathy, but are ultimately components of the latter, thus they should not be used interchangeably.

Lastly, it has been proposed that empathy encompasses both a state and a trait component. This means that some individuals may be –in general– more empathic than others, either due to genetic or early experiential factors (Fonagy, Steele, Steele, & Holder, 1997, in Baron-Cohen and Wheelwright, 2004), but also that empathy may vary depending on the individual's current state. This distinction between state and trait components is important for research since it may affect the interpretation of results and the implications of findings in empathy research. For example, Koopman and Hakemulder (2015) pointed to the potential confound in studies exploring the effects of fiction on empathy regarding participants' trait empathy (a personality variable), and narrative empathy (the ability to identify and share the emotions elicited by a narrative world and its characters). Other authors have proposed that long-term exposure to fiction may lead to stable improvements in theory of mind and empathy (e.g. Mar et al., 2006; Mar, Oatley, & Peterson, 2009, Kidd and Castano, 2013), suggesting that changes in state component of empathy, may lead to changes in the trait component, provided that there is sufficient and constant stimulation (i.e., exposure to fiction). In practical terms, this state-trait distinction translates into the the challenge for empathy training programs to achieve long-term enhancements in trait empathy, beyond short-lived boosts in state empathy.

To sum up, empathy is a concept that has multiple definitions and that is often mistaken or used interchangeably with terms like emotional contagion, sympathy, and theory of mind. Nevertheless, most definitions of empathy coincide in two main

elements: being able to identify the emotional state of another, and experiencing that emotional state oneself. Furthermore, recent proposals supported by neuroimaging studies establish empathy as a process comprised of theory of mind (i.e., identify others' affective states) and emotional contagion (i.e., experiencing those affective states oneself).

Measurement of empathy

One of the earliest measures of empathy to achieve widespread use was The Empathy Scale (Hogan, 1969), a four dimensional scale of empathy measuring social self-confidence, even-temperedness, sensitivity, and nonconformity. This scale was later criticised by several authors arguing that the four dimensions that comprise the scale are a better reflection of social skills than of empathic behaviour (Baron-Cohen & Wheelright, 2004; Davis, 1983 in Spreng et al., 2009). Consequently, other authors have found that the measure has low test-retest reliability and internal consistency, as well as low replicability of its four dimension structure (Froman & Peloquin, 2001).

More recently, Davis (1980; 1983; 1994) developed the Interpersonal Reactivity Index (IRI), one of the most used questionnaires to assess empathy which defines the construct as the reactions of one individual to the observed experiences of another, which is open to the inclusion of its affective and cognitive components. The subscales that comprise the IRI are Perspective Taking and Fantasy in addition to Empathic Concern and Personal Distress, each pair thought to address cognitive and affective components of empathy respectively. Despite its wide use and relatively well installed acceptance, some authors (e.g., Baron-Cohen & Wheelwright, 2004) have criticised the IRI arguing that its Fantasy and Personal Distress subscales contain items that may assess imagination and emotional self-control instead of components of empathy. In this line of thought, Cliffordson (2001) analysed the factor structure and validity of the scale concluding that the Personal Distress subscale may not assess a central component of empathy, but instead may be more related to the personal trait of neuroticism. Similarly, Alterman, McDermott, Cacciola, and Rutherford (2003) suggest that the Empathic Concern and Perspective Taking subscales appear to be the most robust components of empathy.

The IRI case serves as an example of the heterogeneity of measures and meanings associated with empathy which includes: perspective taking, sympathy,

personal distress, emotional contagion and theory of mind among others. In this regard, Spreng et al. (2009) states that there is little agreement in the literature as to whether these terms are distinct from empathy as an accurate affective insight into the feeling of another, or are facets of a central process required for empathic responding.

Partially inspired by the heterogeneity of measures and meanings, Spreng et al. (2009) developed the Toronto Empathy Questionnaire (TEQ), a unidimensional measure of empathy that used the items of prior empathy scales as the item pool from which exploratory factor analysis determined the items that comprise the final version of the scale. The TEQ is consistent with the approach taken by other researchers in forming self-report measures of empathy based on the emotional components (e.g., Mehrabian & Epstein, 1972) or an accurate affective insight into the feelings state of another (Spreng et al., 2009). It is important to note that despite the unidimensional approach to the measurement of empathy taken by the TEQ, the authors recognize that a multifaceted approach may be preferable in some situations, hence, the development of the TEQ should not be taken as a replacement of multidimensional measures, but as a tool to examine the construct at its broadest level.

More recently, Coll et al. (2017) proposed a new framework for the measurement of empathy based on the idea that empathy was comprised of two sequential processes: emotion identification and affect sharing. Emotion identification refers to consciously attributing an emotion to an individual, while affect sharing refers to assuming the affective state that was attributed in the previous step. Empathy being the product of two processes means that it depends on both the accuracy of the emotion identification process and intensity of the affect sharing process, highlighting the need to address both processes when measuring empathy. Consequently, the authors propose that when measuring empathy, reports of the attributed affective states and of the participants' own emotional state should be contrasted with the actual states of others they are trying to empathize with so that measures of accuracy and intensity can be obtained. Despite the authors proposing just a framework, and not a definite way to measure empathy, the framework can be applied to different ways of measuring empathy such as through self-report, implicit paradigms, and imaging techniques.

In sum, there is a wide variety of empathy measures, uni- and multi-dimensional, and each one addressing a specific definition of the concept. Nevertheless, a recent proposal suggest that the measurement of empathy should encompass both

elements that characterize this process: inferring other's emotional states, and experiencing that emotional state oneself. Under this proposal, the measurement of empathy should include accuracy of the inference, and intensity of the affect sharing experience.

Effects of Empathy

Regardless of the varied definitions of empathy and ways of measuring it, a basic assumption is that empathy has an important role in regulating social life by, for example, facilitating prosocial and altruistic behaviour and inhibiting antisocial behaviour.

More precisely, there is evidence associating empathy with prosocial behaviour (e.g., Eisenberg & Miller, 1987; Eisenberg et al., 2010; Geng et al., 2012; Hoffman, 2000), even when prosocial behaviour targets members of stigmatized groups (Batson et al., 1997). Empathy has also been associated with positive interpersonal attitudes and reduced prejudice (e.g., Galinsky et al., 2005; Johnson, 2013), and reduced aggression (e.g., Batanova & Loukas, 2016; Espelage et al., 2004; Lovett & Sheffield, 2007). In this regard, Heckhausen (1989) proposed that by assuming the perspective of the victim, perpetrators may learn about the negative consequences of violence, reducing the chances of them using it in the future. Therefore, under this proposal empathy would regulate violent behaviour (Miller & Eisenberg, 1988). These associations are evidence that empathy plays a central role in the ability to understand and react adaptively to other's emotions and points of view which itself is relevant for a harmonious social life.

Regarding the association between empathy and prosocial behaviour, Eisenberg and Miller (1987) investigated said association through a meta-analysis which organized the relevant literature by the method used to measure empathy. Overall, results show an association (low to moderate effect sizes) between empathy and prosocial behaviour when empathy was assessed through self-report scales, physiological responsivity, or observers' reports of an individual's empathy. Conversely, results showed non-significant associations when empathy was measured with story/picture indices.

Also, as Vachon and Lynam (2016) point out, empathy is associated to several externalizing syndromes. More precisely, according to the Diagnostic and Statistical

Manual of Mental Disorders -DSM-5- (American Psychiatric Association, 2013) deficits in empathy are associated with conduct disorder, antisocial personality disorder, and narcissistic personality disorder. Furthermore, the DSM-5 proposes a new trait model which establishes that deficits in empathy are at the core of all personality disorders (Vachon & Lynam, 2016), thus highlighting the importance of studying empathy given its association with mental disorders.

In conclusion, despite the varied definitions and measurements of empathy, the scientific literature tends to coincide in the relevance of this construct for a harmonious social life. Empathy has been associated with prosocial behaviour, and reduced prejudice and aggression. In contrast, deficits in empathy have been associated with conduct and personality disorder. Overall, these associations support the relevance of investigating ways in which empathy can be fostered.

Theory of Mind

Another relevant concept that emerges in the literature of the effects of reading fiction is theory of mind. Sometimes used interchangeably with empathy, it is considered to play an important role in harmonious social functioning due to its function of estimating the intentions, knowledge and affective states of others. This section explore the definitions and measurements of theory of mind.

Definitions of Theory of Mind

A broad definition of theory of mind refers to the ability to infer the mental states of others, including intention and knowledge. The concept refers to "theory of" because the inferred mental states are not directly observable and so, instead, people generate a theory based on predictions about how others will behave (Olderbak et al., 2015).

The concept of theory of mind was originally developed to describe the behaviour of chimpanzees, focusing on the attribution of mental states of others, as opposed to the concept of empathy which focused on the attribution of emotional states (Premack & Woodruff, 1978). The concept was later extended to describe the development of children in their ability to take the perspective of another person (e.g., Wellman, Cross, & Watson, 2001).

More modern definitions of theory of mind refer to it as the ability, not only to infer, but to also to adopt another individual's perspective, meaning that under this definition, the concept could be used interchangeably with cognitive empathy (Blair, 2005; Lawrence et al., 2004). Furthermore, it has been proposed that there is a distinction between affective theory of mind, which is the ability to detect and understand others' emotions, and cognitive theory of mind, which is the inference and representation of others' beliefs and intentions (Shamay-Tsoory & Aharon-Peretz, 2007, Shamay-Tsoory et al., 2010). Under this paradigm, both affective and cognitive theory of mind could be understood as first stages of affective and cognitive empathy, where the individual identifies the emotional and mental state of another, prior to experiencing that estimation.

Theory of mind has also been referred to as "mentalizing" (Morton, Frith, & Leslie, 1991), "mind reading" (Whiten, 1991), and "social intelligence" (Baron-Cohen et al., 1999) and, as mentioned previously often overlaps with the term "empathy'" (Baron-Cohen et al., 2001). More precisely, the affective component of theory of mind, in particular, is linked to empathy (positively), but the relationship between both concepts is not entirely clear since both are often used interchangeably (Lawrence et al., 2004).

Whether empathy and theory of mind are used interchangeably or as two separate constructs, there is an inherent importance of studying these concepts since the ability to estimate the subjective states of others support the empathic responses that in turn allow individuals to establish and maintain meaningful and harmonious relationships (Batson, 1998; de Waal, 2012; Saxe, Carey, & Kanwisher, 2004; Sebastian et al., 2012; Shamay-Tsoory, 2011). Furthermore, impairments in theory of mind have been linked to clinical populations such as those with traumatic brain injury, schizophrenia, or autism spectrum disorders (Byom & Mutlu, 2013), thus highlighting the relevance of investigating ways to foster theory of mind.

In sum, despite the different definitions of theory of mind, most refer to the ability to accurately infer the cognitive and affective states of others. As described previously, theory of mind has often been used interchangeably with the term of empathy, nevertheless recent proposals establish theory of mind as the first component required for the empathic process to take place. Under this proposal, studying ways to foster theory of mind could benefit individuals' empathy, as well as potentially

benefiting clinical populations linked to theory of mind impairments such as individuals with autism spectrum disorders, schizophrenia, and traumatic brain injury.

Measurement of theory of mind

Most measures of theory of mind refers to the estimations of others' desires, intentions, emotions and perceptions while ignoring one's own point of view, and just as the definition distinguishes between affective and cognitive theory of mind, so do the different measures.

One example of a cognitive theory of mind measure is the Sally-Anne test, developed by Baron-Cohen, Leslie, and Frith (1985). This test uses dolls, Sally and Anne, to present children with a fictitious scenario in which they are asked to answer a question ("Where will Sally look for the marble?") based on the point of view of one of the characters/dolls while ignoring their own privileged point of view (them knowing where the marble is).

More recently, Converse, Lin, Keysar and Epley (2008) developed a modified version of the Sally-Anne False Belief Test which adapted it for an adult population. The new task consisted of a scene presented in two panels from which participants have to estimate the probability of an event based on the point of view of a character inside those panels, while having to ignore their own privileged knowledge. Scores in this measure indicate to what extent participants are able to assume the perspective of the characters while answering. It is expected that participants with high levels of theory of mind ability base their estimations on the point of view of Vicky, while ignoring their own privileged knowledge.

Affective theory of mind has been measured through the Revised Version of the Reading the Mind in the Eyes Test (Baron-Cohen et al., 2001). This test measures the ability of participants to attribute affective mental states to facial expressions presented through photographs that only depicts the face around the eyes. It is comprised of 36 stimuli, balanced by gender, each with four options, one target word and three foils. More recently, Olderbak et al. (2015), proposed a brief version of the Reading the Mind in the Eyes Test, leaving only 10 of the 36 stimuli while retaining psychometric properties of the original scale.

The Yoni Test (Shamay-Tsoory & Aharon-Peretz, 2007) was designed as a response to measures that had addressed cognitive and affective theory of mind

separately by including both dimensions and also first order (tracking one target's mental state) and second order items (tracking two targets' mental states). For each trial, participants are shown four images surrounding a central character (usually named Yoni). For the cognitive theory of mind trials, participants must identify, based on visual and linguistic cues, which of the four surrounding images the central character is thinking about or wants. For affective theory of mind trials, participants must make similar decisions about which image the central character likes, loves, dislikes, or does not love. The Yoni Test is a relatively new measure that has been used in only a handful of studies, however, it has been validated (Shamay-Tsoory & Aharon-Peretz, 2007; Shamay-Tsoory, 2008; Shamay-Tsoory et al., 2010).

More recently Young, Camprodon, Hauser, Pascual-Leone and Saxe (2010) proposed a theory of mind measure based on a moral judgement task which evaluates to what extent individuals think spontaneously about intentions when judging an individual's behaviour. The scale comprises 48 scenarios with four different variations combining (i) either a negative or neutral outcome with (ii) either an intentional or accidental attribution to the outcome, to produce four possible combinations: intended harm (negative outcome with intentional attribution), accidental harm (negative outcome with accidental attribution), attempted harm (neutral outcome with intentional attribution), and no harm (neutral outcome with accidental attribution).

In this task, participants are asked to make judgments for each scenario, rating how forbidden or permissible were the protagonists' actions, which would -and arguably does- indicate moral judgment on the participants' behalf. Nevertheless, the focus of this task is on the variations of these judgments within subjects and/or differences across groups. These variations and differences are interpreted as variations in theory of mind, since participants considering the protagonist's intentions in their judgments would evaluate the actions in the accidental harm scenarios as more permissible, and the actions in attempted harm scenarios as less permissible. Previous studies have shown that responses to accidental harm and attempted harm scenarios provide a sensible measure of theory of mind (Moran et al., 2011; Young et al., 2010).

In sum, a review of the scientific literature suggests that measures of theory of mind tend to focus on individuals being able to infer the mental states of characters in fictional scenarios, focusing on inferring either knowledge (i.e., cognitive theory of mind) or affective states (i.e., affective theory of mind). Measures of theory of mind

can follow a written format (e.g., written vignettes), or graphic format (e.g., pictures of facial expressions). Overall, this review suggests that measuring theory of mind can be achieved through different means, each one associated with a specific definition of theory of mind, but also with limitations.

Theoretical Focus and Methodological Rationale

Previous sections of this chapter have examined the scientific literature showing that reading fiction can enhance people's social cognitive skills, more precisely empathy and theory of mind. This suggests that leisure activities that are part of some people's daily life, such as reading fiction, can boost their understanding of others' intentions, knowledge, and emotions. But are these effects limited to written fiction? This thesis proposes that these effects may also be found when fiction is presented through video games and virtual reality films. To test this proposal, three studies were conducted aiming to evaluate if boosts in social-cognitive skills are associated with reading fiction (Studies 1 to 3), playing video games (Studies 1 to 3), and watching virtual reality films (Study 3). This section provides a brief overview of the scientific literature that informed the theoretical approach and methodological rationale for these studies.

The main theory underlying this thesis' aims can be traced to Oatley's hypothesis that fiction serve as a mental simulation of social worlds in which readers interpret the cues that the authors of fiction offer, thus eliciting theory of mind processes similar to the ones people use in ordinary life (Oatley, 1999, 2008). This hypothesis was later developed in the proposal that fiction serves as an abstraction and simulation of social experiences (Mar & Oatley, 2008). Under this proposal, Mar and Oatley posit that fiction offers a carefully planned abstraction of the human psyche since fiction is about human behaviour and its underlying motivations. In turn, this abstraction provides a simulative experience that allows the compelling and efficient transmission of social knowledge, extending the readers' understanding of the social world, thus enhancing their social-cognitive skills.

The hypothesis that fiction can improve people's understanding of others was explored in correlational and experimental studies. More precisely, Mar et al. (2006), explored the association between lifelong exposure to fiction and social ability, with

results showing a positive association between these two variables. Furthermore, the correlational approach used in this study was used as a template for Study 1 of this thesis, which explores the possible associations between long-term exposure to written fiction and video games, with empathy, cognitive-, and affective theory of mind.

Study 1's approach of exploring the association between long-term exposure to written fiction and video games with empathy and theory of mind, was complemented with the proposal that some genres, but not all, may be associated with the social-cognitive skill of interpersonal sensitivity (Fong, Mullin and Mar, 2013). Authors of this study found that when comparing the effects of different fiction genres, only romance, and suspense and thriller genres were associated with increased interpersonal sensitivity. Therefore, Study 1 explored the association between lifelong exposure to specific genres of written fiction and video games, with empathy, and with cognitive and affective theory of mind.

Nevertheless, it is worth mentioning the disparity between literary and video games genres, which meant that adjustments had to be made to the categorization of video games genres. More precisely, despite literary genres referring to the works' specific contents and emotions they aim to elicit (e.g., romance, science fiction and fantasy), video games genres may refer to a variety of dimensions of games, including: the focus on social interactions and character development (e.g., role-playing games, puzzle games); the way in which the game is played (e.g., first person, third person); and the extent to which the video game incorporates interaction with other players (e.g., single player, massive online multiplayer). This disparity between literary fiction and video games genres means that the proposal of only specific literary genres having an effect on social-cognitive performance may not be easily mapped onto video games genres.

To circumvent the disparity between literary and video games genres, Study 1 followed the proposal that video games genres could be systematized by their levels of complexity and the extent of social interactions needed to play them (Granic et al., 2014). Thus, participants of Study 1 were also asked to evaluate each video game genre by how complex (i.e., players' decisions changing how the game progresses and *vice versa*) and social (i.e., how much the game requires playing with other people) they tend to be. Based on these evaluations, video games genres were classified into one of four categories: complex and social, complex and non-social, simple and social, and

simple and non-social. Under this categorization, arguably, complex and social video games may elicit higher levels of immersion, which in turn was expected to be associated with increased empathy and theory of mind.

Lastly, the selection of measures for Study 1 was informed by some of the studies mentioned earlier, in this and previous sections of this chapter. More precisely, cognitive theory of mind was measured through the False Belief Test (Converse et al., 2008) as used in Kidd and Castano (2013); affective theory of mind was measured through the "Reading the Mind in the Eyes" Test (Baron-Cohen et al., 2001), as used in Mar et al. (2006), Kidd and Castano (2013), and Fong et al. (2013); and empathy was measured through The Interpersonal Reactivity Index (Davis, 1980; 1983; 1994) as used in Mar et al. (2006). As previously mentioned, the concepts of empathy and theory of mind are often used interchangeably, between them and with other concepts; nevertheless, this study focuses on the proposal that they are separate constructs.

Regarding Studies 2 and 3, their methodological rationale can be traced mainly to the study by Kidd and Castano (2013) which hypothesized that not all pieces of fiction produce social-cognitive enhancements, but only fiction that is of high quality. To test this hypothesis, Kidd and Castano randomly assigned participants to either read an award-winning piece of fiction (i.e., higher quality literature, or literary fiction), a piece of popular fiction (i.e., lower quality literature), or a piece of nonfiction (e.g., news article). Consequently, Studies 2 and 3 of this thesis used Kidd and Castano's experiments as templates in terms of its experimental design with random assignation to their conditions, as well as the criteria for the selection of high quality stimuli (i.e., award-winning pieces of fiction, video games, and virtual reality films).

The design and variables of Studies 2 and 3 were complemented by other studies previously discussed in the section regarding the underlying mechanisms connecting fiction to social cognition. More precisely, Studies 2 and 3 included transportation into the narrative (Green and Brock, 2000), and experience-taking (Kaufman & Libby, 2012) to explore the extent to which feeling immersed in the narrative, and being able to assume the experience of a fictional character inside of it, explains the enhancing effect that exposure to fiction has on social-cognitive performance. Considering this, transportation into the narrative and experience-taking were included in Studies 2 and 3 to explore their possible mediation effects.

Study 2 also included the variables imagery ability (Green et al., 2008), and need for cognition (Appel & Richter, 2007; Green & Brock, 2000, 2002; Green et al., 2008). The inclusion of these variables was based on the literature suggesting that people who are skilled at forming mental images in their mind's eye, and that are more inclined towards effortful cognitive activities, may feel more immersed by fiction presented in written form (Green & Brock, 2000, 2002; Green et al., 2008). Conversely, this proposal suggests that people with low imagery ability and need for cognition tend to feel more immersed in narratives that are presented with the help of audio-visual stimulation such as films and –arguably– in video games. Thus, imagery ability and need for cognition were included in Study 2 to test their possible moderation effects in the association between exposure to fiction –as written literature and video games– and transportation into the narrative and experience-taking.

Lastly, Study 2 explored the effect that reading fiction may have on prosocial behaviour as an outcome variable. The inclusion of prosocial behaviour was based on the literature showing a positive association between empathy and prosocial behaviour (e.g., Eisenberg & Miller, 1987; Eisenberg et al., 2010; Geng et al., 2012; Hoffman, 2000) and the idea that, arguably, prosocial behaviour would better reflect the possible benefits of fiction exposure on everyday behaviour.

Based on the abovementioned variables and the hypothesized relationships between them, Studies 2 and 3 adopted an experimental approach, thus differing from Study 1's design. Study 1 followed a correlational design in line with the scientific literature suggesting that lifelong exposure to fiction is positively associated with enhanced social-cognitive performance. By using a correlational approach, Study 1 was expected to evaluate the associations between written fiction and playing video games with social-cognitive performance under real-life conditions. Nevertheless, given the variety of quality and contents of video games, as well as different ways in which they can be played, it may be that some, but not all video games may produce boosts in social-cognitive performance. Considering this, a correlational approach may be unable to capture which video games can produce social-cognitive enhancements since, in real-life conditions, players do not necessarily play only one type of video games. Additionally, there is the limitation that a correlational approach addresses associations between variables, but does not provide information in regards of the causal direction of said associations (assuming there is one). This would be problematic considering the

possibility that, if significant associations were to be found in Study 1, its correlational design would not rule out the alternative explanation that individuals with high social-cognitive skills are more drawn to these leisure activities.

To address these limitations, Studies 2 and 3 followed an experimental design to explore the effect that high quality written fiction, video games and virtual reality films, may have on people's theory of mind. Nevertheless, experimental designs entail limitations and strengths of their own. More precisely, experimental designs can entail generalizability issues due to the specificity of the stimuli and testing conditions which may not be representative of real-life scenarios. In a similar way, there is the possibility of testing conditions affecting the participants' behaviour, meaning that their responses may not be true indicators of their behaviour in real-life scenarios. Thus, these limitations should be taken in consideration when interpreting results and discussing findings of these studies.

Nevertheless, given the overall strengths of experimental designs, it was expected that Studies 2 and 3 would better address the possible causal relationship between exposure to fiction and social-cognitive enhancements. Additionally, after having identified high quality and social contents as two core elements that may be necessary for fiction to produce social-cognitive enhancements, an experimental approach would be optimal to test the effect that specific stimuli that fit these criteria, have on social-cognitive performance. Experimental approaches allow the manipulation and control of extraneous variables; in the case of Studies 2 and 3 this may be relevant to eliminate environmental distractions, standardize the time spent interacting with fiction, and control for possible differences in the stimuli's attributes (e.g., complexity, message, social interactions depicted). In doing so, Studies 2 and 3 would provide a clearer measure of the effects that exposure to fiction –through written literature, playing video games and watching virtual reality films– may have on social-cognitive performance.

Lastly, regarding strengths specific to Study 3's design, they refer to the inclusion of pre- and post-manipulation measurements of theory of mind, while comparing the effects of different forms of fiction, namely: literary fiction, narrative video games, and virtual reality films. This contrasts with Study 2's design which included only post-manipulation measurements of theory of mind given its analytical approach (path analysis). The inclusion of pre- and post-manipulation measurements

in Study 3, provided a stronger evaluation of the effects of fiction on theory of mind by measuring possible variations of theory of mind within each condition over time. Additionally, the inclusion of virtual reality films as third form of fiction in Study 3 allowed to test the effects of a third media for the delivery of fiction, in addition to written literature and video games. In doing so, it improved the generalizability of results regarding if fiction improves people's understanding of others, regardless of the media fiction is presented on.

In summary, the next three chapters present three studies that, firstly, aimed to conceptually replicate previous research suggesting that reading high quality fiction enhances peoples' abilities of estimating others' intentions, knowledge and emotions, and of experiencing said emotions themselves. Secondly, they aimed to explore if these enhancements are also present after people are exposed to fiction in modern media, such as video games, and virtual reality films.

Study 1 (Chapter 3) was an online survey, exploring the association between reading literary fiction, and playing video games, with empathy, and theory of mind. This study also explores the influence that different video game genres may have on empathy, and theory of mind. This study used a broad approach measuring frequency of reading fiction and playing video games (i.e., weekly time spent in these activities) while addressing written fiction and video games genres but without distinguishing their quality or specific contents.

Study 2 followed a more targeted approach by using an experimental design with random assignment that evaluated short-term effects of exposure to fiction that met certain criteria of quality and contents on theory of mind. More precisely, it compared the effects of award-winning short stories of fiction and video games that depicted social interactions between characters (experimental conditions), and of puzzle video games of lower quality and without social contents (control condition). This study also aimed to test the possible mediation roles of transportation into the narrative, and experience-taking and possible moderation roles of imagery ability, and need for cognition. Finally, this study examined the effect that exposure to fiction may have on prosocial behaviour.

Study 3 used an experimental design comparing the effects of award winning short stories of fiction, video games, and virtual reality films that depicted social

interactions between characters, on theory of mind, transportation into the narrative and experience-taking. This study also aimed to compare the effect that virtual reality films may have on theory of mind, in contrast to the other two conditions grouped as non-virtual reality conditions.

Taken together, these studies test if fiction enhances people's abilities of understanding others' intentions, knowledge and emotion and of matching the emotional states of others, as well as exploring if these effects can also be found after people are exposed to fiction in video games and virtual reality films.

Chapter 3:

Reading Fiction and Playing Video Games as Leisure Activities and Its Association with Empathy and Theory of Mind

Considering both the important role that empathy and theory of mind play in adjusted social functioning, the increasing use of video games in everyday social life, as well as the similarity between video games and fiction as imagined worlds, it was deemed both useful and plausible to test if the associations present between reading literary fiction and empathy, and theory of mind are also present with video games playing.

In terms of design, Study 1 sought to replicate and to expand on correlational studies exploring the association between lifelong exposure to fiction and social ability (Mar et al., 2006). The main novel element of this study is the evaluation of lifelong exposure to video games as a possible predictor of increased theory of mind and empathy. This study's approach was also complemented with the proposal that some genres of fiction, but not all, may be associated with social-cognitive skills and interpersonal sensitivity (Fong, et al., 2013). Therefore, this study explored the

association between lifelong exposure to specific genres of written fiction and video games, with empathy, and with cognitive and affective theory of mind. However, considering the disparity between literary and video games genres, adjustments were made to the categorisation of video games, more precisely, video games genres were grouped by their levels of complexity and extent of social interactions needed to play them, as proposed by Granic et al. (2014). Under this categorisation, arguably, complex and social video games may elicit higher levels of immersion, which in turn was expected to be associated with increased empathy and theory of mind.

Lastly, the selection of measures for this study was informed by some of the studies mentioned in the previous section. Namely, cognitive theory of mind was measured through the False Belief Test (Converse et al., 2008), as used by Kidd and Castano (2013); affective theory of mind was measured through the "Reading the Mind in the Eyes" Test (Baron-Cohen et al., 2001), as used by Mar et al. (2006), Kidd and Castano (2013), and Fong et al. (2013); and empathy was measured through The Interpersonal Reactivity Index (Davis, 1980; 1983; 1994) as used by Mar et al. (2006). For the purposes of this study, the concepts of empathy and theory of mind were used as separate constructs.

The first objective of this study was to explore the effect that playing video games and reading books of fiction have on the following social-cognitive skills: cognitive theory of mind, affective theory of mind, and empathy. A second objective was to explore the influence that different video games genres, grouped by levels of complexity and social components, may have on the aforementioned interpersonal variables.

Hypotheses

The main hypothesis of this study was that the amount of hours spent playing video games and reading books of fiction will be positively associated with cognitive and affective theory of mind and with empathy. A secondary hypothesis of this study was that when comparing video games grouped by their level of complexity and social elements, complex and social video games will present a higher positive association with theory of mind and empathy than simple and non-social video games.

The main hypothesis of this study was based on the positive association between lifelong exposure to written fiction and social ability reported in the literature (e.g., Mar et al., 2006), and on studies suggesting that these effects may not be specific to written fiction, with social-cognitive skills being boosted by watching high quality television series (Black & Barnes, 2015a), and by playing narrative video games (Bormann & Greitemeyer, 2015). The secondary hypothesis was based on the literature suggesting that some genres, but not all, may be associated with the social-cognitive skill (Fong, et al., 2013). This hypothesis was complemented with the systematization proposed by Granic et al. (2014) regarding the classification of video game genres by their levels of complexity and social elements. Further details of the research that led to the rationale for the hypotheses of this study can be found in chapter 2.

Method

Design

The present study consisted of an online questionnaire with a non-experimental design, cross-sectional, ex-post-facto with a correlational scope. Overall, the study measured the variables without intentional manipulation, measuring them at only one period of time after they occurred, with the aim of establishing whether two or more variables were associated (Hernández, Fernández, & Baptista, 2004).

Participants

For this study, 373 participants were recruited (176 males, 197 females: M_{age}=25.18 years, SD_{age}=8.81). About their gaming habits, 72.4% of the participants reported playing video games (either on their computer, console, smartphone or tablet) on average 16.9 hours per week (SD = 12.0); 37.0% of participants played with other people to compete and 48.5% did it to collaborate (nonexclusive categories). About their reading habits, 69.4% read books as a leisure activity, for an average of 6.6 hours per week (SD = 4.8). *Post hoc* power analyses show adequate power levels, with values ranging from 0.96 to 0.99 [α = .05; N = 373; f^2 = .06 - .22; 7 predictors). Power was calculated using G*power 3.1.9.2 (Faul, Erdfelder, Lang, & Buchner, 2007).

Participants were recruited through the University of Sheffield mailing list of staff and students volunteers and through the distribution of flyers on university public spaces, following self-selection and opportunistic sampling methods (respectively).

The study was presented to participants as a study of leisure activities in which they would have to answer an online questionnaire about their gaming and/or reading experience as well as identifying different emotions. Participants could opt to partake in a prize draw to win one of three £20 gift cards as an incentive, in which case their contact information was asked (name, email address and telephone number) on a follow-up questionnaire. This personal information was stored separately from the main questionnaire to retain anonymity of the responses. The study received ethical approval from the Ethics Committee of the University of Sheffield's Psychology Department (Reference Number 006846).

Measures

An online questionnaire was administered that included measures of cognitive and affective theory of mind, empathy, current mood, weekly hours of books of fiction read (by genre) and video games played (by genre). Participants were also asked to evaluate video games genres by their levels of complexity and social components. A complementary questionnaire included questions about gender, age and video game playing habits.

Cognitive theory of mind was measured through the False Belief Test (Converse et al., 2008). In this test a series of cards present a scene in which a character, Vicki, places a violin in a blue box and leaves the room. Then, another character enters the room and switches the location of the violin to a red box (false belief scenario) or switches the locations of the blue and red boxes (no false belief scenario). Participants must then estimate the probability (as a percentage) of Vicky looking in the red box. A higher score in the false belief condition compared to the no false belief condition indicates an egocentric response (low theory of mind). This is considering that scores will be higher in the false belief (red) scenario than in the no false belief (blue) scenario, only if participants use their private knowledge (low theory of mind) about the location of the violin. Conversely, there should be no differences between the two scenario conditions if participants ignore their private knowledge and only take into account what the other person knows (high theory of mind). Consequently, the blue condition serves as a comparison to ensure that the score in the red condition reflects use of egocentric knowledge, and not something else (e.g. a person's belief that people sometimes make mistakes). The measure therefore requires testing for an interaction

effect between the scenario condition and the main independent variables of interest (weekly hours spent reading fiction, and hours spent playing video games).

Affective theory of mind was measured through the brief form of Reading the Mind in the Eyes Test proposed by Olderbak et al. (2015), a derived version of the full revised version of the scale proposed by Baron-Cohen et al. (2001). This test measures the ability of the participants to attribute mental states to facial expressions in ten photographs that only show the face around the eyes. Higher scores in this measure indicate higher success rate on the attribution of mental states to the facial expressions, hence higher levels of affective theory of mind.

Empathy was measured through Davis's Interpersonal Reactivity Index - IRI (Davis, 1980; 1983; 1994). The scale is a 5-point scale in which participants have to evaluate how well each item describes them, with 28 items divided equally among four distinct subscales: Perspective taking, defined as the tendency to spontaneously adopt the psychological view of others in everyday life ($\alpha = .79$); empathic concern, as the tendency to experience feelings of sympathy or compassion for unfortunate others ($\alpha = .81$); personal distress, defined as the tendency to experience distress or discomfort in response to extreme distress in others ($\alpha = .81$); and fantasy, the tendency to imaginatively transpose oneself into fictional situations ($\alpha = .77$).

Current mood was also measured to account for its possible effect as a confounding variable. It was measured, as proposed by Poerio, Totterdell, Emerson and Miles (2015), with three bipolar measures: sad-happy, bored-excited and anxious-calm. These items were chosen to measure the pleasure (valence) and arousal (activation) dimensions of core affect (Remington, Fabrigar, & Visser, 2000); specifically, pleasure (sad-happy), pleasant activation (bored-excited) and pleasant deactivation (anxious-calm).

Weekly hours of books of fiction read was assessed by asking the participants how many hours in a week, on average, they spent reading books of different fiction genres (and one non-fiction category that served as a control item). Genre classification was used as proposed by Fong et al. (2013), consisting of: domestic fiction, romance, science fiction and fantasy, suspense and thriller, and non-fiction literature. Each genre was presented in the questionnaire with a brief definition that participants could consult on demand (see Appendix A).

Weekly hours of video games played was assessed by asking the participants how many hours in a week, on average, they spent playing video games of the following genres: action-adventure, adventure, fighting, massive multiplayer online game (MMO), multiplayer battle arena (MOBA), platform/platformer, puzzle, role playing game (RPG), racer, rhythm/dance, shoot 'em up, simulators, sports, strategy. This list is a modified version of the classification used by the Pan European Game Information, PEGI (n.d.), which was validated with 41 video game players through an on-line questionnaire where participants suggested the addition of MOBA and fighting video games to the original list. Each genre was presented in the questionnaire with a brief definition and examples that participants could consult (see Appendix A).

Participants were also asked to evaluate the levels of complexity and social elements of each video game genre. Participants were asked to evaluate only those genres that they reported they played, using two bipolar scales concerning how simple or complex and how non-social or social each genre was on a scale from 0 to 100. Each scale was accompanied by a brief definition: complex games were described as those on which the players' in-game behaviours change how the game itself progresses, feeding back to, and constraining, how the player continues to adapt to these changes in subsequently updated game contexts; social video games were defined as those relying on varied social partners who provide a large amount of variability in game experiences, depending on whom the player encounters each time she or he enters the gaming world (Granic et al., 2014). Finally, the video games genres were grouped by calculating average scores for each genre on both scales and were then relabelled into simple or complex, depending if the score was below or above 50 points respectively, and into non-social or social, if the score was below or above 50 respectively. Finally, video games genres were grouped into one of four groups depending on the possible combinations of that two by two matrix (average scores and final classification of each genre can be seen on Table 3.1).

Table 3.1. Video game genres classification by their levels of complexity and social component.

Groups and Genre	Complexity		Social Component	
	N	Average Score	N	Average Score
Complex and Social				
Multiplayer Online Battle Arena	59	66.6	62	81.0
Massive Multiplayer Online Game	67	61.5	68	84.1
Complex and Non-Social				
Strategy	151	79.1	148	40.9
Role Playing Game	176	67.5	177	38.0
Simulators	91	60.5	99	24.2
Puzzle	126	57.9	126	26.7
Adventure	150	56.3	147	37.2
Action - Adventure	179	53.7	174	33.3
Simple and Social				
Fighting	73	48.6	74	61.6
Sports	69	45.0	70	69.8
Shoot 'em Up	116	37.1	115	66.3
Racer	72	32.1	69	60.7
Simple and Non-Social				
Platform/Platformer	103	40.4	101	23.8
Rhythm-Dance	21	24.4	21	49.7

Analysis Plan

Two sets of six hierarchical multiple regressions were performed to address each of the two hypotheses of this study.

The first set of six hierarchical multiple regressions were performed to address the main hypothesis of the study, which stated that the number of hours spent playing video games and reading books of fiction would be positively associated with cognitive and affective theory of mind and with empathy. Therefore, this set of regressions explored the effects that playing video games and reading books of fiction may have over cognitive theory of mind, affective theory of mind and the four subscales of empathy. This set of analyses used the average weekly hours of books of fiction read and the average weekly hours of video games played as independent variables, these averages were computed by adding the corresponding hours per week read or played of each genre. This set of analyses also explored possible moderator effects of age, gender, and current mood, in the associations between playing video games, and reading fiction, with cognitive and affective theory of mind, and with empathy.

The first hierarchical multiple regression considered cognitive theory of mind as the dependent variable. The following variables were entered in the first step of each model to account for their possible confounding effects: gender (dummy coded), age (standardised as Z score), current mood measures (sad-happy, bored-excited, anxious-

calm, all standardised as Z scores), and the condition task to which participants were assigned in the false belief test (dummy coded). In the second step, the standardised scores for the average weekly hours of both books of fiction read and video games played were entered. The third step incorporated the interaction between the standardised scores of average weekly hours of both books of fiction read and video games played.

The fourth and fifth steps of this regression aimed to explore possible moderator effects of gender, age, and current mood, in the associations between playing video games, and reading fiction, with cognitive theory of mind. To do so, the fourth step included the interaction between the standardised scores of average weekly hours of books of fiction read with: Gender (dummy-coded), age (standardised as Z score) and current mood (sad-happy, bored-excited, anxious-calm, all standardised as Z scores), and the condition task to which participants were assigned in the false belief test (dummy coded). Similarly, the fifth step included the interaction between those same variables variables and the standardised scores of the average weekly hours of video games played. Interactions that resulted statistically significant were further explored via simple slopes tests, as suggested by Dawson (2014).

The remaining five hierarchical multiple regressions followed a similar structure but omitted the variable that specified the theory of mind condition in step 1 and its interaction with other variables on steps 4 and 5. These regressions considered affective theory of mind (second regression) and the four submeasures of empathy as dependent variables (regressions three through six).

The second set of six hierarchical multiple regressions addressed the secondary hypothesis of this study. This hypothesis stated that when comparing video games grouped by their level of complexity and social elements, complex and social video games would present a higher positive association with theory of mind and empathy than simple and non-social video games. This set of regressions explored the effect that playing video games of different genre, grouped by their level of complexity and social component, may have over the following social-cognitive skills: cognitive theory of mind, affective theory of mind and the four subscales of empathy.

The first analysis of this set considered cognitive theory of mind as the dependent variable. The following variables where entered in the first step to account

for their possible confounding effects: gender (dummy coded), age (standardized as Z score), the three current mood measures (sad-happy, bored-excited, anxious-calm, all standardized as Z scores) and the condition task to which participants were assigned in the false belief test (dummy coded). In the second step, the standardized scores (Z scores) for the average weekly hours per week played for each group of video games (i.e., complex and social, complex and non-social, simple and social, and simple and non-social) were entered.

The other five multiple regressions of this set followed a similar structure but omitted the variable that specified the theory of mind condition in step 1. These regressions considered affective theory of mind (second regression) and the four submeasures of empathy as dependent variables of hierarchical multiple regressions (regressions three through six).

Results

Outliers, normality and multicollinearity

A total of 605 questionnaires were screened to ensure quality of the data and sample homogeneity. The screening consisted in the deletion of unfinished questionnaires, participants whose native language was not English, participants with constant answers on scales with ten or more items, and participants with outlier responses for the average hours per week played and average hours per week read, following the outlier labelling rule with a 2.2 multiplier (Hoaglin & Iglewicz, 1987). In the remaining responses, normality of the variables of interest was assessed through visual examination of their histograms. For each of the regressions, multicollinearity was assessed according to the suggestions of Hair, Anderson, Tatham, and Black (1998).

Main Analyses

Is playing video games and reading fiction associated with theory of mind and empathy?

The main hypothesis of this study was that the number of hours spent playing video games and reading books of fiction will be positively associated with cognitive and affective theory of mind and with empathy. To test this hypothesis, six hierarchical multiple regressions were conducted to explore the association between playing video

games and reading books of fiction with cognitive theory of mind, affective theory of mind and the four subscales of empathy.

Results of these hierarchical multiple regressions did not support the aforementioned hypothesis that playing video games and reading books of fiction are positively associated with cognitive and affective theory of mind and with empathy. More precisely, reading fiction was not directly associated with cognitive nor affective theory of mind, and was directly and positively associated only with two of the four subscales that make up empathy (perspective taking and fantasy), while presenting only moderated effects with the other two (empathic concern moderated by age, and personal distress moderated by pleasant activation). Playing video games is not directly associated with cognitive and affective theory of mind, nor with empathy, and it presented only moderated effects on perspective taking (by gender), empathic concern (by pleasant activation) and fantasy (by pleasant deactivation). Results of this set of analyses are presented below.

The first hierarchical multiple regression explored the association between playing video games and reading books of fiction with cognitive theory of mind. This regression analysis resulted in significant overall models at each step ($p < .05$), but only Model 1 ($F(6, 366) = 6.81$, $p < .001$, $R^2 = .1$, $R^2_{Adjusted} = .09$) presented a significant F Change ($F(6, 366) = 6.81$, $p < .001$) which indicates that after Model 1, the addition of other variables did not produce a significant increase in explanatory power. In Model 1, the variables that successfully predicted cognitive theory of mind were the condition to which participants were assigned, which was an expected effect ($\beta = .27$, $t = 5.37$, $p < .001$) and age ($\beta = -.13$, $t = -2.63$, $p = .009$). Thus, it is possible to conclude that neither reading books of fiction nor playing video games were associated with cognitive theory of mind.

The second hierarchical multiple regression explored the association between playing video games and reading books of fiction with affective theory of mind. This regression analysis resulted in non-significant overall models and F Change. Hence, it is possible to conclude that neither reading books of fiction, playing video games or any other variables considered in the study were associated with affective theory of mind.

Four more hierarchical multiple regressions were conducted to explore the association between playing video games and reading books of fiction with each of the four subscales of empathy, namely: perspective taking, empathic concern, personal distress, and fantasy. Results of these analyses are presented below.

For the perspective taking subscale, Models 2 through 5 were significant but only Model 2 ($F_{(7, 365)} = 3.09$, $p = .004$, $R^2 = .06$, $R^2_{Adjusted} = .04$) presented a significant F Change ($F_{(2, 365)} = 5.63$, $p = .004$). The only variable that significantly predicted perspective taking in Model 2 was reading books of fiction ($\beta = .17$, $t = 3.18$, $p = .002$). By looking into the excluded variables for this model, video game playing was moderated by gender ($\beta = .15$, $t = 2.05$, $p = .041$). Therefore, it is possible to conclude that perspective taking is positively predicted by reading books of fiction, and it is negatively predicted by playing video games, with male participants showing a stronger negative association between playing video games and perspective-taking than female participants (results and plots of the simple slope tests can be found in the following section of this chapter).

For the empathic concern subscale, all overall models were significant but only Model 1 ($F_{(5, 367)} = 8.20$, $p < .001$, $R^2 = .1$, $R^2_{Adjusted} = .09$) presented significant F Change ($F_{(5,367)} = 8.20$, $p < .001$). In Model 1, only gender (dummy coded for females) was significant ($\beta = .31$, $t = 6.15$, $p < .001$). By looking into the excluded variables for this model, reading books of fiction was moderated by age ($\beta = -.12$, $t = -2.30$, $p = .022$) and playing video games was moderated by current mood [bored-excited] ($\beta = -.10$, $t = -2.04$, $p = .04$). Detailed results of these moderated effects can be found later on this chapter in the Simple Slope Tests section. Overall, it is possible to conclude that both reading books of fiction and playing video games predict empathic concern, although these associations were moderated by age and current mood, respectively.

For the personal distress subscale, although the multicollinearity assessment showed variables with tolerance and VIF values out of the recommended range, none of them produced Condition Index values above the threshold of 30, thus there was no conclusive support for the existence of multicollinearity in these results. In the regression, all overall models were significant but only Models 1 ($F_{(5,367)} = 6.65$, $p < .001$) and 4 ($F_{(5, 359)} = 2.43$, $p = .035$) presented significant F Changes, hence Model 4 was selected ($F_{(13, 359)} = 3.79$, $p < .001$, $R^2 = .12$, $R^2_{Adjusted} = .09$). The variables

that significantly predicted personal distress in Model 4 were gender, dummy coded for females ($\beta = .15$, $t = 2.56$, $p = .011$), current mood [anxious-calm] ($\beta = -.16$, $t = -2.73$, $p = .007$) and reading moderated by current mood [bored-excited] ($\beta = -.13$, $t = -2.4$, $p = .017$). Detailed results of these moderated effects can be found later on this chapter in the Simple Slope Tests section. Overall, it is possible to conclude that only reading books of fiction successfully predicted personal distress, but this association was moderated by the current mood (bored-excited) of the participant.

For the fantasy scale, all overall models were significant but only Models 1 ($F(5, 367) = 8.24$, $p < .001$) and 2 ($F(2, 365) = 18.52$, $p < .001$) presented significant F Changes, hence Model 2 was selected ($F(7, 365) = 11.74$, $p < .001$, $R^2 = .18$, $R^2_{Adjusted} = .17$). The variables that significantly predicted fantasy in Model 2 were gender, dummy coded for females ($\beta = .27$, $t = 5.03$, $p < .001$), current mood [anxious-calm] ($\beta = -.12$, $t = -2.15$, $p = .032$) and reading books of fiction ($\beta = .29$, $t = 5.93$, $p < .001$). By looking at the excluded variables in Model 2, the following variables were significant: reading books of fiction moderated by gender ($\beta = .18$, $t = 2.55$, $p = .011$) and playing video games moderated by current mood [anxious-calm] ($\beta = .10$, $t = 2.0$, $p = .047$). Detailed results of these moderated effects can be found later on this chapter in the Simple Slope Tests section. Overall, it is possible to conclude that reading books of fiction and playing video games successfully predicted fantasy, but these associations were predicted by gender and current mood [anxious-calm] of the participant, respectively.

Is playing complex and social video games associated with theory of mind and empathy?

A secondary hypothesis of this study was that when comparing video games grouped by their level of complexity and social elements, complex and social video games will present a higher positive association with theory of mind and empathy than simple and non-social video games. To test this hypothesis another set of six multiple hierarchical regressions were performed exploring the effect that playing video games of different genre, grouped by their level of complexity and social component, may have over cognitive theory of mind, affective theory of mind, and the four subscales of empathy. Results of this analyses did not support this hypothesis, with complex and social video games not being associated with cognitive and affective theory of mind, nor with empathy. Results of this set of analyses are presented below.

The first multiple hierarchical regression of this set explored the association between playing different video games genres, grouped by their levels of complexity and on their social components, with cognitive theory of mind. In this regression analysis, both models were significant but only Model 1 ($F(6, 366) = 6.81$, $p < .001$, $R^2 = .10$, $R^2_{Adjusted} = .09$) presented a significant F Change ($F(6,366) = 6.81$, $p < .001$). The variables that significantly predicted cognitive theory of mind in Model 1 were the condition to which participants were assigned, which was an expected effect ($\beta = .27$, $t = 5.37$, $p < .001$), and age ($\beta = -.13$, $t = -2.63$, $p = .009$). It is possible to conclude that playing video games of different genre did not have a significant effect over cognitive theory of mind.

The second multiple hierarchical regression of this set explored the association between playing different video games genres, grouped by their levels of complexity and on their social components, with affective theory of mind. This regression analysis resulted in non-significant overall models and F Change, hence, it is possible to conclude that none of the different groups of video games or any other variables considered in the study were associated with affective theory of mind.

Four more hierarchical multiple regressions were conducted to explore the association between playing different video games genres, grouped by their levels of complexity and their social components, with empathy. Each regression included one of the four subscales of empathy as its dependent variable, namely: perspective taking, empathic concern, personal distress, and fantasy. Results of these four multiple regressions are described below.

For the perspective taking subscale, the hierarchical multiple regression resulted in non-significant overall models and F Change, hence, it is possible to conclude that none of the different groups of video games nor any other variables considered in the study were associated with perspective taking.

For the empathic concern subscale, both models were significant with Model 2 ($F(9, 363) = 5.77$, $p < .001$, $R^2 = .13$, $R^2_{Adjusted} = .10$) having a significant F change ($F(4, 363) = 2.56$, $p = .038$). The following variables were significant predictors of empathic concern in Model 2: gender, dummy coded for females ($\beta = .31$, $t = 5.97$, $p < .001$) and the weekly hours played of complex and non-social video games ($\beta = -.15$, $t = -3.06$, $p = .002$). It is possible to conclude that only playing video games that were

complex and non-social successfully predicted empathic concern, although the association was negative.

For the personal distress subscale, both models were significant but only Model 1 ($F(5, 367) = 6.65$, $p < .001$, $R^2 = .08$, $R^2_{\text{Adjusted}} = .07$) presented a significant F Change ($F(5, 367) = 6.65$, $p < .001$). In this model, the variables that successfully predicted personal distress were gender, dummy coded for females ($\beta = .15$, $t = 2.89$, $p = .004$), age ($\beta = -.11$, $t = -2.22$, $p = .027$) and current mood [anxious-calm] ($\beta = -.15$, $t = -2.51$, $p = .013$). It is possible to conclude that, of the variables of interest, none of the different video games groups predicted personal distress.

For the fantasy subscale both models were significant but only Model 1 ($F(5, 367) = 8.24$, $p < .001$, $R^2 = .10$, $R^2_{\text{Adjusted}} = .09$) presented a significant F Change ($F(5, 367) = 8.24$, $p < .001$). The only variable that is significant in Model 1 is gender, dummy coded for females ($\beta = .30$, $t = 5.93$, $p < .001$). It is possible to conclude that, of the variables of interest, none of the different video games groups predicted personal distress.

Simple Slope Tests

Simple slope tests were conducted to probe the moderator effects of gender, age, and current mood, in the associations between playing video games, and reading fiction, with cognitive theory of mind. These simple slope tests follow the significant moderated effects found in Steps 4 and 5 of the first set of analyses.

Regarding the moderated effects that resulted significant in the prediction of perspective taking, simple slope tests showed that playing video games predicted perspective taking in male participants ($\beta = -.53$, $t = -16.76$, $p < .001$) and in female participants ($\beta = -.38$, $t = -4.05$, $p < .001$), with the former group showing a stronger association between playing video games and perspective-taking. Therefore, it is possible to conclude that perspective taking is positively predicted by reading books of fiction, and is also negatively predicted by playing video games, with male participants showing a stronger negative association than female participants (see Figure 3.1).
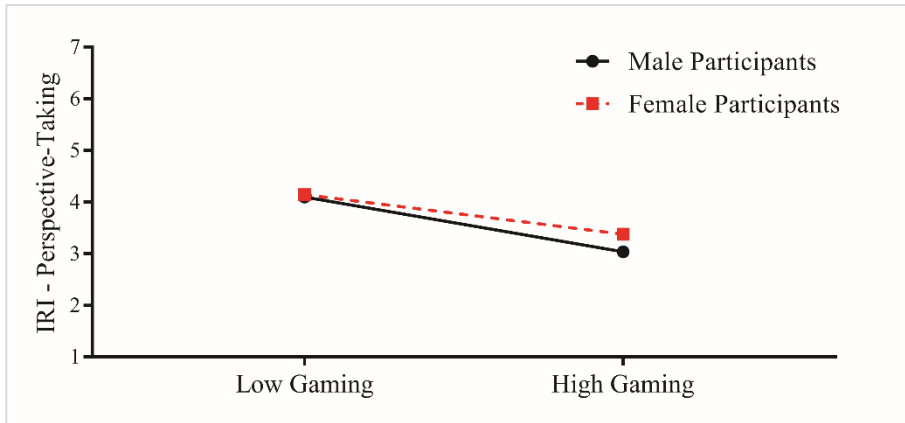
Figure 3.1. Effect of playing video games moderated by gender for Perspective Taking.

Regarding the moderated effects that resulted significant in the prediction of empathic concern, simple slope tests showed that reading fiction predicted empathic concern in younger participants ($\beta = .13$, $t = 2.29$, $p = .02$), but not in older participants ($\beta = -.06$, $t = -1.08$, $p = .28$). On the other hand, playing video games predicted empathic concern when participants reported to be more excited at the moment of responding to the questionnaire ($\beta = -.10$, $t = -2.15$, $p = .03$), but not when participants reported feeling bored ($\beta = .04$, $t = .08$, $p = .41$). See Figures 3.2 and 3.3 for the graphic representation of these results.
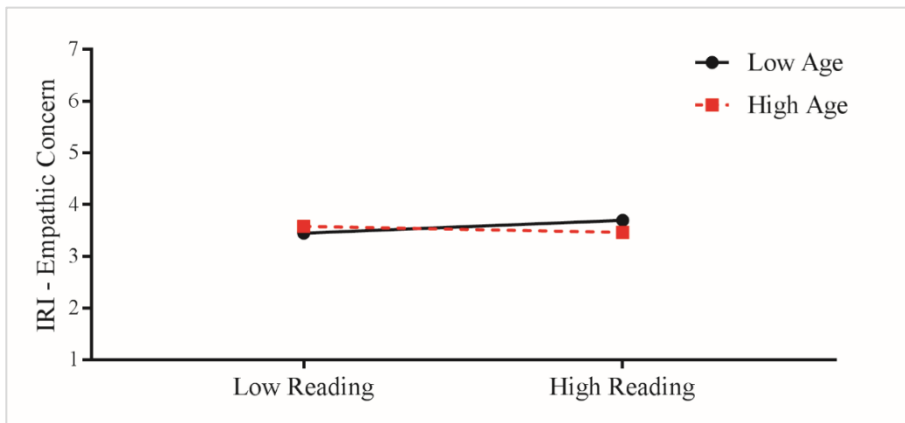
Figure 3.2. Effect of reading books of fiction moderated by age for empathic concern.
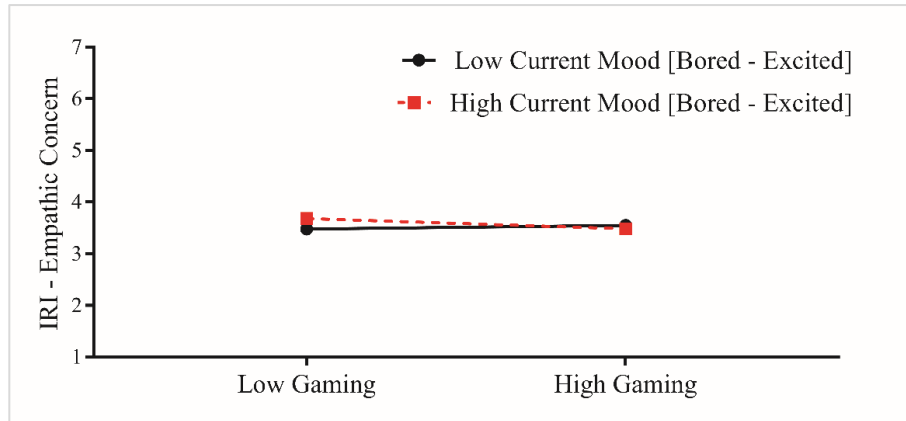
Figure 3.3. Effect of playing video games moderated by current mood [bored-excited] for empathic concern.

Regarding the moderated effect that resulted significant in the prediction of personal distress, simple slope tests showed that reading predicted personal distress when participants reported feeling more excited at the moment of responding to the questionnaire (β = -.13, t = -2.9, p = .004), but not when participants reported feeling bored (β = .06, t = 1.30, p = .20). See Figure 3.4 for the graphic representation of these results.
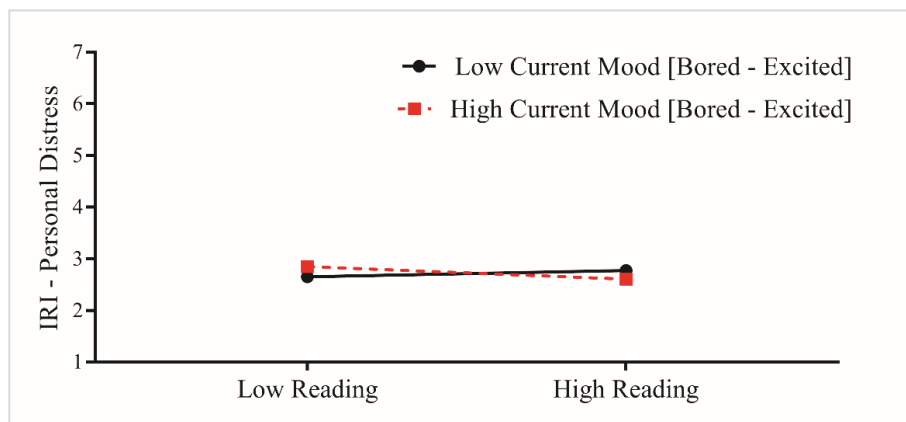
Figure 3.4. Effect of reading books of fiction moderated by current mood [bored-excited] for personal distress.

Regarding the moderated effects that resulted significant in the prediction of fantasy, simple slope tests showed that reading predicted fantasy in male (β = .21, t = 6.48, p < .001) and female participants (β = .38, t = 4.87, p < .001), with the latter group showing a stronger association between reading fiction and fantasy (see Figure 3.5). Regarding the effect of playing video games on fantasy moderated by current mood [anxious-calm], simple slope tests showed an inverse association between playing video games and fantasy when participants reported feeling more anxious at the

moment of responding to the questionnaire ($\beta = -.04$, $t = -.75$, $p = .45$), and a direct association when participants reported feeling more calm ($\beta = .10$, $t = 1.73$, $p = .08$). Nevertheless, both associations resulted non-significant (See Figure 3.6).
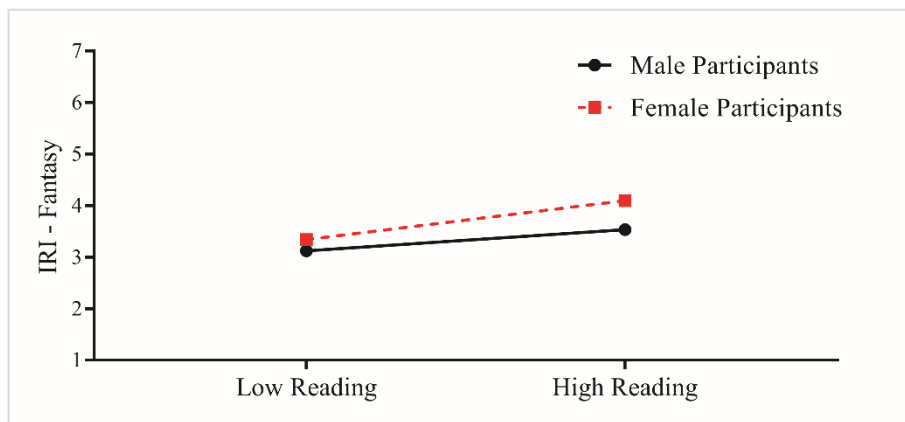
Figure 3.5. Effect of reading books of fiction moderated by gender for Fantasy.
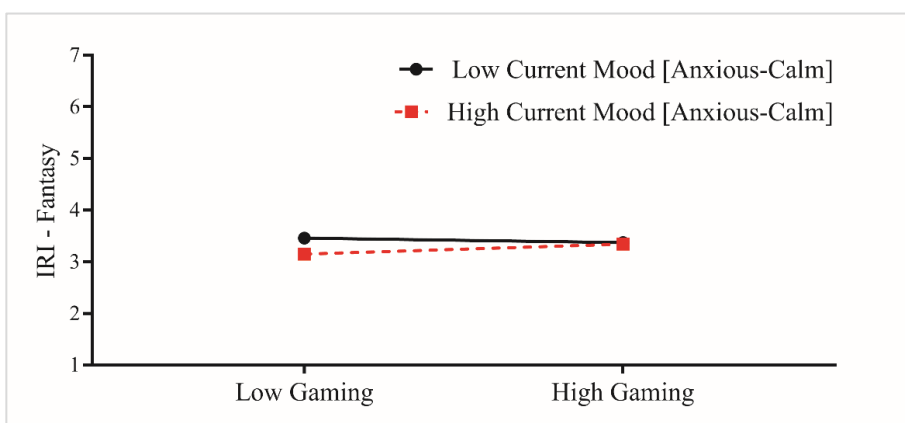
Figure 3.6. Effect of playing video games moderated by current mood (Pleasant Deactivation) for Fantasy.

Overall, results of the simple slope tests showed that gender, age, and current mood of the participants are be relevant variables when investigating the effects that fiction may have on theory of mind and empathy, given their moderation effects in these associations.

Discussion

No support for playing video games and reading fiction being associated with theory of mind and empathy.

The results do not support the hypotheses that playing video games and reading books of fiction are positively associated with cognitive and affective theory of mind and with empathy. More precisely, reading fiction is directly and positively associated

only with two of the four subscales that make up empathy (perspective taking and fantasy), while presenting only moderated effects with the other two (empathic concern moderated by age and personal distress moderated by pleasant activation), but it is not directly associated with cognitive nor affective theory of mind. Playing video games is not directly associated with any of the mentioned variables, but this activity presented moderated effects on perspective taking (by gender), empathic concern (by pleasant activation) and fantasy (by pleasant deactivation).

The first possible explanation for these direct associations with only two of the four dimensions of empathy, is that cognitive theory of mind and empathy were being predicted by age and gender (respectively), and that reading fiction and playing video games do not contribute to the explanation of the variance of the dependent variables, once the effects of age and gender have been accounted for. In this matter, the results show a negative association between age and egocentrism (as a counter-measure of cognitive theory of mind in the False Belief Test). This association supports the notion that cognitive theory of mind improves from younger to older adulthood (Happe, Winner, & Brownell, 1998), although, as Bernstein, Thornton and Sommerville (2011) state, there's still mixed evidence regarding this issue. In terms of gender differences, the results showed that gender successfully predicted three of the four measures of empathy (empathic concern, personal distress and fantasy), which supports the findings that women score significantly higher than men in self-report measures of empathy (Eisenberg and Lennon, 1983) such as the Emotional Quotient (Baron-Cohen & Wheelwright, 2004; Wheelwright et al., 2006) and the Interpersonal Reactivity Index (Davis, 1980).

Another possible explanation for the results comes from the raw measurements used in the present study, weekly hours of reading fiction and video games played, that didn't differentiate the books read nor video games played by their quality. This might be an important consideration since previous studies proposed that literary fiction, that is, high quality literature, tends to be more challenging, engaging and relatable than popular fiction (Mar et al., 2006), making it a better elicitor for mental simulations of social interactions that improve empathy and theory of mind. With this in consideration, one could argue that there could also be high quality video games that are more suitable to elicit the mental simulation that improves empathy and theory of mind. Future studies should consider differentiating high quality literature and video

games they may serve as possible predictors of empathy and theory of mind improvement. A possible criterion for selecting high quality video games may be award-winning video games recognized by the gaming industry and specialised media, as Black and Barnes (2015a) did in their study of award-winning television dramas and their effect on theory of mind.

A complementary explanation for the results is the fact that the present study did not control for the equivalency of the stimuli's social content. According to Nussbaum (1995) and Vitz (1990), when individuals read fiction, they try to take the perspective of the characters presented, which, in the end, elicits mental simulation of social interactions that in turn produces improvements on empathy. The discrepancy emerges because written fiction refers to stories that depict fictional characters and their interactions, while video games genres may or may not refer to: the portrayal of social interactions (e.g., role-playing versus puzzle video games); the way the video game is played (e.g., first person, third person); and the extent to which the video game incorporates interaction with other players (e.g., massive online multiplayer). In this regard, future studies should consider the comparison of video games that depict similar social contents as those portrayed in written fiction.

Another explanation for the finding that playing video games were not associated with cognitive and affective theory of mind and with empathy, comes from the fact that the present study did not control for the level of transportation that the participants experienced when interacting with fiction, either reading or playing video games. According to Oatley (1999, 2002) when readers feel transported into the narrative, they become emotionally involved with the story and connected with the characters, allowing them to change as a results of reading. This claim is supported by the findings of Green and Brock (2000), in which readers that became transported into a story experimented a stronger change in their attitudes towards topics portrayed in the stories. Similarly, other studies (Appel, 2008; Appel and Richter, 2007, 2010) found that transportation into narratives is the main precursor of changes in the individual. More recently, Bal and Veltkamp (2013) found similar results when participants read a fictional story over a week, and participants that experienced high transportation became more empathic while non-transported readers became less empathic. With this in consideration, it might be worthwhile to consider transportation into the story as a

possible mediator in the interaction between fiction, both with written fiction and video games, and empathy

Complementary to the idea that transportation is a mediator in the relationship between fiction and empathy, is the idea that individuals with different dispositional variables may benefit from different media. For example, Green et al. (2008) stated that individuals who have difficulty creating mental imagery may benefit from the fully vivid and concrete set of images provided by films; that is, films may be especially helpful to produce transportation for those low in imagery ability, and hence, this may affect their empathy. This idea may be transferable to video games since some of them provide a similar stimulation to that of films. Green et al. (2008) also stated that need for cognition may be an important moderator for transportation, since the former tends to have a low to moderate positive correlation with the latter (Appel & Richter, 2007; Green & Brock, 2000). More specifically, people who enjoy the exertion required by reading tend to feel more transported by this medium, while individual with low need for cognition tend to feel more transported media that are, arguably, less demanding such as film or for the purposes of this study, video games. With this in consideration, imagery ability and need for cognition may moderate the relationship of the interaction with fiction (e.g., reading fiction and/or playing video games) and transportation, which itself may be mediating the relationship of the interaction with fiction with empathy and theory of mind.

About the moderation effects, results for age and gender confirm the importance of these sociodemographic variables when studying empathy and theory of mind, since they are not only predictors on their own, but also moderate the associations between reading books and empathic concern (moderated by age) and also between reading fiction with and fantasy (moderated by gender). More specifically, younger participants presented a positive association between reading fiction and empathic concern while older participants presented a negative association. On the other hand, female participants showed a stronger positive association between reading fiction and fantasy when compared to males, while male participants presented a stronger negative association between playing video games and perspective taking when compared to female participants. Considering these results, age and gender should be included in the design of future studies to clarify these moderation effects along with possible explanations.

There are also moderation effects from current mood measurements, that is, how participants felt at the moment of answering the questionnaire. Results show that pleasant activation (bored-excited) moderates the associations between reading fiction and personal distress and between playing video games and empathic concern. Similarly, pleasant deactivation (anxious-calm) moderates the association between playing video games and fantasy. Being an ex-post-facto correlational study, this might signal that current mood at the moment of the participation is an important variable that modulates the recollection of how much time participants spend interacting with fiction (reading fiction or playing video games) and the recollection about their behaviour related to empathy (empathic concern, personal distress and fantasy). A possible solution would be an experimental design that manipulates the participants' current mood through the selection of specific stimuli (e.g., written fiction or video games), while focusing on immediate measures of empathy and/or theory of mind as opposed to a self-report measures used in the present study.

No support for complex and social video games being associated with theory of mind and empathy.

The results do not support the secondary hypothesis that video games that are complex and also require a social component present a higher positive association with theory of mind and empathy (in contrast to simple and non-social video games). A possible explanation for this, besides the ones argued in previous paragraphs, would be that the complexity of the video game and the social interactions with other players may not necessarily elicit an improvement in empathy. Hence, future studies should consider other relevant aspects of video game playing such as the social contents that they depict and the quality of the video game, since, as previously suggested, they might serve as better predictors of empathy and theory of mind improvement.

Regarding the results showing that weekly hours played of complex and non-social video games predicts empathic concern with a negative association, possible interpretations are unclear since this was an unexpected result. A possible explanation would be that participants who play these video games may feel more motivated to continue playing (given the challenge that they pose to the player based on their complexity) while abstracting themselves from other activities that may enhance empathy such as time spent with family, arts, or community service (Ren et al., 2015). This explanation is based on the fact that the group of complex and non-social video

games comprised six of the fourteen video games genres considered in this study (see Table 3.1), while also being the group with the highest weekly hours played (Table 3.2). Finally, given the correlational design of the study, it could be that participants who are less empathic are more drawn to video games in which complexity is the salient characteristic instead of the social interactions with other players. Nevertheless, precise explanations for this effect are unclear and require further exploration.

Table 3.2. Weekly hours played of video games grouped by their level of complexity and its social elements.

	Mean	Std. Deviation
Complex and Social video games	1.70	4.32
Complex and Non-social video games	7.57	9.35
Simple and Social video games	2.46	4.10
Simple and Non-social video games	0.51	1.23

Limitations

On the limitations of the study, one emerges from the non-significant differences found in affective theory of mind. It seems that the brief version of the reading the mind in the eyes test used does not measure subtle variations in theory of mind in a sample without an autism diagnosis (such as the non-clinical sample of this study). More specifically, considering the mean score of 8.32 (from a range of 1 to 10), standard deviation of 1.30 and skewness of -0.65, it seems that the items that comprise the brief version of the scale posed too low of a challenge for the participants, thus not being sensitive enough to measure small variations in participants with relatively high levels of theory of mind. Therefore, a further revision of the instrument is proposed for future studies.

Another limitation is the correlational nature of the study design that prevents causal interpretations from being drawn. The models and analysis used in the study presuppose a causal relationship between reading fiction and playing video games with empathy and theory of mind, but there is also the possibility that more empathic people and with higher levels of theory of mind may be more drawn to leisure activities that depict social interactions, such as literary fiction. An experimental design with randomized groups is suggested for future studies to solve this limitation.

Also, there are limitations linked to the measurements used for reading fiction and playing video games that consisted of raw estimations of how much time

participants spent reading books and playing video games of different genres. First, participants responded making an average estimation based on the last six months, which is susceptible to bias such as making the estimation based on the more recent books read or video games played (recency effect), or the more relevant books or video games for each person (salience effect). Considering this, it is possible that these measures could better reflect the current frequency of usage instead of overall exposure to fiction and to video games. This issue could be solved in future studies by either using a diary method in which participants keep records of their behaviour (e.g., genres of fiction books read and/or video games played) for a certain period; or by following an experimental design with pre-selected stimuli, such as books and video games of different genres, that may help clarify their specific effects on empathy and theory of mind beyond the recall of past behaviour.

Another limitation linked to the measurements used is the comparison made by the frequency of use of the media (i.e., average hours of books of fiction read and video games played) instead of comparing the effect of a change in frequency for individuals. This is an important issue that may help establish the effect of reading fiction and playing video games on empathy and theory of mind beyond its cumulative effects over time.

Finally, there is the fact that the measurements used assumed that the frequency of usage would be the most relevant factor in predicting empathy and theory of mind improvements while ignoring other factors, like the quality of the stimuli and the presence or social interactions depicted in the books and/or video games. Considering the relevance that these variables may have, as mentioned in previous paragraphs, it would be important to control for these variables in future studies, by either selecting books of fiction and video games of high quality and that also portray social interactions, or by comparing them with low quality video games that don't focus on social interactions as their main content (e.g., racing games or non-fiction books) in all possible combinations.

Conclusions

Considering the above ideas, and to address the causal relation between the interactions with fiction and empathy, the next study will use an experimental design that controls for the stimuli by their quality and content, e.g., literary fiction and award-

winning video games that portray social interactions. One way to do that is to select books of literary fiction and award-winning video games that depict similar social interactions. Also, transportation should be measured as a possible mediator between the interaction with the stimuli and both empathy and theory of mind, while including imagery ability and need for cognition as possible moderators between the interaction with the stimuli and transportation. An immediate measurement of empathy and theory of mind would also be needed.

Chapter 4:
Effect of Reading and Playing Video Games on Theory of Mind

This chapter presents Study 2, which followed an experimental design aiming to overcome some of the limitations of the previous study. These limitations wereits correlational design, measures of long-term exposure to fiction and video games through raw estimations of time spent reading and playing, and its focus on frequency of usage (of fiction and video games) while ignoring other factors (e.g. quality and content).

Therefore, the present study followed an experimental design, comparing possible enhancements in theory of mind after reading literary fiction, playing narrative video games, and playing puzzle video games as a control condition. Additionally, this study aimed to examine mediation effects of transportation into the narrative and experience-taking in the association between exposure to fiction and theory of mind, and moderation effects of imagery ability and need for cognition for the relationships between fiction exposure and transportation into the narrative and experience-taking. Lastly, this study aimed to explore the effect of exposure to fiction on prosocial

behaviour, a measure that was estimated would reflect the possible benefits of being exposed to fiction on everyday behaviour.

This study's methodological rationale followed Kidd and Castano (2013), who hypothesised that not all pieces of fiction produce social-cognitive enhancements, but only fiction that is of high quality. To test this hypothesis, Kidd and Castano randomly assigned participants to either read an award-winning piece of fiction (i.e., higher quality literature, or literary fiction), a piece of popular fiction (i.e., lower quality literature), or a piece of nonfiction (e.g., news article). Consequently, the current study used Kidd and Castano's experiments as a template in terms of its design, with random participant allocation to its conditions, as well as the criteria for the selection of high quality stimuli (i.e., award-winning pieces of fiction and video games).

This study's design was complemented with studies exploring the underlying mechanisms connecting fiction to social cognition. More precisely, this study included transportation into the narrative (Green and Brock, 2000), and experience-taking (Kaufman & Libby, 2012). These variables allowed to, respectively, explore the extent to which feeling immersed in the narrative, and being able to assume the experience of a fictional character inside of it, explains the enhancing effect that exposure to fiction has (according to the literature) on social-cognitive performance. Therefore, transportation into the narrative and experience-taking were included to explore their possible mediation effects.

Additionally, this study included the variables imagery ability (Green et al., 2008), and need for cognition (Appel & Richter, 2007; Green & Brock, 2000, 2002; Green et al., 2008). The inclusion of these variables was based on the literature suggesting that people who are skilled at forming mental images in their mind's eye, and who are more inclined towards effortful cognitive activities, may feel more immersed in fiction presented in written form (Green & Brock, 2000, 2002; Green et al., 2008). Conversely, people with low imagery ability and need for cognition tend to feel more immersed in narratives that are presented with the help of audio-visual stimulation, such as films and –arguably– in video games. Thus, imagery ability and need for cognition were included to test their possible moderation effects in the association between exposure to fiction –as written literature and video games– and transportation into the narrative and experience-taking.

Lastly, this study explored the effect that reading fiction may have on prosocial behaviour. The inclusion of prosocial behaviour as an outcome variable was based on the literature showing a positive association between empathy and prosocial behaviour (e.g., Eisenberg & Miller, 1987; Eisenberg et al., 2010; Geng et al., 2012; Hoffman, 2000), and the idea that, arguably, prosocial behaviour would better reflect the possible benefits of fiction exposure on everyday behaviour.

Hypotheses

The first and main hypothesis of the study is that the exposure to fiction, through reading fiction and playing narrative video games, will be positively associated with theory of mind as when compared to non-narrative video games. The second hypothesis of the study was that transportation into the narrative and experience-taking will mediate the relationship between exposure to fiction and theory of mind. A third hypothesis was that participants with high imagery ability and with high need for cognition, reading fiction (as opposed to playing narrative video games) will present a higher positive association with transportation into the narrative and experience-taking (when compared to those who score low on imagery ability and need for cognition). Finally, it was hypothesised that the exposure to fiction will be positively associated with prosocial behaviour when compared to non-narrative video-games.

These hypotheses were based on evidence suggesting that lifelong exposure to written fiction is positively associated with social ability (e.g., Mar et al., 2006), and on experimental studies suggesting that that not all pieces of fiction produce social-cognitive enhancements, but fiction that is of high quality (Kidd & Castano, 2013). Therefore, the first hypothesis of this study seeks to test if this proposal could also be applied to fiction when is presented in the form of video games, that is, if high quality narrative video games can produce boosts in theory of mind.

The second hypothesis of the study was based on studies showing that readers who become more transported into a story experience a stronger change in their attitudes towards topics portrayed in the stories (Green & Brock, 2000), and that readers who experienced high transportation became more empathic while non-transported participants became less empathic (Bal & Veltkamp, 2013). In a similar line, this hypothesis is based on studies suggesting that stories eliciting the simulation of the

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experience of a fictional character –or experience-taking– may lead to meaningful behavioural changes in the readers (Kaufman & Libby, 2012). Therefore, the second aim of this study aims to test if transportation into the narrative and experience-taking mediate the association between exposure to fiction and theory of mind.

The third hypothesis of this study was based on the proposal that individuals with different dispositional traits may benefit from different media. Firstly, Green et al. (2008) proposed that individuals who have difficulty creating mental imagery may benefit from the fully vivid and concrete set of images provided by films; that is, films may be especially helpful to produce transportation for those low in imagery ability, which in turns affects their empathy. It is proposed here that this idea could also be applied to video games since they provide audio-visual stimulation similar to that of films in the sense that they provide a visual representation of the narrative that is often accompanied by sound and music cues that enhances the experience of storytelling. Secondly, there is the proposal that need for cognition may play an important role in transportation into narrative. More precisely, that people who enjoy the mental exertion of reading tend to feel more transported when exposed to this medium, while people who do not enjoy the mental exertion of reading tend to feel more transported when exposed to the, arguably, less-demanding medium of film (Appel & Richter, 2007; Green & Brock, 2000; Green et al., 2008) and –arguably– video games. Therefore, the third hypothesis of this study explores the possible moderation role of imagery ability and need for cognition in the association between exposure to fiction, through written literature and video games, with transportation into the narrative and experience taking.

Lastly, the fourth hypothesis of this study is based on the literature linking empathy to prosocial behaviour (e.g., Eisenberg & Miller, 1987; Eisenberg, Eggum, & Giunta, 2010; Geng, Xia, & Qin, 2012; Hoffman, 2000). It was also estimated that prosocial behaviour may better reflect the possible benefits of being exposed to fiction on everyday behaviour. Further details of the research that led to the rationale for the hypotheses of this study can be found in chapter 2.

Method

Design

It is worth mentioning that the selection of measures and stimuli used in the present study was informed by a pilot study which aimed to test two measures of theory of mind in terms of their distribution of responses, and to test the equivalency of stimuli in terms of elicited mood and perceived attributes. The pilot study had 47 participants, data was collected between December 2016 and February 2018. A full description of the pilot study can be found in Appendix B.

The main study consisted of two parts. The first part of the study was an online questionnaire which collected the participants' sociodemographic information, measurements of their self-reported imagery ability and need for cognition, and contact information and time availability for the laboratory experiment. The second part of the sturdy was a laboratory experiment in which participants were randomly assigned to one of six subconditions: play one of two narrative video games, play one of two puzzle video games, or read one of two short stories of literary fiction. Finally, participants were presented a questionnaire regarding perceived attributes of the stimuli, mood elicited by the stimuli, self-reported transportation into the story and experience-taking, theory of mind, and a prosocial behaviour task.

Participants

For the main study, 78 participants were recruited (29 males, 49 females: M_{age}=21.73 years, SD_{age}=8.59). Of the total or participants, 67 were native speakers of English and the remaining 11 participants had in average 13.36 years of proficiency in English (the minimum to take part in the study was 10). Sample was comprised of 61 undergraduate students, four masters' students, eight PhD students, two members of staff, and three participants who weren't part of the University or of the categories above. These last three participants were removed from the analyses of the study in order to achieve a more homogeneous sample of participants who were linked to the University either as students, academics, or members of staff. The sample size for this study was estimated based on the suggestions by Fritz and MacKinnon (2007), regarding estimated sample sizes required to detect mediation effects with power levels of 0.8. Nevertheless, Fritz and MacKinnon's proposal establishes power estimations for simple mediation models, and it does not cover more complex models such as the

ones tested in this study (i.e., models with 2 parallel mediators, with and without two moderators). An alternative way to estimate sample size comes from Kline's (2016) recommendations for SEM models of having 20 cases per parameter of the model, which in the case of this study could mean needing at least 160 participants for the simpler 8 parameters models, or 440 participants for the more complex models with 22 parameters. Considering this, it is likely that analyses of this study are underpowered. A further discussion of the limitations of an underpowered study are discussed in the Limitations section of this chapter.

Participants were recruited through the distribution of flyers on university public spaces (opportunistic), through the mailing list of volunteer students (self-selection), and through the Department of Psychology volunteer scheme in exchange for credits (self-selection) at The University of Sheffield. The study was presented to participants as a study of leisure activities in which they would have to answer an online questionnaire and to take part in an experiment at a time of their convenience to either play a video game or read a short story. The study received ethical approval from the Ethics Committee of the University of Sheffield's Psychology Department (Reference Number 010738).

Materials

The online questionnaire included measures of imagery ability, need for cognition and sociodemographic information (age, gender, years of English fluency, ethnicity and occupation), as well as time availability and contact information (name and email) for the experiment session. During the experiment, participants were presented measures of transportation into the narrative, experience-taking, perceived attributes of the stimuli, elicited mood, theory of mind and a measure of prosocial behaviour task. The study also included the use of the following stimuli for the experiment: two narrative video games, two short stories of literary fiction, and two puzzle video games.

Measures

Imagery Ability was measured through the Vividness of Visual Imagery Questionnaire (VVIQ) by Marks (1973). The VVIQ comprises 16 items referring to 4 different scenarios (4 items per scenario) that the subject is asked to visualize and to rate the vividness of the visual imagery that the items may evoke on a 5-point scale

from "No image at all, you only "know" that you are thinking of the object" to "Perfectly clear and as vivid as normal vision". As an example, instructions for the first set of items are "Think of some relative or friend whom you frequently see (but who is not with you at present) and consider carefully the picture that comes before your mind's eye", after which participants are asked to rate how clearly or vividly they were able to form a mental image of "The exact contour of face, head shoulders and body", "Characteristic poses of head, attitudes of body, etc.", "The precise carriage, length of step, etc., in walking" and "The different colours worn in some familiar clothes". The VVIQ has good psychometric qualities (Childers, Houston, & Heckler, 1985) with good reliability in the present study ($\alpha = 0.89$).

Need for Cognition was measured as proposed by Cacioppo, Petty and Kao (1984). This scale assesses the tendency for an individual to engage in and enjoy thinking (Cacioppo & Petty, 1982). The scale asks individuals to rate the extent to which they agree with each of 18 statements about the satisfaction they gain from thinking on a 7-point scale, from "Strongly disagree" to "Strongly agree". Example items of this scale are "I would prefer complex to simple problems" and "I only think as hard as I have to" (reverse-scored). The study's reliability score for this scale was adequate ($\alpha = .89$).

Transportation into the Narrative was measured through the Transportation Scale proposed by Green and Brock (2000). The scale was created to capture Gerrig's (1993) dimensions of transportation: emotional involvement in the story, cognitive attention to the story, feelings of suspense, lack of awareness of surroundings, and mental imagery. The scale has 15 items, 4 of which are adapted to each story, which ask individuals to rate to what extent they agree with each of them on a 7-point scale, ranging from "Absolutely no" to "Absolutely yes". Example items of the scale are "I could picture myself in the scene of the events described in the story" and "After finishing the story, I found it easy to put it out of my mind" (reverse-scored). Overall reliability for the scale in the present study was adequate ($\alpha = .8$).

Experience-Taking was measured as proposed by Kaufman and Libby (2012). Experience-taking is defined as the immersive phenomenon of simulating the mindset and persona of a protagonist in a fictional scenario (Kaufman & Libby, 2012). Using a 7-point response scale, ranging from "Strongly disagree" to "Strongly agree", participants rated to what extent they agreed with each of its seven items. Examples

items of the scale are "I found myself thinking what the character in the story was thinking" and "I was not able to get inside the character's head" (reverse-scored). Overall reliability for the scale in the present study was adequate (α = .94).

Perceived Attributes of the stimulus were measured using four 10-point scale bipolar items that asked the participants to evaluate the message of the story/game (positive or negative), the complexity of the story/game (simple or complex), the quality of the social interactions in the story/game (poorly/in a good manner) and how important they were to the plot (unimportant/very important).

Mood elicited by the stimuli was assessed as proposed by Poerio et al. (2015), with three 10-point scale bipolar items that asked how sad-happy, bored-excited and anxious-calm participants felt (after being exposed to the experimental or control conditions). These items were chosen to measure the pleasure (valence) and arousal (activation) dimensions of core affect (Remington et al., 2000); specifically, pleasure (sad-happy), pleasant activation (bored-excited) and pleasant deactivation (anxious-calm).

Theory of Mind was measured with a Moral Judgment Test (MJT) as proposed by Young et al. (2010) which evaluates to what extent individuals think spontaneously about intentions when judging an individual's behaviour. The scale comprises 48 scenarios with four different variations combining two story elements: (i) either a negative or neutral outcome and (ii) either an intentional or accidental attribution to the outcome. The resulting variations are: intended harm (negative outcome with intentional attribution), accidental harm (negative outcome with accidental attribution), attempted harm (neutral outcome with intentional attribution), and no harm (neutral outcome with accidental attribution). Example items can be found in Appendix C. Because of time limitations of the study, a subset of 24 scenarios were randomly selected prior data collection. All participants received all 24 scenarios; for each scenario, they randomly received one of the four variations. Individuals were asked to make judgments for each scenario on 7-point scale items, rating how forbidden or permissible were the protagonists' actions. The instrument provided four average scores, one for each scenario variation.

In this task, participants are asked to make moral judgments for each scenario, rating how forbidden or permissible were the protagonists' actions, which would -and

arguably does- indicate moral judgment on the participants' behalf. Nevertheless, the focus of this task is on the variations within subject and/or differences across groups in the judgments of how forbidden/permissible the protagonist's intentions in these scenarios are. These variations and differences are interpreted as variations in theory of mind, since participants considering the protagonist's intentions in their judgments should evaluate the actions in the accidental harm scenarios as more permissible and the actions in attempted harm scenarios as less permissible. Previous studies have shown that responses to accidental harm and attempted harm scenarios provide a sensible measure of theory of mind (Moran et al., 2011; Young et al., 2010).

Prosocial Behaviour was measured using a procedure adapted from Vohs, Mead, and Goode (2006). At the end of the experiment session, participants were asked their willingness to help the experimenter in a future task (coding data) without any retribution, payment or incentive for it. This question was framed as an actual request for help, separate from the study. Participants indicated their response in a sign-up sheet along with their contact details, indicating how many sheets of paper they were willing to code.

Stimuli

Experimental conditions consisted of playing one of two narrative video games or reading one of two short stories of literary fiction. Video games and stories for the experimental conditions were selected based on their high quality and on the depiction of social interactions between two or more characters. High quality of the video games was ensured by selecting video games that had been recognized, either nominated or awarded, for their story by the video game developer community or specialized media. The narrative video games used were: 1) "Life is Strange" (Dontnod Entertainment, 2015), which was awarded as best story in a game by the 12th British Academy Games Awards. The game tells the story of Max, a senior photography student who suddenly discovers she is able to rewind time. The game focuses on realistic interactions, exploring themes of human emotions and coming of age. 2) "Everybody's gone to the Rapture" (The Chinese Room, 2015) which was nominated to the 12th British Academy Games Awards for its story. The game mixes themes human drama, science fiction and religion, where the player reconstructs the last days of Yaughton, a small English town whose inhabitants have mysteriously disappeared.

High quality of the short stories of literary fiction was ensured by using stories selected for the O. Henry Awards, an award given to short stories of exceptional merits. The stories selected were: 1) "The History of Happiness" by Brenda Peynado (in O. Henry Prize Stories, 2015) which is about an unnamed traveller stranded with no money in Singapore who is also dealing with the emotional aftermath of a relationship breakup. 2) "The Vandercook" by Alice Matisson (in O. Henry Prize Stories, 2012) which is the story of Lorenzo and Molly, a married couple disentangling a family secret after they move back to Lorenzo's childhood town to help his father with the family business.

Control conditions consisted of two puzzle games which were selected based on their relative simplicity and non-narrative game-play. The puzzle games were: 1) "Peggle Deluxe" (PopCap Games, 2007) in which players must clear pegs in scenarios resembling a pachinko arcade. 2) "Bejeweled 3" (PopCap Games, 2010) which is a matching tile game were players must sort three (or more) tiles of the same colour in a row.

Procedure

Participants were recruited at The University of Sheffield through the distribution of flyers in university public spaces, mailing lists, and volunteer schemes in exchange for credits. The invitation presented the study as regarding video games and short stories and how they make people feel and think, and framed participation involving having to answer an online questionnaire and meet the researcher to take part in an experiment.

The online questionnaire presented the participant information sheet and consent form detailing the ethical guidelines of the study. It was also mentioned that some of the video games were suitable for 18 years old and over only and that they may include: strong language, depictions of violence and drug use (according to the Pan European Game Information ratings). This information was followed with the instruction to refrain from participating if they were sensitive to any of these subjects. In a similar way, since short stories may present sensitive subjects, possible participants are advised to refrain from participating if that were the case. The online questionnaire registered the potential participants' interest in taking part in the study, and included questions regarding sociodemographic information (age, gender, years of English

fluency, ethnicity and occupation), imagery ability and need for cognition. Finally, participants were asked for their time availability and contact information (name and email address) to arrange a meeting for the experiment.

During the laboratory experiment participants were reminded about the ethical guidelines of the study, as well as the suggestion to refrain from participating in case they were sensitive to the video games or book's contents. Participants were then randomly assigned to one of the study's conditions. Participants in the narrative video game condition were presented with a brief description of the game, instructions on how to play the game (mouse and keyboard control scheme) and a 3-minute video demonstrating the game. Participants in this condition were asked to play the game for 23 minutes as if they were doing it in their own leisure time, without any specific goals being set for this study. Video game playing time was estimated by the expected reading times of the short stories at a speed of 250 words per minute. Participants in the short stories condition were instructed to read the story as if they were doing it in their own leisure time, at their own pace, without any goals associated with them reading the story. Average reading time of the stories was 25.3 ($\pm$ 5.9 minutes) minutes. Participants in the puzzle video game conditions were asked to play the game as if they were doing it in their own leisure time, without any specific goals being set for this study. Participants played the game for 23 minutes. After playing or reading, participants answered a questionnaire which included measures of transportation into the narrative, experience-taking, perceived attributes of the stimulus and elicited mood, theory of mind and a measure of prosocial behaviour. The average time for each experimental session was 49.7 minutes ($\pm$ 7.8 minutes) plus an estimated 5 extra minutes in which participants were welcomed and received the overall instructions for the session. Data was collected from January 2017 to February 2018.

Analysis Plan

Five path analyses were conducted to address the hypotheses of the study. These analyses were conducted using Process 3.0 macro for SPSS (Hayes, 2018) with levels of confidence for confidence intervals at 95%.

Models 1 and 2 are mediation models that address the first two hypotheses of the study: 1) Exposure to fiction, through reading fiction and playing narrative video games, will be positively associated with theory of mind as when compared to non-

narrative video games; and, 2) Transportation into the narrative and experience-taking will mediate the relationship between exposure to fiction and theory of mind. Therefore, Models 1 and 2 included exposure to fiction as the independent variable; and experience-taking and transportation into the narrative as the mediator variables. Also, Models 1 and 2 included one of the following measures as a dependent variable: Moral Judgement Test scenarios of Accidental Harm (Model 1) and Attempted Harm (Model 2). Conceptual and statistical diagrams for Models 1 and 2 can be found in Figures 4.1 and 4.2, respectively.

Models 3 and 4 are moderated mediation models that address the third hypothesis of the study: that reading fiction (as opposed to playing narrative video games) will present a higher positive association with transportation into the narrative and experience-taking in participants with high imagery ability and with high need for cognition. Models 3 and 4 are variations of the previous models, the difference being that now they include imagery ability and need for cognition as the moderator variables between exposure to fiction and the mediators: transportation into the narrative, and experience taking. Conceptual and statistical diagrams for Models 3 and 4 can be found in Figures 4.3 and 4.4, respectively.

Model 5 address the fourth hypothesis of the study: that the exposure to fiction will be positively associated with prosocial behaviour when compared to non-narrative video-games. This model is a variation of Models 1 and 2, but instead it uses Prosocial Behaviour as the dependent variable. Conceptual and statistical diagram for Models 5 can be found in Figure 4.5.

A Helmert coding scheme was used for exposure to ficton in Models 1 through 5, given the multicategorical nature of this variable and the need for speciffic sets of comparisons among its categories. This orthogonal coding scheme allows the comparison between two groups or sets of groups that provide non-overlapping information about how a larger set of groups differ from one another (Hayes 2018).

In the case of this study, using Helmert coding allowed the comparison between groups of participants who were not exposed to fiction (participants who played non-narrative video games) versus participants who were exposed to fiction in any form (participants who read fiction and participants who played narrative video games). These comparisons addressed Hypotheses 1, 2 and 5. This coding scheme allowed the

comparison of the groups that were exposed to fiction by reading fiction versus participants who were exposed to fiction by playing narrative video games. These comparisons addressed Hypotheses 3 and 4.

Under this coding scheme, the regression coeficient for D_1 (C_1), quantifies the difference between the unweighted average scores for the Moral Judgement Test scenarios of participants of the two "fiction" conditons (reading fiction and playing narrative video games), and the mean scores of participants of the "non-fiction" (non-narrative video games, or puzzle video games). Conversely the regression coefficient for D_2 (C_2), quantifies the difference between the mean scores in the Moral Judgement Test scenarios of participants in the "fiction" conditons, i.e., participants who read fiction and participants who played narrative video games.
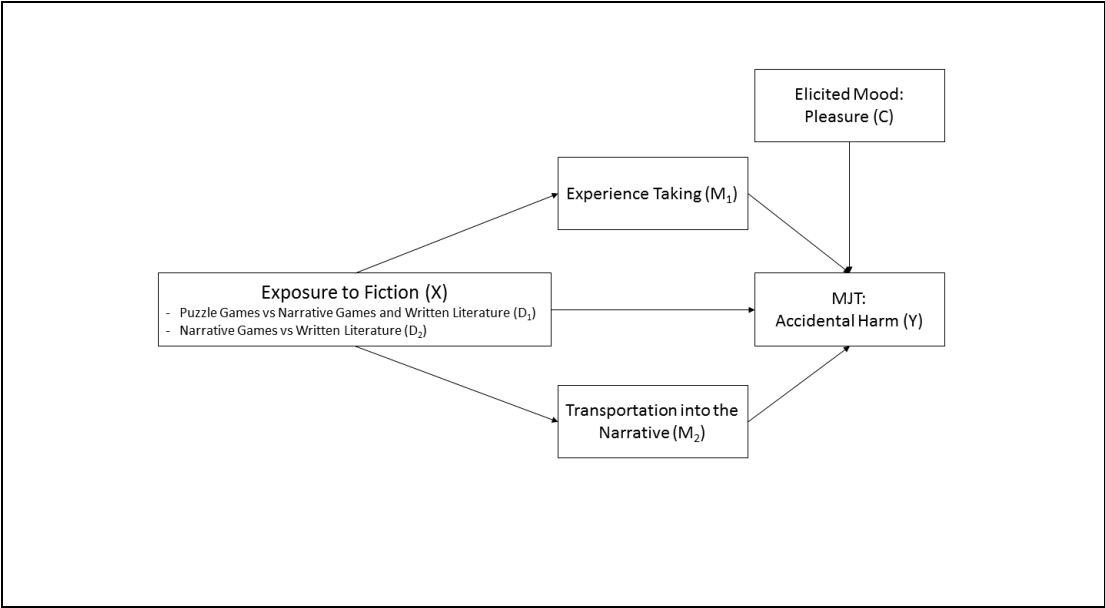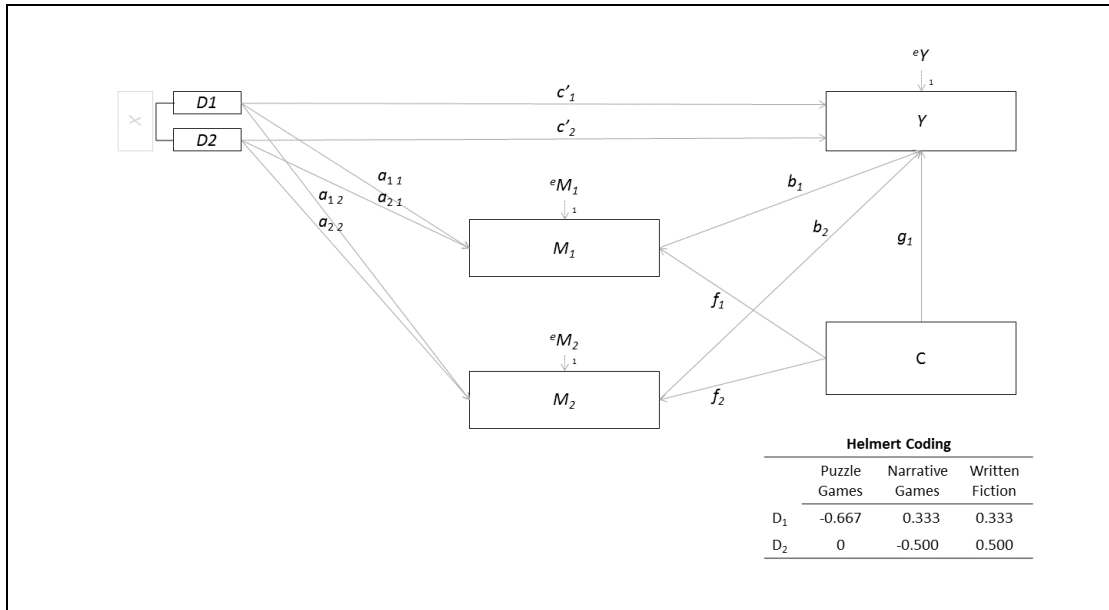
Figure 4.1. Conceptual and statistical diagrams for Model 1. Exposure to fiction and theory of mind (Accidental Harm scenarios), mediated by experience-taking and transportation into the narrative.
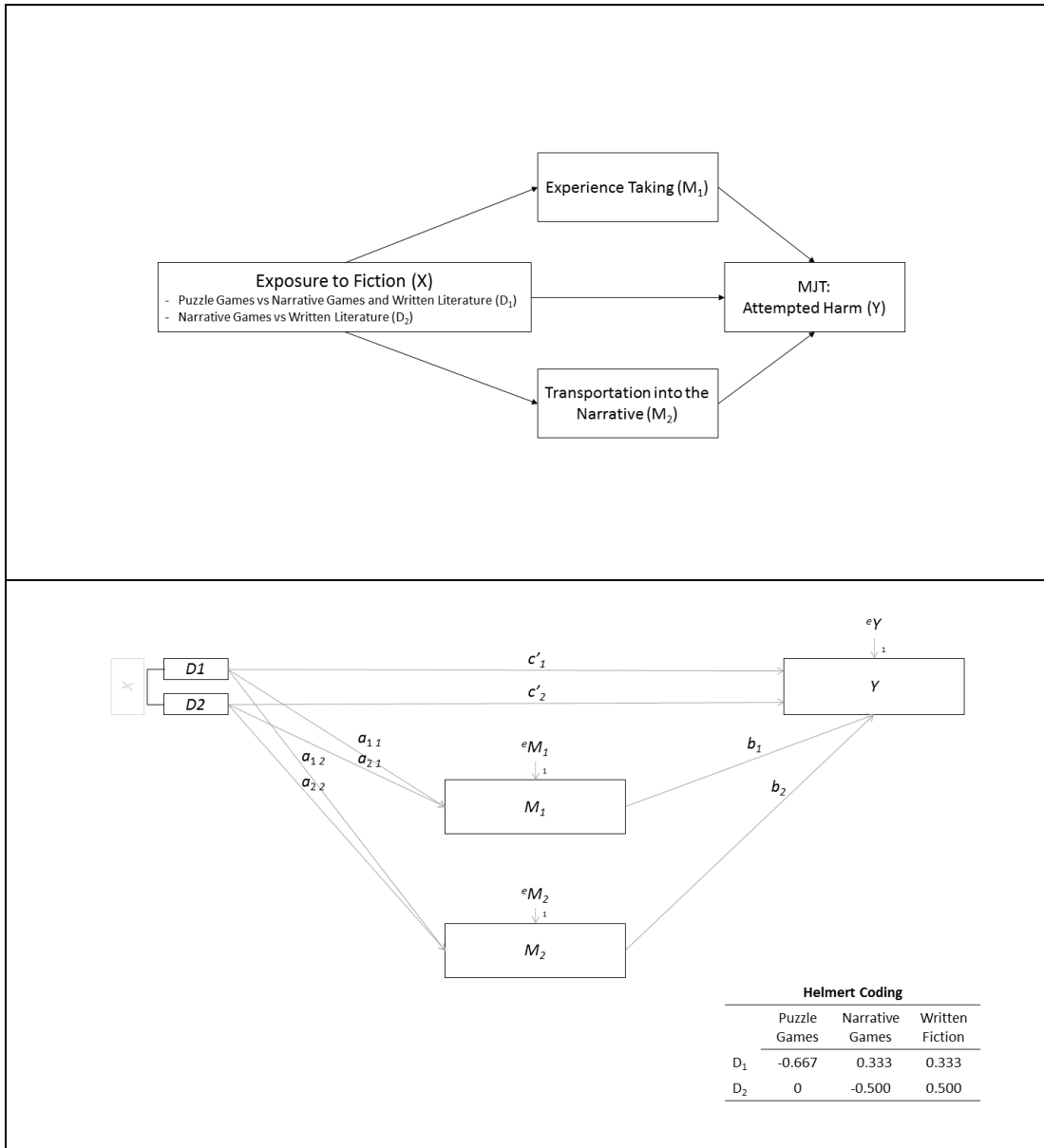
Figure 4.2. Conceptual and statistical diagrams for Model 2. Exposure to fiction and theory of mind (Attempted Harm scenarios), mediated by experience-taking and transportation into the narrative.
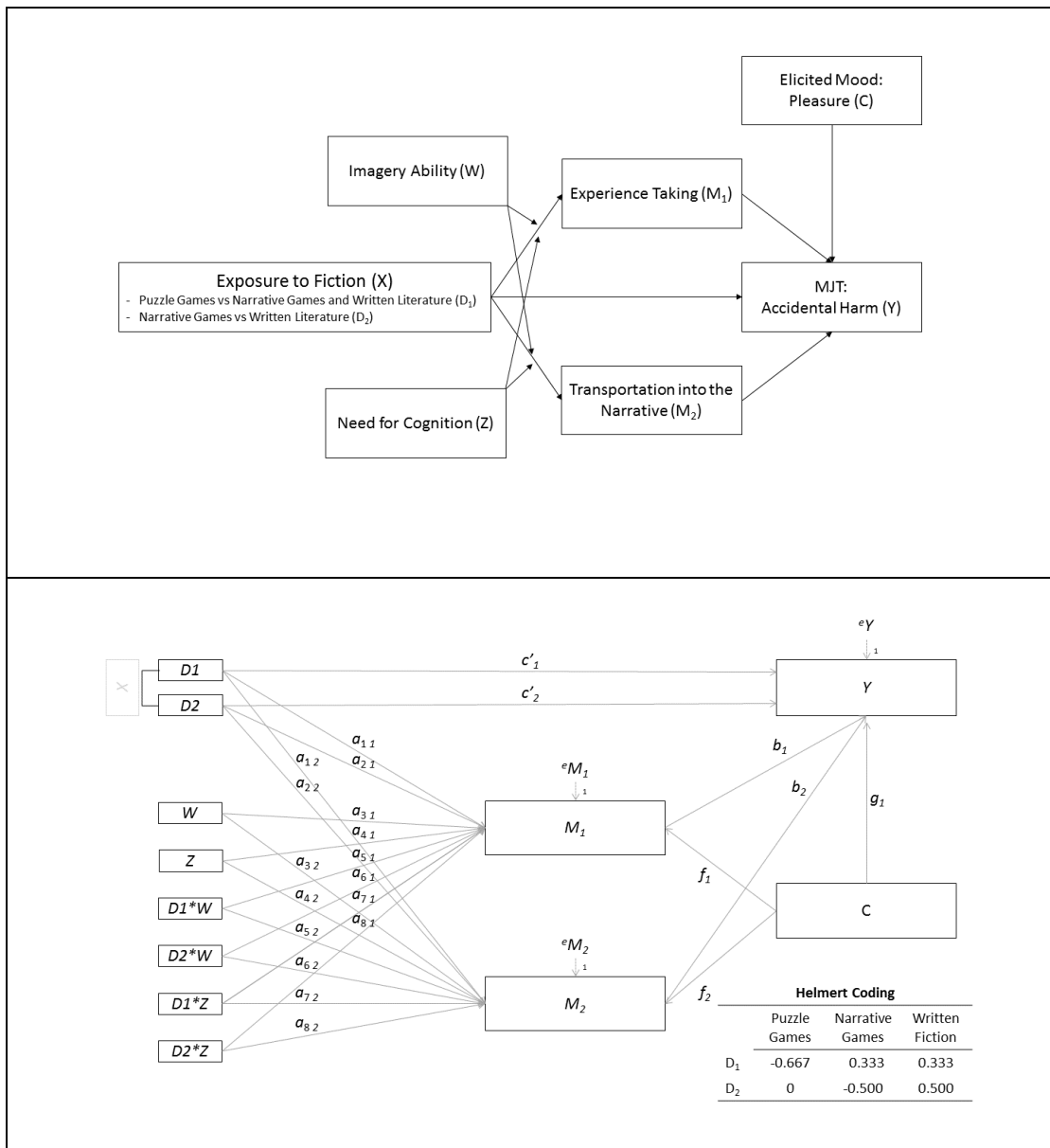
Figure 4.3. Conceptual and statistical diagrams for Model 3. Exposure to fiction and theory of mind (Accidental Harm scenarios), mediated by experience-taking and transportation into the narrative, and including imagery ability and need for cognition as moderator variables.
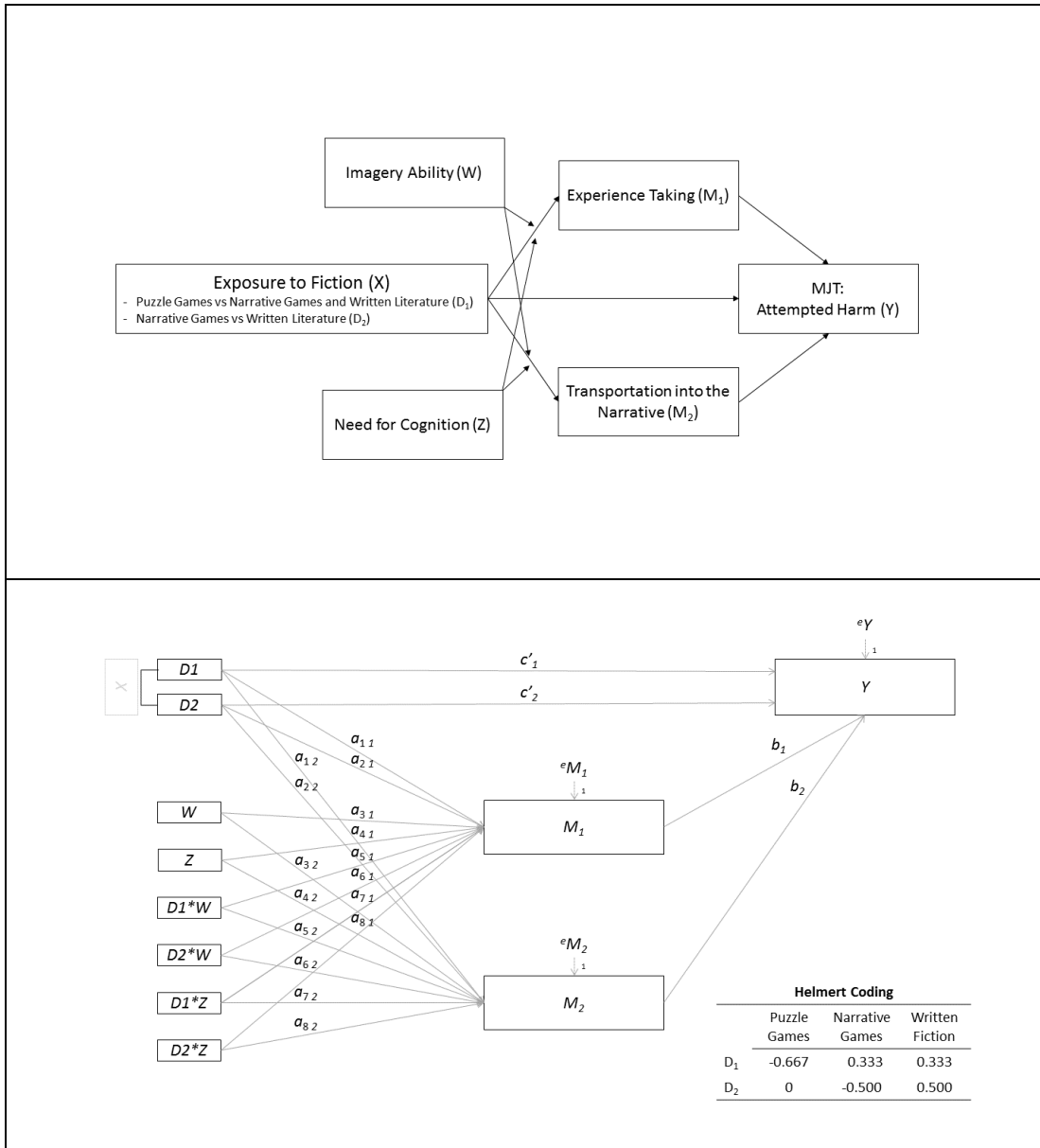
Figure 4.4. Conceptual and statistical diagrams for Model 4. Exposure to fiction and theory of mind (Attempted Harm scenarios), mediated by experience-taking and transportation into the narrative, and including imagery ability and need for cognition as moderator variables.
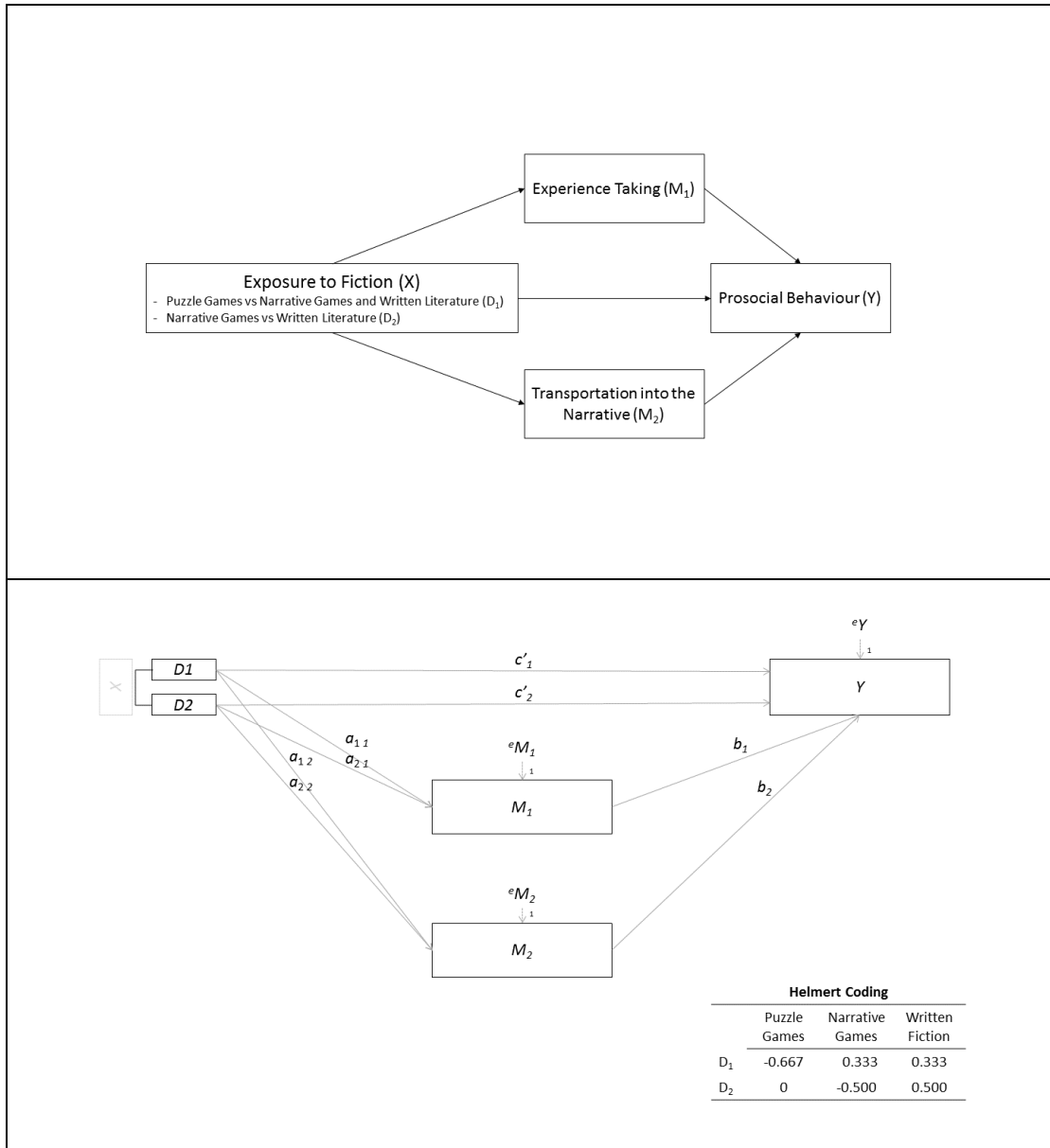
Figure 4.5. Conceptual and statistical diagrams for Model 5. Exposure to fiction and prosocial behaviour, mediated by experience-taking and transportation into the narrative.

Results

Outliers, confounding effects and assumption testing

A total of 78 participants responded to the questionnaire. Since three of the 78 participants were not students, academics nor staff from the University, they were removed from the analyses in order to achieve a more homogeneus sample of participants who were linked to the University. The remaining 75 participants distributed evenly across conditions. Prior to conducting the main analyses, data was checked for outliers and for possible confounding effects, and assumptions for multiple regression analyses were tested.

Outliers were checked following the outlier-labelling rule by Hoaglin and Iglewicz (1987), with a 2.2 multiplier. Table 4.1 shows the lower and upper values resulting from the labelling formula and the number of cases removed which correspond to any observations below or above the lower and upper limit respectively.

Table 4.1. Cases removed by outlier labelling rule.

	Lower Limit	Upper Limit	No. of cases removed
Imagery Ability	1.21	5.60	0
Need for Cognition	1.17	7.92	0
Experience-Taking	-5.16	12.59	0
Transportation	-0.71	8.62	0
MJT: Accidental harm	-1.29	8.34	0
MJT: Attempted harm	-1.59	7.23	0
Prosocial Task	-26.40	38.40	3

When looking at possible confounding variables, correlations (Table 4.2) showed a positive association between pleasure (elicited mood item) and the accidental harm condition of the moral judgement test ($r = .26$, $p = .024$). Considering this, pleasure was included as a covariate when testing the model with accidental harm as the dependent variable. No other significant correlations with the main dependent variables of the study were found.

Table 4.2. Correlations between elicited mood, perceived attributes and dependent variables of the study.

		Moderators		Mediators		Dependent Variables		
		Imagery Ability	Need for Cognition	Experience-Taking	Transportation into the narrative	MJT: Accidental harm	MJT: Attempted harm	Prosocial Behaviour
Elicited mood	Pleasant deactivation	.02	.09	-.10	-.12	.06	-.09	-.04
	Pleasant activation	.18	.25*	.29*	.47***	.16	-.09	.16
	Pleasure	.15	.25*	-.07	.05	.26*	-.08	-.05
Perceived attributes	Message	-.12	.07	-.44***	-.23*	-.08	.16	.05
	Complexity	.03	-.10	.43**	.31**	-.06	-.12	.11
	Quality of social interactions	-.01	-.06	.70***	.60***	.12	-.02	.03
	Importance of social interactions	.02	.11	.67***	.65***	.02	-.20	.05
Moderator Variables	Imagery Ability		.48***	.16	.03	.09	-.02	-.04
	Need for Cognition			.07	.12	.21	-.07	.08
Mediator variables	Experience-Taking				.74***	.13	-.16	-.05
	Transp. into the narrative					.09	-.15	.06

* Correlation significant at .05 level (2-tailed)
** Correlation significant at .01 level (2-tailed)
*** Correlation significant at .001 level (2-tailed)

In testing assumptions for regression analysis, possible multicollinearity issues were found between the mediator variables, experience-taking and transportation into the narrative, with a correlation of .74 ($p < .001$). Other assumptions were tested by visual inspection of histograms, P-P plots and scatterplots of lineal regression analyses with randomly generated data as the dependent variables, and the variables of the model as the independent variables. These inspections revealed no further issues regarding normal distribution, linearity, homoscedasticity and homogeneity.

Main analyses

Is exposure to fiction -through reading fiction and playing narrative video games- positively associated with theory of mind as when compared to non-narrative video games?

The main research hypothesis was that exposure to fiction, through reading fiction and playing narrative video games, would be positively associated with theory of mind as when compared to non-narrative video games. Results did not support this hypothesis as the relative total effects comparing puzzle video games with narrative games and written fiction resulted non-significant for Model 1, [c_1] $b = 0.14$, $t(70) = 0.46$, $p = .65$), and Model 2, [c_1] $b = -0.36$, $t(71) = -1.37$, $p = .17$. As expected, the overall models for the total effect also resulted non-significant for Model 1, $R^2 = .07$, MSE = 1.31, $F(3,70) = 1.98$, $p = .13$, and Model 2, $R^2 = .03$, MSE = 1.13, $F(2,71) = 1.01$, $p = .37$.

Does experience-taking and transportation into the narrative mediate the relationship between exposure to fiction and theory of mind?

The second hypothesis of the study was that experience-taking and transportation would mediate the relationship between exposure to fiction and theory of mind. The results provided no evidence for this hypothesis. As shown in Table 4.3, possible direct and indirect effects were discounted since none of the variables expected to predict theory mind (as the Accidental Harm condition of the Moral Judgment Test) resulted in significant effects, namely: experience-taking, [b_1] $b = 0.16$, $t(68) = 1.17$, $p = .25$; transportation into the narrative, [b_2] $b = -0.06$, $t(68) = -0.26$, $p = .79$; and neither of the comparisons of exposure to fiction, [c'_1] $b = -0.19$, $t(68) = -0.39$, $p = .70$, [c'_2] $b = 0.08$, $t(68) = 0.20$, $p = .85$, respectively. Accordingly, the model was non-significant, $R^2 = .09$, MSE = 1.32, $F(5,68) = 2.02$, $p = .09$. When looking into the relative conditional indirect effects of Exposure to Fiction on Accidental Harm Scenarios, all

paths did not significantly differ from zero, with all confidence intervals including zero in it.

Similar results appeared when looking at the second measure of theory of mind in Model 2. As shown in Table 4.4, none of the variables expected to predict theory of mind (as the Attempted Harm Scenario of the Moral Judgement Test) resulted in significant effects, namely: experience-taking, $[b_1]$ $b = -0.06$, $t(69) = -0.40$, $p = .69$; transportation into the narrative, $[b_2]$ $b = -0.03$, $t(69) = -0.19$, $p = .85$; and neither of the comparisons of exposure to fiction, $[c'_1]$ $b = -0.17$, $t(69) = -0.49$, $p = .63$, $[c'_2]$ $b = -0.12$, $t(69) = -0.35$, $p = .73$. Accordingly, the overall model was non-significant, $R^2 = .03$, MSE = 1.15, $F(4,69) = 0.55$, $p = .70$. Results of the relative conditional indirect effects of Exposure to Fiction on Accidental Harm Scenarios showed that all paths did not significantly differ from zero, with all confidence intervals including zero in it.

Does reading fiction (compared to playing narrative video games) have a stronger positive association with experience-taking and transportation into the narrative in participants with high imagery ability and with high need for cognition?

The third hypothesis of the study was that that reading fiction, compared to playing narrative video games, would present a higher positive association with transportation and experience-taking in participants with high imagery ability and with high need for cognition. Table 4.5 shows the sub-models predicting experience-taking and transportation into the narrative resulting in statistically significant overall models, $R^2 = .55$, MSE = 1.60, $F(9,64) = 10.68$, $p < .001$ and $R^2 = .53$, MSE = 0.70, $F(9,64) = 8.96$, $p < .001$. However, the comparison between narrative video games with literary fiction predicting experience-taking and transportation into the narrative, resulted in non-significant effects $[a_{2\,1}]$ $b = -0.45$, $t(64) = -1.07$, $p = .29$ and $[a_{2\,2}]$ $b = -0.20$, $t(64) = -0.66$, $p = .51$. Additionally, neither imagery ability nor need for cognition predicted experience-taking $[a_{3\,1}]$ $b = 0.51$, $t(64) = 1.75$, $p = .09$, $[a_{4\,1}]$ $b = -0.04$, $t(64) = -0.19$, $p = .85$, nor transportation into the narrative $[a_{3\,2}]$ $b = -0.04$, $t(64) = -0.19$, $p = .85$, $[a_{4\,2}]$ $b = 0.14$, $t(64) = 1.01$, $p = .32$.

The interaction terms relevant to the third hypothesis also resulted in non-significant effects. The relations examined were: the comparison of narrative video games with literary fiction predicting experience-taking while moderated by imagery ability, $[a_{6\,1}]$ $b = 0.02$, $t(64) = 0.03$, $p = .98$; the comparison of narrative video games with literary fiction predicting experience-taking while moderated by need for

cognition, $[a_{8\,1}]$ $b = 0.13$, $t(64) = 0.25$, $p = .81$; the comparison of narrative video games with literary fiction predicting transportation into the narrative while moderated by imagery ability, $[a_{6\,2}]$ $b = -0.16$, $t(64) = -0.32$, $p = .75$; and the comparison of narrative video games with literary fiction predicting transportation into the narrative while moderated by need for cognition, $[a_{8\,2}]$ $b = -0.09$, $t(64) = -0.24$, $p = .81$. Models 3 and 4, having slightly different sample compositions due to missing data, offered similar results with no major changes to the overall conclusions (Tables 4.5 and 4.6, respectively).

Is exposure to fiction positively associatied with prosocial behaviour when compared to non-narrative video games?

Finally, results did not support the hypothesis that exposure to fiction would be positively associated with prosocial behaviour when compared to non-narrative video games. As shown in Table 4.7, possible direct and indirect effects of exposure to fiction on the prediction of prosocial behaviour were discounted since none of the variables expected to predict prosocial behaviour resulted in significant effects, namely: the comparison between puzzle video games with narrative video games and literary fiction, $[c'_1]$ $b = 2.32$, $t(66) = 0.64$, $p = .52$; experience-taking, $[b_1]$ $b = -1.98$, $t(66) = -1.42$, $p = .16$; and transportation into the narrative, $[b_2]$ $b = 2.31$, $t(66) = 1.16$, $p = .25$. Accordingly, the model resulted non-significant, $R^2 = .03$, MSE $= 256.10$, $F(4,66) = 0.67$, $p = .61$. Similarly, the relative total effect comparing puzzle video games with narrative video games and written fiction, $[c_1]$ $b = 0.83$, $t(68) = 0.22$, $p = .82$ as well as the model for the total effect $R^2 = .01$, MSE $= 253.99$, $F(3,68) = 0.18$, $p = .83$.

Table 4.3. Model Coefficients for Model 1, effect of exposure to fiction on Accidental Harm condition of the Moral Judgement Test mediated by experience-taking and transportation into the narrative.

					Consequent									
	Experience-Taking (M1)					Transportation into the Narrative (M2)					Moral Judgement: Accidental Harm (Y)			
Antecedent		Coeff.	SE	t	p		Coeff.	SE	t	p		Coeff.	SE	t	p
Constant	i_y	3.36	0.55	6.14	.000	i_y	3.08	0.41	7.44	.000	i_y	2.102	0.72	2.91	.005
D_1 †	a_{11}	2.67	0.32	8.24	.000	a_{12}	1.73	0.22	7.72	.000	c'_1	-0.189	0.49	-0.39	.698
D_2 ‡	a_{21}	-0.43	0.45	-0.96	.340	a_{22}	-0.17	0.29	-0.58	.567	c'_2	0.083	0.42	0.20	.846
Experience-Taking (M1)	-	-	-	-	-	-	-	-	-	-	b_1	0.159	0.14	1.17	.246
Transport. into the Narrative (M2)	-	-	-	-	-	-	-	-	-	-	b_2	-0.056	0.21	-0.26	.794
Elicited Mood: Pleasure (C)	f_1	0.09	0.08	1.07	.289	f_2	0.13	0.06	2.19	.032	g_1	0.149	0.09	1.76	.083
	$R^2 = .49$, $MSE = 1.67$, $F(3,70) = 25.41$, $p < .001$					$R^2 = .47$, $MSE = 0.72$, $F(3,70) = 22.46$, $p < .001$					$R^2 = .09$, $MSE = 1.32$, $F(5,68) = 2.02$, $p = .09$			

† D_1 compares puzzle video games condition to narrative video games and reading fiction (unweighted mean).
‡ D_2 compares narrative video games to written fiction.

Table 4.4. Model Coefficients for Model 2, effect of exposure to fiction on Attempted Harm condition of the Moral Judgement Test mediated by experience-taking and transportation into the narrative.

					Consequent									
	Experience-Taking (M1)					Transportation into the Narrative (M2)					Moral Judgement: Attempted Harm (Y)			
Antecedent		Coeff.	SE	t	p		Coeff.	SE	t	p		Coeff.	SE	t	p
Constant	i_y	3.94	0.15	25.78	.000	i_y	3.95	0.10	38.22	.000	i_y	3.24	0.52	6.18	.000
D_1	a_{11}	2.55	0.31	8.36	.000	a_{12}	1.54	0.21	7.34	.000	c'_1	-0.17	0.35	-0.49	.628
D_2	a_{21}	-0.63	0.40	-1.61	.113	a_{22}	-0.47	0.26	-1.80	.077	c'_2	-0.12	0.35	-0.35	.727
Experience-Taking (M1)	-	-	-	-	-	-	-	-	-	-	b_1	-0.06	0.14	-0.40	.689
Transport. into the Narrative (M2)	-	-	-	-	-	-	-	-	-	-	b_2	-0.03	0.17	-0.19	.853
	$R^2 = .48$, $MSE = 1.67$, $F(2,71) = 37.37$, $p < .001$					$R^2 = .43$, $MSE = 0.76$, $F(2,71) = 29.38$, $p < .001$					$R^2 = .03$, $MSE = 1.15$, $F(4,69) = 0.55$, $p = .70$			

† D1 compares puzzle video games condition to narrative video games and reading fiction (unweighted mean).
‡ D2 compares narrative video games to written fiction.

Table 4.5. Model Coefficients for Model 3, a moderated mediation model of exposure to fiction on Accidental Harm condition of the Moral Judgement Test.

		Consequent											
		Experience-Taking (M1)					Transportation into the Narrative (M2)					Moral Judgement: Accidental Harm (Y)			
Antecedent		Coeff.	SE	t	p		Coeff.	SE	t	p		Coeff.	SE	t	p
Constant	i_y	3.56	0.76	4.69	.000	i_y	3.29	0.47	7.00	.000	i_y	2.10	0.72	2.91	.005
D_1	a_{11}	2.65	0.35	7.61	.000	a_{12}	1.67	0.23	7.25	.000	c'_1	-0.19	0.49	-0.39	.698
D_2	a_{21}	-0.45	0.42	-1.07	.291	a_{22}	-0.20	0.30	-0.66	.513	c'_2	0.08	0.42	0.20	.846
Experience-Taking (M1)		-	-	-	-		-	-	-	-	b_1	0.16	0.14	1.17	.246
Transport. into the Narrative (M2)		-	-	-	-		-	-	-	-	b_2	-0.06	0.21	-0.26	.794
Imagery Ability (W)	a_{31}	0.51	0.29	1.75	.085	a_{32}	-0.04	0.21	-0.19	.850		-	-	-	-
Need for Cognition (Z)	a_{41}	-0.04	0.22	-0.19	.850	a_{42}	0.14	0.14	1.01	.318		-	-	-	-
D_1 x Imagery Ability (D_1W)	a_{51}	0.94	0.66	1.43	.157	a_{52}	0.84	0.44	1.92	.059		-	-	-	-
D_2 x Imagery Ability (D_2W)	a_{61}	0.02	0.76	0.03	.975	a_{62}	-0.16	0.51	-0.32	.753		-	-	-	-
D_1 x Need for Cognition (D_1Z)	a_{71}	0.07	0.48	0.14	.891	a_{72}	-0.06	0.26	-0.23	.818		-	-	-	-
D_2 x Need for Cognition (D_2Z)	a_{81}	0.13	0.52	0.25	.805	a_{82}	-0.09	0.37	-0.24	.811		-	-	-	-
Elicited Mood: Pleasure (C)	f_1	0.06	0.11	0.53	.601	f_2	0.10	0.07	1.42	.161	g_1	0.15	0.09	1.76	.083
		\multicolumn{4}{c}{$R^2 = .55$, $MSE = 1.60$, $F(9,64) = 10.68$, $p < .001$}		\multicolumn{4}{c}{$R^2 = .53$, $MSE = 0.70$, $F(9,64) = 8.96$, $p < .001$}		\multicolumn{4}{c}{$R^2 = .09$, $MSE = 1.32$, $F(5,68) = 2.02$, $p = .087$}			

† D1 compares puzzle video games condition to narrative video games and reading fiction (unweighted mean).

‡ D2 compares narrative video games to written fiction.

Table 4.6. Model Coefficients for Model 4, a moderated mediation model of exposure to fiction on Attempted Harm condition of the Moral Judgement Test.

		Consequent											
		Experience-Taking (M1)					Transportation into the Narrative (M2)					Moral Judgement: Attempted Harm (Y)			
Antecedent		Coeff.	SE	t	p		Coeff.	SE	t	p		Coeff.	SE	t	p
Constant	i_y	3.95	0.16	25.07	.000	i_y	3.95	0.10	39.14	.000	i_y	3.24	0.52	6.18	.000
D_1	a_{11}	2.56	0.32	7.91	.000	a_{12}	1.53	0.21	7.33	.000	c'_1	-0.17	0.35	-0.49	.628
D_2	a_{21}	-0.58	0.40	-1.46	.149	a_{22}	-0.43	0.26	-1.67	.100	c'_2	-0.12	0.35	-0.35	.727
Experience-Taking (M1)		-	-	-	-		-	-	-	-	b_1	-0.06	0.14	-0.40	.690
Transport. into the Narrative (M2)		-	-	-	-		-	-	-	-	b_2	-0.03	0.17	-0.19	.853
Imagery Ability (W)	a_{31}	0.53	0.29	1.87	.066	a_{32}	-0.00	0.20	-0.01	.990		-	-	-	-
Need for Cognition (Z)	a_{41}	-0.03	0.20	-0.14	.892	a_{42}	0.16	0.14	1.13	.261		-	-	-	-
D_1 x Imagery Ability (D_1W)	a_{51}	0.92	0.63	1.47	.147	a_{52}	0.81	0.45	1.81	.074		-	-	-	-
D_2 x Imagery Ability (D_2W)	a_{61}	-0.11	0.67	-0.17	.867	a_{62}	-0.40	0.48	-0.83	.412		-	-	-	-
D_1 x Need for Cognition (D_1Z)	a_{71}	0.13	0.42	0.31	.761	a_{72}	0.04	0.28	0.15	.878		-	-	-	-
D_2 x Need for Cognition (D_2Z)	a_{81}	0.13	0.52	0.25	.800	a_{82}	-0.09	0.37	-0.23	.817		-	-	-	-
		\multicolumn{4}{c}{$R^2 = .55$, $MSE = 1.59$, $F(8,65) = 12.25$, $p < .001$}		\multicolumn{4}{c}{$R^2 = .51$, $MSE = 0.72$, $F(8,65) = 9.20$, $p < .001$}		\multicolumn{4}{c}{$R^2 = .03$, $MSE = 1.15$, $F(4,69) = 0.55$, $p = .703$}			

† D1 compares puzzle video games condition to narrative video games and reading fiction (unweighted mean).

‡ D2 compares narrative video games to written fiction.

Table 4.7. Model Coefficients for Model 5, effect of exposure to fiction on prosocial behaviour mediated by experience-taking and transportation into the narrative.

Antecedent		Experience-Taking (M1)					Transportation into the Narrative (M2)					Prosocial behaviour (Y)			
		Coeff.	SE	t	p		Coeff.	SE	t	p		Coeff.	SE	t	p
Constant	i_y	3.93	0.16	24.94	.000	i_y	3.94	0.11	37.70	.000	i_y	9.09	6.92	1.31	.194
D_1	a_{11}	2.54	0.32	8.01	.000	a_{12}	1.53	0.22	7.07	.000	c'_1	2.32	3.61	0.64	.523
D_2	a_{21}	-0.62	0.41	-1.52	.132	a_{22}	-0.45	0.26	-1.70	.094	c'_2	-2.71	5.53	-0.49	.626
Experience-Taking (M1)		-	-	-	-		-	-	-	-	b_1	-1.98	1.33	-1.42	.160
Transport. into the Narrative (M2)		-	-	-	-		-	-	-	-	b_2	2.31	1.99	1.16	.251
		$R^2 = .47, MSE = 1.71, F(2,68) = 33.69, p < .001$					$R^2 = .43, MSE = 0.75, F(2,68) = 27.15, p < .001$					$R^2 = .03, MSE = 256.10, F(4,66) = 0.67, p = .612$			

† D_1 compares puzzle video games condition to narrative video games and reading fiction (unweighted mean).

‡ D_2 compares narrative video games to written fiction.

Discussion

The current study aimed to test a model of the causal relation between the exposure to fiction, through reading fiction and playing video games, and theory of mind, while considering transportation into the narrative and experience-taking as possible mediators and imagery ability and need for cognition as moderators. The main hypothesis of the study is that the exposure to fiction, through reading fiction and playing narrative video games, will be positively associated with theory of mind as when compared to non-narrative video games. Secondary hypotheses of the study were that transportation into the narrative and experience-taking will mediate the relationship between exposure to fiction and theory of mind and that reading fiction as opposed to playing narrative video games will present a higher positive association with transportation into the narrative and experience-taking in participants with high imagery ability and with high need for cognition. It was also hypothesised that the exposure to fiction will be positively associated with prosocial behaviour when compared to non-narrative video-games.

No support for exposure to fiction -through reading fiction and playing narrative video games- being positively associated with theory of mind as when compared to non-narrative video games.

Overall, results do not support the hypothesis that exposure to fiction, through reading fiction and playing narrative video games, is positively associated with theory of mind as when compared to non-narrative video games. More precisely, results show non-significant differences in the Accidental and Attempted Harm scenarios of the Moral Judgement Test (Models 1 and 2, respectively) when comparing participants of the puzzle video games condition to participants of the written fiction and narrative video games conditions.

Regarding these results, it is important to notice that the study design did not consider a pre-manipulation measurement of theory of mind and thus, no conclusions can be drawn regarding changes in theory of mind, but only regarding differences (or lack of them) across conditions. Considering this limitation and the aforementioned results, it could be the case that all three conditions produced either a boost, a decrease or no change at all in theory of mind, but no definite conclusion can be drawn with the current design. In any case, all three possibilities do not support the scientific literature suggesting, since they imply that either puzzle games produced a boost on theory of

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mind or that narrative games and written fiction produced either a detrimental effect or no effect at all on theory of mind, thus contradicting the hypothesis that that exposure to high quality fiction, as opposed to low quality fiction and no fiction, boosts people's theory of mind (Black & Barnes, 2015a, Black & Barnes, 2015b; Bormann & Greitemeyer, 2015; Kidd & Castano, 2013; Pino & Mazza, 2016). In conclusion, these findings add up to recent studies failing to replicate said findings (Djikic et al., 2013; Panero et al., 2016; Samur et al., 2018).

No support for transportation into the narrative and experience-taking mediating the relationship between exposure to fiction and theory of mind.

Results do not support the hypothesis that experience-taking and transportation into the narrative mediates the relationship between exposure to fiction and theory of mind. As shown in results of Models 1 and 2, possible direct and indirect effects were discounted since none of the variables expected to predict theory mind (as the Accidental and Attempted Harm scenarios of the Moral Judgment Test) resulted in significant effects as well as the overall Models 1 and 2. When looking into the relative conditional effects of Models 3 and 4, all paths did not significantly differ from zero, with all confidence intervals including zero in them. Considering these results, it is concluded that experience-taking and transportation into the narrative do not mediate the relationship between exposure to fiction and theory of mind, neither when considering mediation-only models (Models 1 and 2) nor when considering moderated mediation models with need for cognition and imagery ability as moderator variables (Models 3 and 4).

These are unexpected results considering the literature linking transportation into the narrative to empathy (Bal & Veltkamp, 2013) and experience-taking to behavioural and attitudinal change towards minority groups depicted in fiction (Kaufman & Libby, 2012). It was expected that transportation into the narrative and experience-taking would mediate the relationship between exposure to fiction and theory of mind, meaning that participants would experience boosts in theory of mind after being exposed to fiction, as long as they were able to feel transported into the narrative and were able to take the perspective of the characters in them, but no support for this hypothesis was found.

By looking at the submodels predicting experience-taking and transportation into the narrative in Models 1 and 2, significant effects can be found for the comparison of puzzle games to narrative games and written fiction. More precisely, participants of the narrative games and written fiction obtaining higher scores in experience-taking and transportation into the narrative supports the idea that high quality narrative fiction facilitates the participants' engagement with the story. In contrast, when looking at the submodels predicting Accidental and Attempted Harm scenarios, neither transportation into the narrative nor experience-taking predict theory of mind. With this in consideration, it can be argued that despite narrative games and written fiction producing higher levels of experience-taking and transportation into the narrative as when compared to puzzle video games, they don't produce changes in theory of mind neither by themselves, nor when mediated by experience-taking nor transportation into the narrative.

No support for imagery ability and need for cognition moderating the association between exposure fiction with transportation into the narrative and experience-taking.

Results do not support the hypothesis that reading fiction, compared to playing narrative video games, would present a higher positive association with transportation into the narrative and experience-taking in participants with high imagery ability and with high need for cognition. As per shown in results of Models 3 and 4, despite the significant overall sub-models predicting experience-taking and transportation into the narrative, the comparison between narrative video games with literary fiction resulted in non-significant effects for the prediction of experience-taking and transportation into the narrative. Complementary, neither imagery ability nor need for cognition predicted experience-taking nor transportation into the narrative by themselves, nor when moderating the comparison between narrative video games and written fiction. These results are consistent in the Accidental and Attempted Harm Scenarios.

The non-significant differences in experience-taking and transportation into the narrative between participants of the narrative games and written fiction conditions suggest that they had a similar effect in terms of how well participants were able to simulate the events presented in the narrative as if they were a particular character in the story (Kaufman & Libby, 2012) and how well participants were able to better meld attention, imagery, and feelings, focusing on story events (Green & Brock, 2000).

Non-significant effects for imagery ability and need for cognition in the prediction of experience-taking and transportation into the narrative nor by themselves, nor when interacting with the comparison of narrative video games to written fiction, allow to discount moderation effects. These are considered unexpected results since they do not support the literature suggesting moderation roles for imagery ability (Green et al., 2008) and need for cognition (Appel & Richter, 2007; Green & Brock, 2000) in the relationship between exposure to fiction and transportation into the narrative as when comparing films to written fiction. Considering the similarities in terms of visual stimulation between films and video games, it was expected that these effects would be replicated in the present study.

Overall, when comparing narrative video games to written fiction, both forms of fiction do not differ in terms of how much transportation into the narrative and experience-taking they elicit and said relationship is not moderated by the participants' imagery ability nor need for cognition.

No support for exposure to fiction being positively associated with prosocial behaviour when compared to non-narrative video-games.

Finally, the hypothesis that exposure to fiction is positively associated with prosocial behaviour when compared to non-narrative video games was not supported by the results. This conclusion is reached considering that none of the variables expected to predict prosocial behaviour in Model 5 resulted in significant effects. In a similar fashion, the comparison of puzzle games to narrative video games and narrative fiction as well as the overall model resulted in non-significant effects. Based on these results, it was concluded that prosocial behaviour is not predicted by exposure to fiction, as when comparing puzzle video games to narrative games and written fiction, nor when comparing these last two forms of fiction. Complementary, these results hold for when testing direct effects as well as when testing effects mediated by transportation into the narrative and experience-taking.

It is worth noting that the use of a prosocial behaviour measure as the dependent variable in this hypothesis is the product of past research showing a positive association between said variable and theory of mind (e.g., Caputi, Lecce, Pagnin, & Banerjee, 2012). Based on this evidence, it was estimated that the use a prosocial behaviour could

provide a more ecologically valid measure of the possible benefits of being exposed to fiction, but results do not support the hypothesis.

Limitations

A number of limitations were identified for this study, the first of which comes from the design of the study. The study used an experimental design with post-manipulation measurements only, which means that only differences across the experimental conditions can be tested but since there are no baseline measurements, magnitudes of the changes cannot be established and, in case of null differences across conditions (as it was in most cases in this study), direction of changes can't be established either and thus further investigation is suggested. To address this limitation it is suggested that future research include pre- and post-manipulation measurements of theory of mind.

A second limitation comes from the sampling method by opportunity that used in the study. The use of the sampling method may entail a self-selection bias since the study recruited participants that were available and willing to take part in a study of video games and short stories and how they make people feel and think. Considering this, people who feel more drawn to these leisure activities may have been more likely to take part in it, thus producing results that may be different to those produced by people who are not as drawn to these leisure activities. Similarly, sample was comprised mostly of university students which resulted in a relatively homogeneous group in terms of age (M_{age}=21.73 years, SD_{age}=8.59) and educational level, thus restricting the generalizability of results. To address these limitations, it is suggested to mask the aims and use of stimuli in the study, to broaden the inclusion criteria for participants, and to change recruitment method to include participants across the adulthood spectrum, and from a more varied occupational and educational background.

A third limitation comes from the relative limited range of stimuli used in the study. More precisely, the study used only two subconditions per condition with specific criteria for their selection with the intention of using relatively homogeneous stimuli. This allowed to narrow down to specific boundary conditions of the stimuli in terms of quality and social elements portrayed in them, but this also means that results obtained are specific to stimuli of similar characteristics and cannot be generalised. In a similar line, the study used a control condition in the form of puzzle video games,

which are low quality and non-social, but other combinations were not tested (i.e., low quality with social contents and high quality without social contents). Considering this, it is suggested that future studies use different stimuli but following similar criteria of high quality and social contents for the experimental conditions, and that control conditions include other combinations of quality and social contents (e.g., low quality with social contents) to explore their possible influence on theory of mind enhancements.

Another limitation comes from the theory of mind measure used, which may differ from the exercise of theory of mind in everyday life scenarios where other sources of information are at play. The Moral Judgement Test requires participants to read a series of vignettes, some of which include serious consequences for the characters, such as illness or death. These two characteristics, the written nature of the vignettes and the relatively extreme consequences for the characters, raise questions about the ecological validity of the measure, considering that theory of mind is a process expected to take place in everyday interactions, where people take into account verbal and non-verbal cues (e.g., facial expressions, body posture) to evaluate others' emotions and intentions, which may not necessarily include consequences as serious as illness and death.

In this regard, an alternative measure of theory of mind that may be used in future studies would be the Strange Stories Film Task (SSFT) by Murray et al. (2017). The SSFT offers some advantages in its design which address some of the issues regarding ecologic validity. Firstly, the SSFT uses 15 naturalistic video scenarios performed by semi-professional actors, which in which participants have to assess multiple social cues (e.g., facial expressions, voice inflections, body posture) and not only written text. Secondly, the SSFT portray different types of scenarios such as characters telling a white lie, persuasion attempts, and double bluffs, which means that participants have to react to a broader range of social intentions, and not only to no harm/serious harm scenarios. Thirdly, the SSFT ask participants about intentions, interactions and memory questions after each clip, which offers a more detailed evaluation of the participants' ability to assess others' intentions. Conversely, since the SSFT was designed to assess theory of mind differences in adults with autism spectrum disorders, further research would be needed to evaluate if the test can capture variations

in theory of mind in a neurotypical samples. And finally, considering the relatively small pool of items, pre- and post-measurements may be difficult.

Lastly, there is the limitation coming from a small sample size which translates into underpowered analyses. As it has been mentioned in the Participants section of this chapter, sample size for this study was estimated using Fritz and MacKinnon's (2007) suggestions regarding estimated sample sizes required to detect mediation effects with power levels of 0.8. Nevertheless, Fritz and MacKinnon's proposal established power estimations for simple mediation models, and it does not cover more complex models such as the ones tested in this study (i.e., models with 2 parallel mediators, with and without two moderators). Given this consideration and Kline's (2016) recommendations for SEM models of 20 cases per parameter of the model, analyses of this study resulted underpowered. Ultimately, this means that no final conclusion can be drawn from the results that do not support the hypotheses, which could be due to this study not having enough participants to detect small effects sizes, or to an absence of a true effect. Considering this limitation, it is recommended that future studies include a combination of the following measures which, according to the literature, increase power in research (e.g. Kline, 2016): larger samples sizes (to increase the number of observations), using a within-subjects design (which usually require smaller sample sizes than between-subjects designs), and to test simpler models in order to reduce the total number of participants required.

Considering the findings and limitations of the study, the following suggestions are made for future studies. Firstly, it is suggested a change in design, one that includes pre- and post-manipulation measurements of theory of mind. This would help address possible changes in theory of mind, in terms of magnitude and direction, and not only differences across conditions as it was the case of the current study. In the same line, it is suggested that future studies include control groups with different combinations of quality and social contents, to address not only possible changes within condition, but also differences across different conditions. Another recommendation is to mask the use of stimuli during the recruitment and testing process to minimize self-selection bias that could influence the results.

Conclusions

In summary, no differences in theory of mind nor in prosocial behaviour were found when comparing participants who played puzzle video games to participants who read fiction or that played narrative video games, nor when comparing the latter two. Explanations for these results are still inconclusive since, given the design of the study, no conclusions can be drawn regarding changes in theory of mind across the different experimental conditions. Participants who played puzzle video games experienced lower transportation into the narrative and experience-taking than participants who read fiction or played narrative games, but not differences were found between the latter two groups. Transportation into the narrative and experience-taking were not associated with theory of mind nor with prosocial behaviour. Finally, no evidence of moderation effects was found for imagery ability and need for cognition, in the relationships of exposure to fiction with transportation into the narrative and with experience-taking.

Chapter 5:

Effect of Reading Fiction, Playing Video Games and Watching Virtual Reality Films on Theory of Mind

This chapter presents Study 3, which followed the main suggestion made after the previous study regarding the implementation of an experimental design with pre- and post-manipulation measurements of theory of mind. Such design would allow to evaluate possible variations of theory of mind within each condition over time. Another change of Study 3 relates to the inclusion of virtual reality films (VR films) as a third experimental condition. The decision to include VR films was made based on this media being considered particularly immersive, which was estimated could produce higher levels of transportation into the narrative and experience-taking, and potentially of higher enhancements of theory of mind.

The study aimed to compare the effects of exposure to fiction through reading fiction, playing video games and watching VR films on theory of mind, and to compare these different media in terms of the elicitation of transportation into the narrative and experience-taking.

This study's rationale is similar to Study 2's (Chapter 4), inasmuch it followed Kidd and Castano's (2013) hypothesis that not all pieces of fiction produce social-cognitive enhancements, but only fiction that is of high quality. To test this hypothesis, Kidd and Castano randomly assigned participants to either read an award-winning piece of fiction (i.e., higher quality literature, or literary fiction), a piece of popular fiction (i.e., lower quality literature), or a piece of nonfiction (e.g., news article). Consequently, the present study used Kidd and Castano's experiments as templates in terms of its experimental design with random assignation to their conditions, as well as the criteria for the selection of high quality stimuli (i.e., award-winning pieces of fiction, video games, and virtual reality films).

In line with Study 2's, Study 3 in this chapter also included the variables transportation into the narrative (Green and Brock, 2000), and experience-taking (Kaufman & Libby, 2012). The inclusion of these variables aimed to test the extent to which feeling immersed in the narrative, and being able to assume the experience of a fictional character inside of it, explains the enhancing effect that exposure to fiction has on social-cognitive performance. The inclusion of these variales would allow to evaluate if fiction presented through VR films elicits higher levels of immersion and experience-taking when compared to fiction presented in written form and through video games.

Hypotheses

The first and main hypothesis of the study was that exposure to all three forms of fiction -written, video games, and virtual reality films- will boost theory of mind. The second hypothesis of this study was that VR films will produce greater theory of mind enhancements when compared to reading fiction and playing video games. Lastly, the third hypothesis of this study was that, when compared to reading fiction and playing video games, VR films will elicit higher transportation into the narrative and experience-taking.

The main hypothesis of this study seeked to further explore the extent to which fiction can enhance individuals´ social-cognitive skills, beyond written literature. In line with the previous studies of this thesis, this hypothesis was based on the evidence suggesting that lifelong exposure to written fiction is positively associated with social

ability (e.g., Mar et al., 2006), and on experimental studies suggesting that that not all pieces of fiction produce social-cognitive enhancements, but fiction that is of high quality (Kidd & Castano, 2013). Additionally, this hypothesis was based on studies showing social-cognitive skills being boosted by watching high quality television series (Black & Barnes, 2015a), and by playing narrative video games (Bormann & Greitemeyer, 2015), thus suggesting that boosts in social-cognitive skills are not limited to written fiction.

The second and third hypothesis of this study were based on the notion that VR is a particularly immersive media, which –arguably– may make it particularly effective at eliciting higher transportation into the narrative and experience-taking, and at producing greater theory of mind enhancements (compared to reading fictions and playing narrative video games). Consistent with the previous study, the second and third hypotheses of this study were based on research suggesting that transportation into the narrative may mediate the association between exposure to fiction and empathy (Bal & Veltkamp, 2013) and on studies showing that experience-taking is positively associated with greater behavioural changes (Kaufman & Libby, 2012). Given that VR may be a particularly immersive media, this study explored the extent to which VR produce greater transportation into the narrative and experience-taking, when compared to written fiction and video games. Lastly, given the association between transportation into the narrative and empathy (Bal & Veltkamp, 2013), the this study also explored if VR films produce greater theory of mind enhancements when compared to written fiction and narrative video games. Further details of the research that led to the rationale for the hypotheses of this study can be found in chapter 2.

Method

Design

The design of the study consisted of two parts. The first part of the study used an online questionnaire to collect the participants' sociodemographic information, and contact information and time availability for the laboratory experiment. The second part of the study was a laboratory experiment with three conditions (literary fiction, narrative game or VR film), each of which consisted of two stimuli for a total of six subconditions.

To address the hypothesis regarding the comparison that effects of VR and non-VR conditions have on theory of mind, it was decided that VR films subconditions would have twice as many participants as the other two subconditions. This decision was made considering that, prior to this study, VR films were an untested stimulus, and thus a larger sample size for this group would provide stronger evidence in case effects were to be detected. On the other hand, since literary fiction and narrative games conditions were already tested in Study 2, results regarding these two groups could be interpreted in light of that study's results.

To operationalise the unequal sample sizes, quotas were established in the online system that hosted the questionnaires (Qualtrics): 18 places for reading one of the two stories of fiction (9 per story), 18 for playing one of the two narrative games (9 per game), and 36 to watch one of the two virtual reality films (18 per film). Subsequently, using the online system's randomising tool, participants were assigned to one of the six subconditions of the study, which resulted in participants being assigned to the testing conditions without direct intervention of the researcher, while also considering the unequal sample sizes in the assignment.

It is worth mentioning that according to the literature (Field, 2009), having unequal group sizes may originate violations to the homogeneity of variance in ANOVA analyses (main analyses for this study). Therefore, it is recommended that this assumption is tested when conducting these analyses with unqueal group sizes. Tests of homogeneity of variance for this study can be found in the Results section and their implications in the Discussion section regarding this study's limitations.

During the experiment, participants were presented with measures of theory of mind (measured pre- and post-manipulation), transportation into the narrative, experience-taking, perceived attributes of the stimulus (fiction, game, or VR film), and mood elicited by the stimulus they had received (measured post-manipulation). The study was pre-registered before finishing data collection at AsPredicted.org (see Appendix D).

Participants

For this study, 72 participants were recruited (33 males, 39 females: M_{age}=21.56 years, SD_{age}=4.31). Of the total participants, 57 were native speakers of English and the remaining 15 participants had in average 11.47 years of proficiency in English (the

minimum to take part in the study was 10). All participants where students at the University of Sheffield of which 48 undergoing their undergrad studies, 9 where studying to obtain a Masters' degree (or equivalent) and 15 to obtain a PhD degree (or equivalent).

Post hoc power analyses conducted for each of the main analyses of the study showed acceptable levels for the mixed ANOVA analyses, with a power of 0.96 for the mixed ANOVA comparing the effects of the three conditions –literary fiction, VR films, and video games– [α = .05; ES = .25; N = 72; 3 Groups; 2 Measurements], and of 0.98 for the mixed ANOVA comparing the effects of VR versus non-VR conditions [α = .05; ES = .25; N = 72; 2 Groups; 2 Measurements]. Based on these results, the mixed ANOVA analyses were deemed sufficiently powered for the detection of mid-sized effects.

Conversely, *post hoc* power analyses for the one-way ANOVA analyses resulted in a power of .76 for effect comparison of the three conditions on experience taking [α = .05; ES = .36; N = 72; 3 unequeal groups], and of .58 when comparing the effects of the three conditions on transportation into the narrative [α = .05; ES = .29; N = 72; 3 unequeal groups]. Therefore, it can be concluded that one-way ANOVA analyses in this study may be underpowered and thus results should be addressed with caution. Power was calculated using G*power 3.1.9.2 (Faul et al., 2007).

Participants were recruited at the University of Sheffield through the distribution of flyers on university public spaces (opportunistic), through the mailing list of volunteer students (self-selection), and through the Department of Psychology volunteer scheme in exchange for credits (self-selection). Students from the Department of Psychology who signed-up through the volunteer scheme received four credits in exchange for an estimated participation of 60 minutes. Participants recruited through the distribution of flyers and the mailing list of volunteers did not receive any incentive. The study was presented to participants as a study of leisure activities in which they would have to answer an online questionnaire and to take part in an experiment at a time of their convenience to either read a short story, play a video game or watch a VR film.

Inclusion criteria for participants included age (18 years old and above), occupation (university students), English proficiency (English as first language, or at

least ten years of proficiency when English is a second language), and health status (without a history or diagnosis of epilepsy and/or blackouts). The study received ethical approval from the Ethics Committee of the University of Sheffield's Psychology Department (Reference Number 016065).

Materials

The online questionnaire collected sociodemographic information (age, gender, years of English fluency, ethnicity, occupation, and history and/or diagnosis of epilepsy or blackouts), as well as time availability and contact information (name and email) for the experiment session. During the experiment, participants were presented measures of theory of mind, transportation into the narrative, experience-taking, perceived attributes of the stimuli and mood elicited by the stimuli. The experiment also included the use of the following stimuli: two short stories of literary fiction, two narrative video games, and two VR films.

Measures

Theory of Mind was measured with a Moral Judgment Test (MJT) as proposed by Young et al. (2010) which evaluates the extent to which individuals think spontaneously about intentions when judging an individual's behaviour. The scale comprises 48 scenarios with four different variations combining two story elements: (i) either a negative or neutral outcome and (ii) either an intentional or accidental attribution to the outcome. The resulting variations are: intended harm (negative outcome with intentional attribution), accidental harm (negative outcome with accidental attribution), attempted harm (neutral outcome with intentional attribution), and no harm (neutral outcome with accidental attribution). Example items can be found in Appendix C. Because of time limitations of the study, a subset of 24 scenarios were randomly selected prior to data collection, 12 items were used to obtain a baseline measurement of theory of mind (pre-manipulation) and 12 items were used for a post-manipulation measurement of theory mind. All participants received all 24 scenarios in the same order; for each scenario they randomly received one of the four variations. Individuals were asked to make judgments for each scenario on 7-point scale items, rating how forbidden or permissible were the protagonists' actions. The instrument provided four average scores, one for each scenario variation.

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In this task, participants are asked to make moral judgments for each scenario, rating how forbidden or permissible were the protagonists' actions, which would -and arguably does- indicate moral judgment on the participants' behalf. Nevertheless, the focus of this task is on the variations within subject and/or differences across groups in the judgments of how forbidden/permissible the protagonist's intentions in these scenarios are. These variations and differences are interpreted as variations in theory of mind since participants considering the protagonist's intentions in their judgments should evaluate the actions in the accidental harm scenarios as more permissible and the actions in attempted harm scenarios as less permissible. Previous studies have shown that responses to accidental harm and attempted harm scenarios provide a sensible measure of theory of mind (Moran et al., 2011; Young et al., 2010).

Transportation into the Narrative was measured through the Transportation Scale proposed by Green and Brock (2000). The scale was created to capture Gerrig's (1993) dimensions of transportation: emotional involvement in the story, cognitive attention to the story, feelings of suspense, lack of awareness of surroundings, and mental imagery. The scale has 15 items, 4 of which are adapted to each story, which ask individuals to rate to what extent they agree with each of them on a 7-point scale, ranging from "Absolutely no" to "Absolutely yes". Example items of the scale were "I could picture myself in the scene of the events described in the story" and "After finishing the story, I found it easy to put it out of my mind" (reverse-scored). Overall reliability for the scale in the present study was adequate (α =0.727).

Experience-Taking was measured as proposed by Kaufman and Libby (2012). Experience-taking is defined as the immersive phenomenon of simulating the mindset and persona of a protagonist in a fictional scenario (Kaufman & Libby, 2012). Using a 7-point response scale, ranging from "Strongly disagree" to "Strongly agree", participants rated to what extent they agreed with each of its seven items. Examples items of the scale were "I found myself thinking what the character in the story was thinking" and "I was not able to get inside the character's head" (reverse-scored). Overall reliability for the scale in the present study was adequate (α =0.862).

Perceived Attributes of the stimulus were measured using four 10-point scale bipolar items that asked the participants to evaluate the message of the story/game (positive or negative), the complexity of the story/game (simple or complex), the

quality of the social interactions in the story/game (poorly/in a good manner) and how important they were to the plot (unimportant/very important).

Mood elicited by the stimuli was assessed as proposed by Poerio et al. (2015), with three 10-point scale bipolar items that asked how sad-happy, bored-excited and anxious-calm participants felt (after being exposed to the stimuli). These items were chosen to measure the pleasure (valence) and arousal (activation) dimensions of core affect (Remington et al., 2000); specifically, pleasure (sad-happy), pleasant activation (bored-excited) and pleasant deactivation (anxious-calm).

Stimuli

The fiction, games and VR film stimuli were selected based on the criteria that they had to depict social interactions between two or more characters and had to be high quality, meaning that they had to have won or been nominated for an award by the industry/community or specialized media.

The *Short stories of literary fiction* used were: 1) "The History of Happiness" by Brenda Peynado (in O. Henry Prize Stories, 2015) which is about an unnamed traveller stranded with no money in Singapore who is also dealing with the emotional aftermath of a relationship breakup. 2) "The Vandercook" by Alice Matisson (in O. Henry Prize Stories, 2012) which is the story of Lorenzo and Molly, a married couple disentangling a family secret after they move back to Lorenzo's childhood town to help his father with the family business.

The *narrative video games* used were: 1) "Life is Strange" (Dontnod Entertainment, 2015), which was awarded as best story in a game by the 12th British Academy Games Awards. The game tells the story of Max, a senior photography student who suddenly discovers she is able to rewind time. The game focuses on realistic interactions, exploring themes of human emotions and coming of age. 2) "Everybody's gone to the Rapture" (The Chinese Room, 2015) which was nominated to the 12th British Academy Games Awards for its story. The game mixes themes human drama, science fiction and religion, where the player reconstructs the last days of Yaughton, a small English town whose inhabitants have mysteriously disappeared.

The *virtual reality films* used were: 1) "Alteration" (Okio-Studio, Arte France, Saint George Studio, & Blanquet, 2017) which tells the story of Alexandro as he volunteers for a dream experiment where (unknowingly to him) scientists injects him

with an Artificial Intelligence entity that digitizes and takes over his emotions and experiences. 2) "Miyubi" (by Dumont, Dananay, Lajeunesse, & Raphael, 2017) puts the viewer in the body and mind of a Japanese toy robot that is gifted to a young boy on his birthday in 1982 suburban America, and the story deals with themes of obsolescence and family relationships. Both films were awarded the Jury Special Prize at the Paris Virtual Film Festival 2017. In the present study, the VR films were presented to participants using a Samsung Gear VR headset, which was a certified and commercially available product and a Samsung Galaxy S7 Edge mobile (SM-G935F).

Procedure

Participants were recruited at The University of Sheffield through the distribution of flyers in university public spaces, university wide mailing lists, and the Department of Psychology volunteer scheme. Participants recruited through the volunteer scheme received credits in exchange for their participation, while the rest of the participants did not receive any form of incentive. The invitation presented the study as regarding reading, video games and virtual reality as leisure activities, and how they make people feel and think, and framed participation as involving having to answer an online questionnaire and meet the researcher to take part in an experiment.

The online questionnaire presented the participant information sheet and consent form detailing the ethical guidelines of the study. The participant information sheet also advised participants to refrain from participating in cases where: 1) they were sensitive to strong language, depictions of violence and drug use, which were present in some of the games, stories and films; 2) they were prone to experience motion sickness, nausea, disorientation, blurred vision, or similar symptoms since they may be triggered by the use of virtual reality headsets; 3) they had a history or a diagnosis of epilepsy and/or blackouts, since the use of virtual reality headsets may act as triggers. The online questionnaire presented questions regarding sociodemographic information (age, gender, years of English fluency, ethnicity, occupation, and history and/or diagnosis of epilepsy or blackouts) and time availability and contact information (name and email address) to arrange a meeting for the experiment.

The laboratory setup consisted in a private cubicle with a desk and a swivelling chair where the laboratory experiment took part, a laptop and mouse for the online questionnaires and narrative games subconditions, paper versions of the short stories

for the literary fiction subconditions, and the VR headset and mobile phone for the VR films subconditions. Using a standard script, the experimenter provided a description of the experimental session at its beginning, guided the participant through each of the steps, and provided demonstrations of the equipment for the VR films subconditions. The experimenter was present in-between each of the steps, while waiting outside of the cubicle during each of the steps. Since assignment was done at random, the experimenter was aware of the conditions only after participants were assigned to a condition.

During the laboratory experiment, participants were reminded about the ethical guidelines of the study and health and safety warnings. Participants where then asked to answer a brief questionnaire to obtain a baseline measure of theory of mind, after which they were randomly assigned to one of six subconditions to: read one of two short stories of literary fiction, play one of two narrative video games, or watch one of two VR films. Random assignation to the subconditions was done using features (randomize and quotas) of the platform hosting the online questionnaires. Participants in the short stories condition were instructed to read the story as if they were doing it in their own leisure time, at their own pace, without any goals associated with them reading the story. Average reading time of the stories was 26.8 minutes ($\pm$ 6.5 minutes). Participants in the narrative video game condition were presented with a brief description of the game, instructions on how to play the game (mouse and keyboard controls scheme) and a 3-minute video demonstrating the game. Participants in this condition were asked to play the game for 23 minutes as if they were doing it in their own leisure time, without any specific goals being set for this study. Participants in the VR film condition received verbal instructions on how to operate the virtual reality headset and were then asked watch the film for 18 minutes in the case of "Alteration" (entire runtime of the film) and for 21 minutes approximately in the case of "Miyubi" (runtime of 40 minutes). Finally, participants were asked to answer another questionnaire pertaining to: mood elicited by the stimuli, perceived attributes of the stimuli, theory of mind, transportation into the narrative, and experience-taking. After participants had finished completing the questionnaire, they were given the opportunity to ask questions regarding the study and provide general feedback about their experience in the experiment. The average time for each experimental session was 52.28 minutes ($\pm$ 8.48 minutes) plus an estimated 5 extra minutes in which participants

were welcomed and received the overall instructions for the session. Data was collected from October 2017 to April 2018.

Analysis Plan

Two sets of four mixed ANOVA analyses were conducted to address the first and second hypotheses of this study. In both sets, each of the four analyses had one of the four theory of mind scenarios as the within-subjects factor (pre- and post-manipulation). Even though the main focus of these analyses is on the accidental and attempted harm scenarios, results of the no harm and intentional harm scenarios are reported to aid interpretation of the theory of mind scale and overall results.

The first set of mixed ANOVA analyses addressed the first hypothesis of the study: that exposure to all three forms of fiction -written, video games, and virtual reality films- will boost theory of mind. To do so, this set of analyses tested all three media conditions as the between-subjects factor (short stories of literary fiction, narrative video games, and VR films). As previously mentioned, each of the four analyses of this set had one of four theory of mind scenarios as the within-subjects factor (pre- and post-manipulation).

The second set of mixed ANOVA analyses addressed the second hypothesis of the study: that, when compared to reading fiction and playing video games, VR films will elicit higher transportation into the narrative and experience-taking. This set of analyses tested the comparison between VR films (VR film condition) versus short stories and narratives games (non-virtual reality conditions) as the between-subjects factor. As previously mentioned, each of the four analyses of this set had one of four theory of mind scenarios as the within-subjects factor (pre- and post-manipulation).

Lastly, one-way ANOVA analyses were conducted comparing transportation into the narrative and experience-taking between media conditions. These analyses addressed the third hypothesis of this study: that VR films will produce greater theory of mind enhancements when compared to reading fiction and playing video games.

Results

A total of 72 participants responded to the questionnaire, with the following distribution across conditions: 18 read one of two short stories of literary fiction, 18 played one of two narrative video games, and 36 watched one of two VR films.

Prior to conducting the main analyses of the study, checks for outlier scores and normality checks were performed followed by exploratory bivariate correlations, and t-tests to explore the equivalence for each pair of subconditions (i.e., short stories of literary fiction, narrative video games, and VR films).

Outliers and normality

Outliers were checked following the outlier-labelling rule by Hoaglin and Iglewicz (1987), with a 2.2 multiplier. Table 5.1 shows the lower and upper values resulting from the labelling formula and the number of cases removed which correspond to observations below or above the lower and upper limit respectively. No outliers were identified and therefore no participants were removed.

Table 5.1. Upper and lower limit for outlier removal by variable and number of cases removed.

		Lower Limit	Upper Limit	No. of cases removed
Attempted Harm	Pre-manipulation	-0.80	7.30	0
	Post-manipulation	-1.80	6.30	0
Accidental Harm	Pre-manipulation	-3.13	9.47	0
	Post-manipulation	-1.37	8.53	0
No Harm	Pre-manipulation	2.73	9.93	0
	Post-manipulation	1.70	9.80	0
Intentional Harm	Pre-manipulation	-1.20	4.20	0
	Post-manipulation	-0.10	2.60	0
Experience Taking		0.69	9.17	0
Transportation		2.85	6.81	0

Normality was tested in these variables by visual inspection of histograms and P-P plots for each combination of the groups (within-subjects factor and between-subjects). These inspections revealed no issues regarding normal distribution.

Exploratory bivariate correlations

Exploratory bivariate correlation analyses revealed some statistically significant associations with the dependent variables of the study. More precisely, the post-manipulation measurement of accidental harm was associated with gender ($r_{pb}(67)$ = .25, p = .04), where female participants tended to evaluate the protagonists' actions as more permissible. The pre-manipulation measurement of no harm was inversely associated with being a native speaker of English ($r_{pb}(66)$ = -0.41, $p < .001$), where native speakers of English tend to evaluate the protagonists' actions as more permissible. Considering the influence that gender and English as first language, as sociodemographic variables, may have on the accidental harm scenarios and no harm

scenarios, they were included in the respective mixed ANOVA analyses as a second between-subjects factors.

The correlation matrix with the full list of results which, under parsimony principle, won't be described in detail, can found in Table 5.2. These results include: associations within sociodemographic variables, elicited mood, and perceived attribute; associations between elicited mood and perceived attributes submeasures with the dependent variables; and between dependent variables.

Equivalence of subconditions

Equivalence of subconditions was assessed using t-tests for independent samples comparing each pair of subconditions' means in terms of elicited mood, perceived attributes, experience-taking, and transportation into the narrative.

In the VR films subconditions, there were statistically significant differences in the elicited mood submeasure of the pleasant deactivation, and the submeasures of perceived attributes of message, and complexity. Participants of the VR film condition who watched "Miyubi" felt more calm ($M = 6.44$, $SD = 2.57$) than those who watched "Alteration" ($M = 4.33$, $SD = 2.52$), $t(34) = -2.487$, $p = .018$, $d = -0.829$; perceived the message of the VR film as more positive ($M = 5.11$, $SD = 1.75$) than those who watched "Alteration" ($M = 3.78$, $SD = 1.99$), $t(34) = -2.139$, $p = .040$, $d = -0.710$; and perceived the VR film as less complex ($M = 5.94$, $SD = 1.76$) than those who watched "Alteration" ($M = 8.50$, $SD = 0.99$), $t(27)$ 5.364, $p < .001$, $d = 1.793$. In the narrative video games subconditions, participants who played "Life is Strange" perceived the message of the game as more positive than ($M = 7.00$, $SD = 2.55$) than those who played "Everybody's gone to the Rapture" ($M = 4.56$, $SD = 2.13$), $t(16) = -2.208$, $p = .042$, $d = -1.039$. Mean scores, standard deviations and t-tests comparing each pair of subconditions can be found in Table 5.3.

Table 5.2. Correlations between sociodemographic variables, elicited moods, perceived attributes, experience-taking, transportation and theory of mind submeasures (accidental harm and attempted harm, pre- and post-manipulation)

	1	2 †	3 †	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
1. Age	-																			
2. Gender † (1 = Male, 2 = Female)	-.14	-																		
3. Native-speaker of English † (1 = Yes, 2 = No)	.33**	-.21	-																	
4. Years of proficiency in English (when English is a second language)	-.52*	-.19	‡	-																
5. Elicited mood: Pleasant deactivation	.00	-.29*	-.05	.39	-															
6. Elicited mood: Pleasant activation	.06	.09	-.04	.01	-.02	-														
7. Elicited mood: Pleasure	-.13	-.10	-.15	.26	.59***	.36**	-													
8. Perceived attributes: Message	.05	-.24*	.22	.46	.53***	.15	.43***	-												
9. Perceived attributes: Complexity	.24*	.12	.04	-.52*	-.38***	.07	-.29*	-.22	-											
10. Perceived attributes: Quality of social interactions	-.07	.02	.13	.49	.09	.39***	.19	.35**	-.02	-										
11. Perceived attributes: Importance of social interactions	.06	-.12	.06	.25	.07	.36**	.18	.25*	.03	.55***	-									
12. Experience Taking	-.15	.05	.06	-.01	.07	.60***	.30*	.22	-.12	.39***	.24*	-								
13. Transportation into the Narrative	-.02	.01	-.07	-.20	.05	.65***	.16	.16	.10	.43***	.24*	.74***	-							
14. Attempted Harm, pre-manipulation	-.16	.16	.02	.18	-.10	-.07	-.11	-.02	-.05	-.12	-.17	.08	.05	-						
15. Attempted Harm, post-manipulation	-.18	.14	-.20	-.27	.17	-.12	.16	.15	-.15	-.11	.06	-.02	-.09	.30**	-					
16. Accidental Harm, pre-manipulation	.22	-.21	.16	.27	.09	-.16	.01	.09	.04	.10	-.01	-.10	-.19	-.26*	-.26*	-				
17. Accidental Harm, post-manipulation	.09	.25*	-.11	.14	-.18	.12	.10	-.11	.09	.00	.02	-.04	-.13	-.24*	-.24*	.12	-			
18. No Harm, pre-manipulation	.17	-.03	-.41***	-.04	.07	-.09	-.03	.12	-.05	.02	.00	.00	.09	-.02	.05	.10	.11	-		
19. No Harm, post-manipulation	.16	-.12	.00	.04	.18	.00	.10	.29*	-.14	.32**	.17	.03	.13	-.12	-.10	.32**	.14	.31*	-	
20. Intentional Harm, pre-manipulation	-.17	.14	-.15	-.37	-.08	-.06	.00	.02	-.05	-.08	-.24	.04	.06	.36**	.06	-.06	-.17	-.01	.07	-
21. Intentional Harm, post-manipulation	-.08	.03	-.05	-.25	-.04	-.08	-.10	-.13	.11	-.14	-.29*	-.01	.10	.36**	.14	-.14	-.19	-.16	-.21	.46***

* Correlation significant at .05 level (2-tailed)
** Correlation significant at .01 level (2-tailed)
*** Correlation significant at .001 level (2-tailed)
† Point-Biserial Correlations for dichotomous variables (Gender, Native speakers of English)
‡ Not computed because at least one of the variables is a constant

Table 5.3. Comparison of means for each pair of subconditions by elicited mood, perceived attributes, experience-taking, and transportation into the narrative.

	Subcondition	Mean	SD	t	df	p	Cohen's d
				t-test			
Elicited mood: Pleasant deactivation (Anxious - Calm)	"The History of Happiness"	6.67	1.73	0.21	16	.83	0.10
	"The Vandercook"	6.44	2.60				
	"Alteration"	4.33	2.52	-2.49	34	.02	-0.83
	"Miyubi"	6.44	2.57				
	"Everybody's gone…"	5.78	2.28	-1.89	16	.08	-0.89
	"Life is Strange"	8.00	2.69				
Elicited mood: Pleasant activation (Bored - Excited)	"The History of Happiness"	5.44	2.19	-0.71	16	.49	-0.34
	"The Vandercook"	6.11	1.76				
	"Alteration"	7.50	0.92	-0.75	34	.46	-0.25
	"Miyubi"	7.78	1.26				
	"Everybody's gone…"	7.67	1.66	1.30	16	.21	0.61
	"Life is Strange"	6.78	1.20				
Elicited mood: Pleasure (Sad - Happy)	"The History of Happiness"	6.67	1.41	1.95	16	.07	0.93
	"The Vandercook"	5.44	1.24				
	"Alteration"	6.22	2.02	-1.71	34	.10	-0.57
	"Miyubi"	7.33	1.88				
	"Everybody's gone…"	6.89	1.45	-1.25	16	.23	-0.59
	"Life is Strange"	8.00	2.24				
Perceived attributes: Message (Negative - Positive)	"The History of Happiness"	5.00	2.87	0.43	16	.67	0.20
	"The Vandercook"	4.56	1.13				
	"Alteration"	3.78	1.99	-2.14	34	.04	-0.71
	"Miyubi"	5.11	1.75				
	"Everybody's gone…"	4.56	2.13	-2.21	16	.04	-1.04
	"Life is Strange"	7.00	2.55				
Perceived attributes: Complexity (Simple - Complex)	"The History of Happiness"	5.89	2.37	0.19	16	.85	0.09
	"The Vandercook"	5.67	2.55				
	"Alteration"	8.50	0.99	5.36	27	.00	1.79
	"Miyubi"	5.94	1.76				
	"Everybody's gone…"	4.67	3.28	-0.30	16	.77	-0.14
	"Life is Strange"	5.11	3.06				
Perceived attributes: Quality of social interactions (Poorly – In a good manner)	"The History of Happiness"	6.00	2.24	-0.33	16	.75	-0.15
	"The Vandercook"	6.33	2.06				
	"Alteration"	6.89	2.22	-0.27	34	.79	-0.09
	"Miyubi"	7.11	2.65				
	"Everybody's gone…"	7.44	1.67	0.26	16	.80	0.12
	"Life is Strange"	7.11	3.48				
Perceived attributes: Importance of social interactions (Unimportant - Very important)	"The History of Happiness"	8.33	2.45	0.22	16	.83	0.10
	"The Vandercook"	8.11	1.83				
	"Alteration"	7.44	1.92	0.00	34	1.00	0.00
	"Miyubi"	7.44	1.89				
	"Everybody's gone…"	9.33	1.00	1.09	16	.29	0.51
	"Life is Strange"	8.22	2.91				
Experience Taking	"The History of Happiness"	3.83	1.30	-0.88	16	.39	-0.41
	"The Vandercook"	4.43	1.61				
	"Alteration"	4.87	0.93	-1.55	34	.13	-0.52
	"Miyubi"	5.37	1.01				
	"Everybody's gone…"	5.10	1.13	-0.16	16	.88	-0.07
	"Life is Strange"	5.17	1.01				
Transportation into the Narrative	"The History of Happiness"	4.24	1.04	-0.90	16	.38	-0.43
	"The Vandercook"	4.62	0.70				
	"Alteration"	4.89	0.61	-0.39	34	.70	-0.13
	"Miyubi"	4.96	0.45				
	"Everybody's gone…"	4.85	0.89	0.86	16	.40	0.40
	"Life is Strange"	4.56	0.52				

Main Analyses

Does exposure to fiction -in the form of written stories, video games and virtual reality films- boost theory of mind?

The main hypothesis of this study was that exposure to fiction, through reading fiction, watching a VR film, or playing video games, would boost theory of mind. To test this hypothesis, four mixed ANOVA analyses were carried out, each focussed on one of the four theory of mind scenarios (i.e., attempted harm, accidental harm, no harm, and intentional harm) with their pre- and post-manipulation measures as the within-subjects factor, and all three media conditions as the between subjects factor (i.e., literary fiction, narrative video games, and VR films). Additionally, gender and English as first language were included as second between-subjects factors in the analysis of accidental harm scenarios and no harm scenarios, respectively. This decision derives from the correlations which suggest possible confounding effects coming from these sociodemographic variables with the respective theory of mind scenarios.

Results provided partial support for this hypothesis, as participants scored higher on theory of mind in the attempted harm scenarios after being exposed to fiction; however, in the accidental harm scenarios, there was an increase in theory of mind scores only in female participants. It is also concluded that boosts in theory of mind can be found after fiction exposure through different media. This conclusion is drawn from results showing that boosts in theory of mind did not differ across the three different media included in the study. Detailed results of these analyses follow below.

Mean scores and standard deviations of the theory of mind scenarios, pre- and post-manipulation and across media conditions, can be found in Table 5.4. A graph with this information can be found in Figure 5.1.

Table 5.4. Mean scores and standard deviations for the theory of mind scenarios, pre- and post-manipulation, across media conditions.

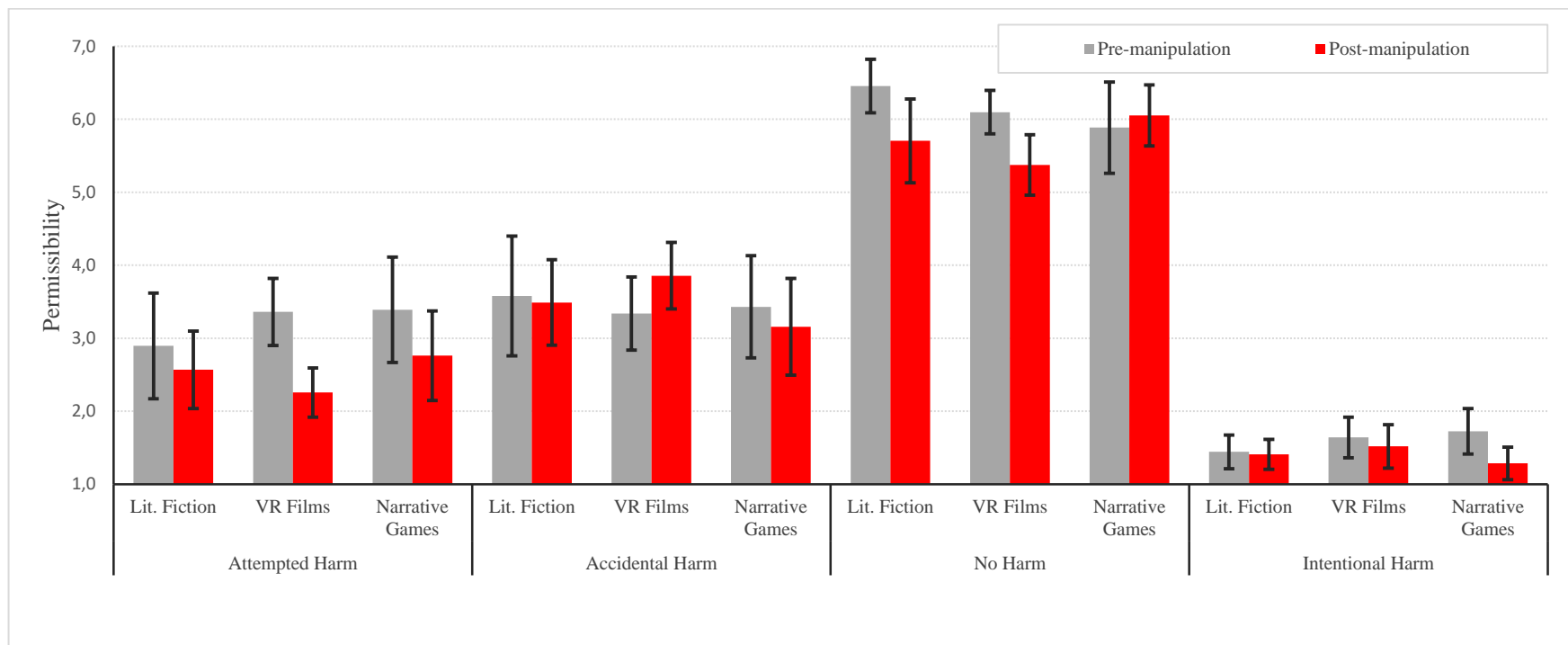|		Pre-manipulation			Post-manipulation		
		N	Mean	SD	N	Mean	SD
Attempted Harm	Lit. Fiction	18	2.90	1.46	17	2.57	1.03
	VR Films	36	3.36	1.36	36	2.26	1.00
	Narrative Games	18	3.39	1.45	18	2.76	1.24
	Total	72	3.25	1.40	71	2.46	1.08
Accidental Harm	Lit. Fiction	16	3.58	1.54	17	3.49	1.14
	VR Films	35	3.34	1.46	35	3.86	1.33
	Narrative Games	17	3.43	1.36	17	3.16	1.29
	Total	68	3.42	1.44	69	3.59	1.29
No Harm	Lit. Fiction	17	6.45	0.72	18	5.70	1.16
	VR Films	35	6.10	0.87	35	5.37	1.21
	Narrative Games	16	5.89	1.17	18	6.05	0.84
	Total	68	6.14	0.92	71	5.63	1.13
Intentional Harm	Lit. Fiction	17	1.44	0.45	17	1.41	0.40
	VR Films	35	1.64	0.81	35	1.52	0.87
	Narrative Games	17	1.73	0.61	17	1.28	0.44
	Total	69	1.61	0.69	69	1.43	0.68

Figure 5.1. Mean scores for theory of mind scenarios, pre- and post-manipulation, across media conditions (Confidence Intervals at 95%).

Maulchy's Tests of Sphericity are not reported since there were not enough elements to establish the required comparison due to the analyses including only two within-subject measures. Instead, test the homogeneity of variances across media conditions, Levene's Tests were conducted comparing the scores for all scenarios, pre- and post-manipulation, between all three media conditions. Results showed non-significant differences in all cases, except the pre-manipulation measurement of the no harm scenarios, more specifically for the attempted harm scenarios, pre- ($F(2, 68) = 0.04$; $p = .96$) and post-manipulation ($F(2, 68) = 1.48$; $p = .24$); for the accidental harm scenarios, pre- ($F(5, 59) = 2.03$; $p = .09$) and post-manipulation ($F(5, 59) = 0.62$; $p = .69$), for the no harm scenarios, pre- ($F(5, 61) = 2.40$; $p = .05$) and post-manipulation ($F(5, 61) = 0.69$; $p = .64$); and for the intentional harm scenarios, pre- ($F(2, 63) = 1.78$; $p = .18$) and post-manipulation ($F(2, 63) = 2.79$; $p = .07$). Considering these results, and mixed ANOVA analyses robustness, homogeneity of variance was assumed for all mixed ANOVA, including the no harm scenarios.

Regarding the results of the mixed ANOVA for the attempted harm scenarios, there was a significant main effect for manipulation with a large effect size ($F(1, 68) = 15.50$; $p < .001$, $\eta^2_p = 0.19$), but the main effect of media condition was non-significant ($F(2, 68) = 0.50$; $p = .61$, $\eta^2_p = 0.02$), as well as the interaction between the two ($F(2, 68) = 1.40$; $p = .25$, $\eta^2_p = 0.04$). Mean scores revealed lower judged permissibility in the post-manipulation measurement of attempted harm. This decrease in the judged permissibility of the protagonist's actions is interpreted as an increase in theory of mind, since participants' answers would be more influenced by the protagonists' intentions of hurting others. On the other hand, the non-significant effect of the interaction suggests that this effect did not differ across media conditions. A graph with the mean scores of the pre- and post-manipulation measurements of the attempted harm scenarios across media conditions can be seen in Figure 5.2.
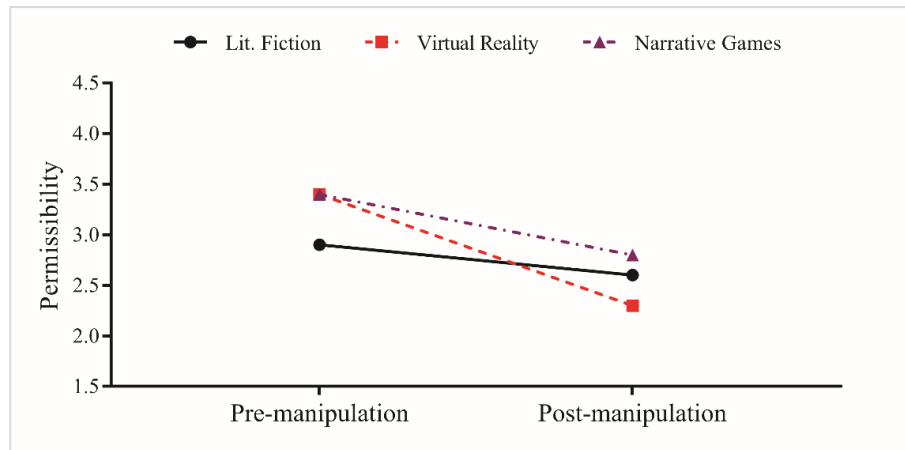
Figure 5.2. Mean scores for the pre- and post-measurements of the attempted harm scenarios across media conditions.

Results of the mixed ANOVA for the accidental harm scenarios show non-significant main effects for manipulation ($F(1, 59) = 0.01$; $p = .92$, $\eta^2_p = .00$), media condition ($F(2, 59) = 0.67$; $p = .52$, $\eta^2_p = .02$), and gender ($F(1, 59) = 0.19$, $p = .67$, $\eta^2_p = 0.00$). Similarly, the interactions between manipulation and media condition ($F(2, 59) = 0.86$, $p = .43$, $\eta^2_p = 0.03$), media condition and gender ($F(2, 59) = 1.80$, $p = .18$, $\eta^2_p = 0.06$), and manipulation with media condition and gender ($F(2, 59) = 0.24$, $p = .79$, $\eta^2_p = 0.01$) resulted non-significant, but conversely the interaction between media manipulation and gender resulted significant with a medium effect size ($F(1, 59) = 5.39$, $p = .02$, $\eta^2_p = 0.08$).

The significant effect of the interaction between manipulation and gender suggests that the participant's evaluation about the permissibility of the protagonists' behaviour changed after being exposed to fiction, depending on the participants' gender but not on the media condition they were assigned to. Specifically, results of the simple main effects show that male participants' scores did not differ significantly ($F(1, 27) = 2.02$, $p = .17$, $\eta^2_p = 0.07$) between the pre- ($M = 3.78$, $SD = 1.47$) and post-manipulation measurements of the accidental harm scenarios ($M = 3.30$, $SD = 1.25$), but scores of female participants did differ significantly with a large effect size ($F(1, 36) = 7.55$, $p = .01$, $\eta^2_p = 0.17$) between the pre- ($M = 3.11$, $SD = 1.39$) and post-manipulation measurements ($M = 3.87$, $SD = 1.32$). This increase in the scores in the post-manipulation measurement denotes an increase in theory of mind since participants would be taking into account the protagonists' neutral intentions (to hurt others), thus judging them as more permissible. Complementary, the non-significant interactions

suggest that results did not differ across media conditions. Graphs with the mean scores of the pre- and post-manipulation measurements of the accidental harm scenarios, for male and female participants and across media conditions, can be seen in Figure 5.3.
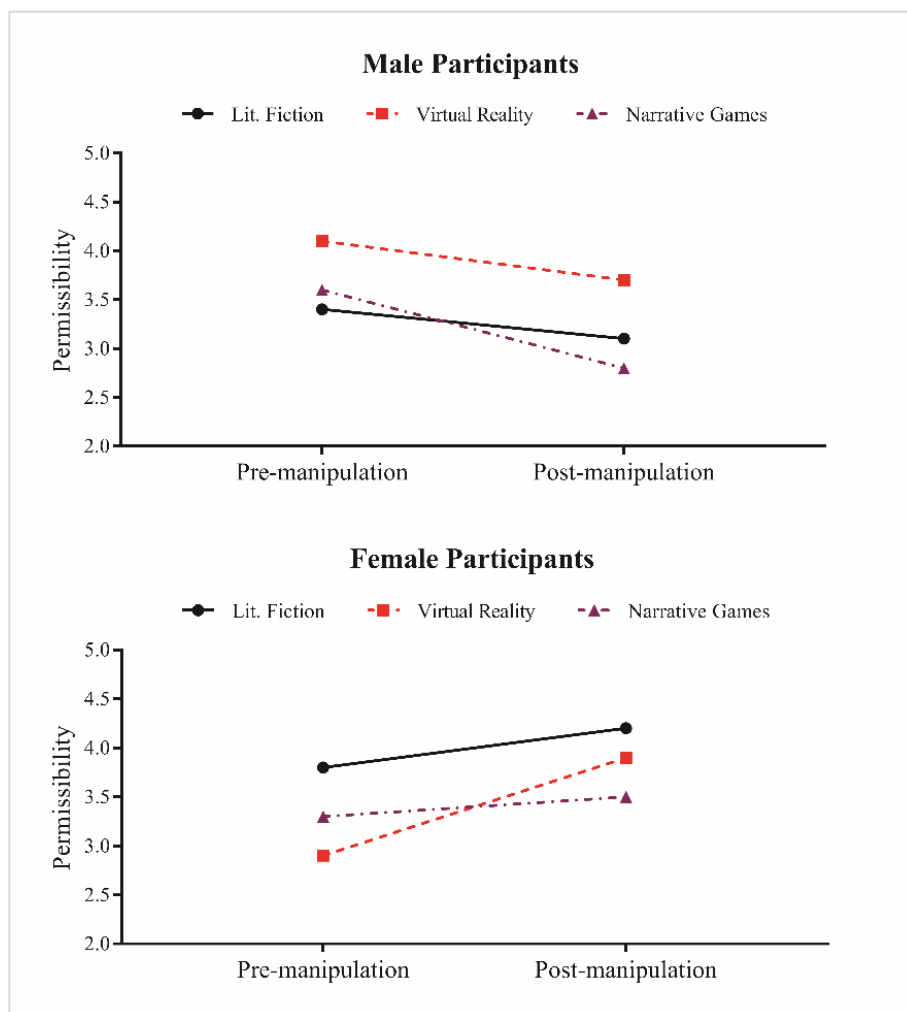

Figure 5.3. Mean scores for the pre- and post-measurements of the accidental harm scenarios, by gender and across media conditions.

The results for the mixed ANOVA of the no harm scenarios showed non-significant main effects for manipulation ($F(1, 61) = 2.47$; $p = .12$, $\eta^2_p = .04$), media condition ($F(2, 61) = 2.27$; $p = .11$, $\eta^2_p = .07$), and English as first language ($F(1, 59) = 2.42$; $p = .13$, $\eta^2_p = .04$). Interaction effects showed significant results for manipulation and media condition ($F(2, 61) = 3.15$; $p = .05$, $\eta^2_p = .09$), and for manipulation and English as first language ($F(1, 61) = 4.45$; $p = .04$, $\eta^2_p = .07$), both with medium effect sizes. Conversely, the interaction between media condition and English as first language resulted non-significant ($F(2, 61) = 2.39$, $p = .10$, $\eta^2_p = 0.07$), as well as the

three-way interaction between manipulation, media condition and English as first language ($F(2, 61) = 0.54$; $p = .58$, $\eta^2_{p} = .02$).

Regarding the results for the interaction between manipulation and media condition, simple main effects indicate that the participant's evaluation about the permissibility of the protagonists' behaviour changed after interacting with fiction depending on the media condition they were assigned to. There was a significant difference with a large effect size ($F(1, 33) = 15.57$; $p < .001$, $\eta^2_{p} = .32$) in the VR films condition, between the pre- ($M = 6.10$, $SD = 0.88$) and post-manipulation measurements of the no harm scenarios ($M = 5.33$, $SD = 1.19$). This decrease in post-manipulation measurement is interpreted as a decrease of theory of mind, since judging the protagonists' actions as less permissible implies less focus on the protagonists' point of view (i.e., their neutral intentions to harm others) when making that judgement. No changes in theory of mind were found for participants in the literary fiction ($F(1, 16) = 4.39$; $p = .05$, $\eta^2_{p} = .22$), and the narrative games conditions ($F(1, 15) = 0.59$; $p = .45$, $\eta^2_{p} = .04$). A graph with mean scores of the pre- and post-manipulation measurements of the no harm scenarios and across media conditions can be seen in Figure 5.4.
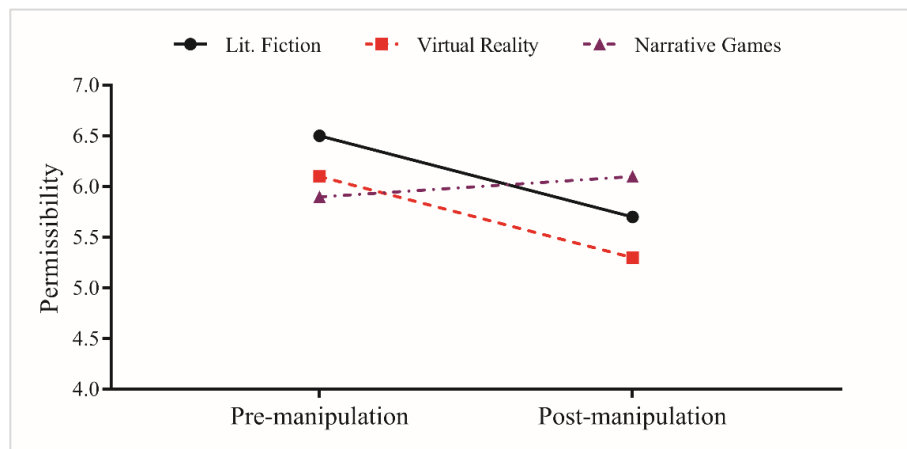

Figure 5.4. Mean scores for the pre- and post-measurements of the no harm scenarios across media conditions.

Regarding the results for the interaction between manipulation and English as first language, simple main effects showed that participant's evaluation about the permissibility of the protagonists actions changed after exposure to fiction only if they were native speakers of English. Native speakers of English showed significant differences with a large effect size ($F(1, 51) = 21.30$, $p < .001$, $\eta^2_{p} = .30$ between the pre- ($M = 6.35$, $SD = 0.73$) and post-manipulation measurements of the no harm

scenarios ($M = 5.59$, $SD = 1.19$). This decrease in post-manipulation measurement is interpreted as a decrease of theory of mind since judging the protagonists' actions as less permissible, implies that the participants focused less on the protagonists' point of view (i.e., their neutral intentions to harm others) when making that judgement. For the non-native speakers of English, the difference between the pre- and post-manipulation measurement of no harm resulted non-significant ($F(1, 14) = 48$, $p = .50$, $\eta^2_p = .03$). A graph with mean scores of the pre- and post-manipulation measurements of the no harm scenarios, across media conditions and separately for native and non-native speakers of English, can be seen in Figure 5.5.
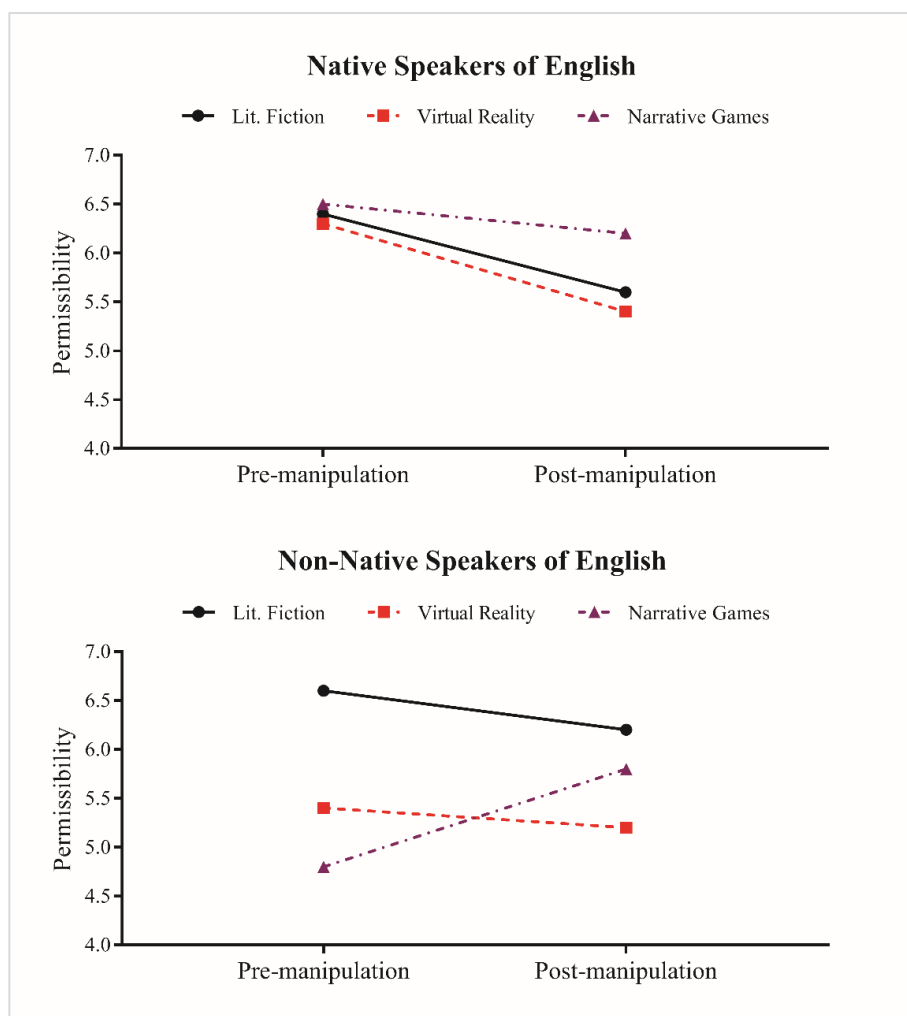

Figure 5.5. Mean scores for the pre- and post-measurements of the no harm scenarios across media conditions, for native and non-native speakers of English.

The reduction of theory of mind in participants allocated to the VR films condition, and who were native speakers of English, is an unexpected result. The no harm scenarios consisted of neutral outcomes attributed to accidents, thus no significant

changes were expected, or, in case of variations, these should relate to an improvement on theory of mind, and not a reduction.

Results for the ANOVA analysis of the intentional harm scenarios showed non-significant differences for the main effects of manipulation ($F(1, 63) = 3.12$, $p = .08$, $\eta^2_p = .05$) and media condition ($F(2, 63) = 0.40$, $p = .67$, $\eta^2_p = .01$), and the interaction between the two ($F(2, 63) = 0.85$, $p = .43$, $\eta^2_p = .03$). The results suggest no variations of theory of mind when participants focus on scenarios with a negative outcome (e.g., death of a character of the story) that is attributed to the protagonists' intentions (as opposed to accidents). A graph with mean scores of the pre- and post-manipulation measurements of the intentional harm scenarios across media conditions can be seen in Figure 5.6.
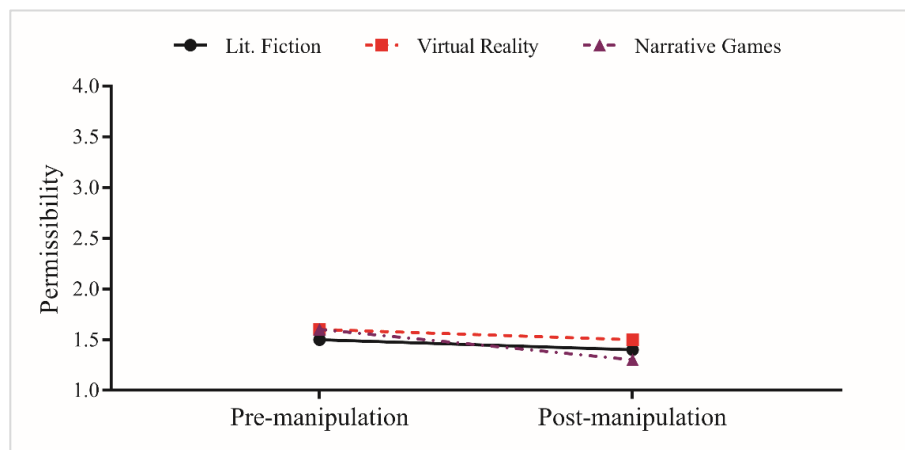

Figure 5.6. Mean scores for the pre- and post-measurements of the no harm scenarios across media conditions, for native and non-native speakers of English.

Does fiction presented through virtual reality films elicit higher boosts in theory of mind, when compared to written fiction and narrative video games?

It was also hypothesized that VR films would produce greater theory of mind enhancements when compared to reading fiction and playing video games. To address this hypothesis, another set of four mixed ANOVA analyses were carried out. This set of analyses followed a similar structure to the set used in the previous section with the difference that the current set focused on the comparisons of virtual reality and non-virtual reality conditions. To make these comparisons possible, literary fiction and narrative games conditions were merged into a single condition labelled as non-VR conditions. The final two conditions, VR and non-VR, were then used in the analyses as the between-subjects factor. Similar to the previous set of mixed ANOVA analyses,

gender and English as a first language were included as second between-subject factors in the analysis of accidental harm and no harm scenarios, respectively.

Overall, results of these analyses do not support the hypothesis that VR films present a significantly higher positive association with theory of mind. This conclusion is drawn from results showing that boosts in theory of mind did not differ when comparing VR to non-VR conditions. Detailed results of these analyses follow below.

Just as in the previous section, Maulchy's Tests of Sphericity were not conducted. Instead, Levene's Tests of homogeneity of variances were conducted comparing the scores for all four scenarios, pre- and post-manipulation. Results showed significant differences in the pre-manipulation measurements of accidental harm and no harm scenarios and the post-manipulation measurement of intentional harm. For the attempted harm scenarios, pre- ($F(1, 69) = 0.01$; $p = .92$) and post-manipulation ($F(1, 69) = 0.27$; $p = .60$): for the accidental harm scenarios, pre- ($F(3, 61) = 3.35$; $p = .03$), and post-manipulation ($F(3, 61) = 0.34$; $p = .79$); for the no harm scenarios pre- ($F(3, 63) = 3.29$; $p = .03$), and post-manipulation ($F(3, 63) = 0.53$; $p = .66$); and for the intentional harm scenarios pre- ($F(1, 64) = 2.70$; $p = .11$), and post-manipulation measurement ($F(1, 64) = 5.51$; $p = .02$). Considering these results, and mixed ANOVA analyses robustness, homogeneity of variance was assumed for all mixed ANOVA, including the no harm scenarios.

Mean scores and standard deviations of theory of mind scenarios, pre- and post-manipulation, for VR and Non-VR conditions, can be found in Table 5.5 and its graphical representation in Figure 5.7.

Table 5.5. Mean scores and standard deviations for the theory of mind scenarios, pre- and post-manipulation, for VR and Non-VR conditions.

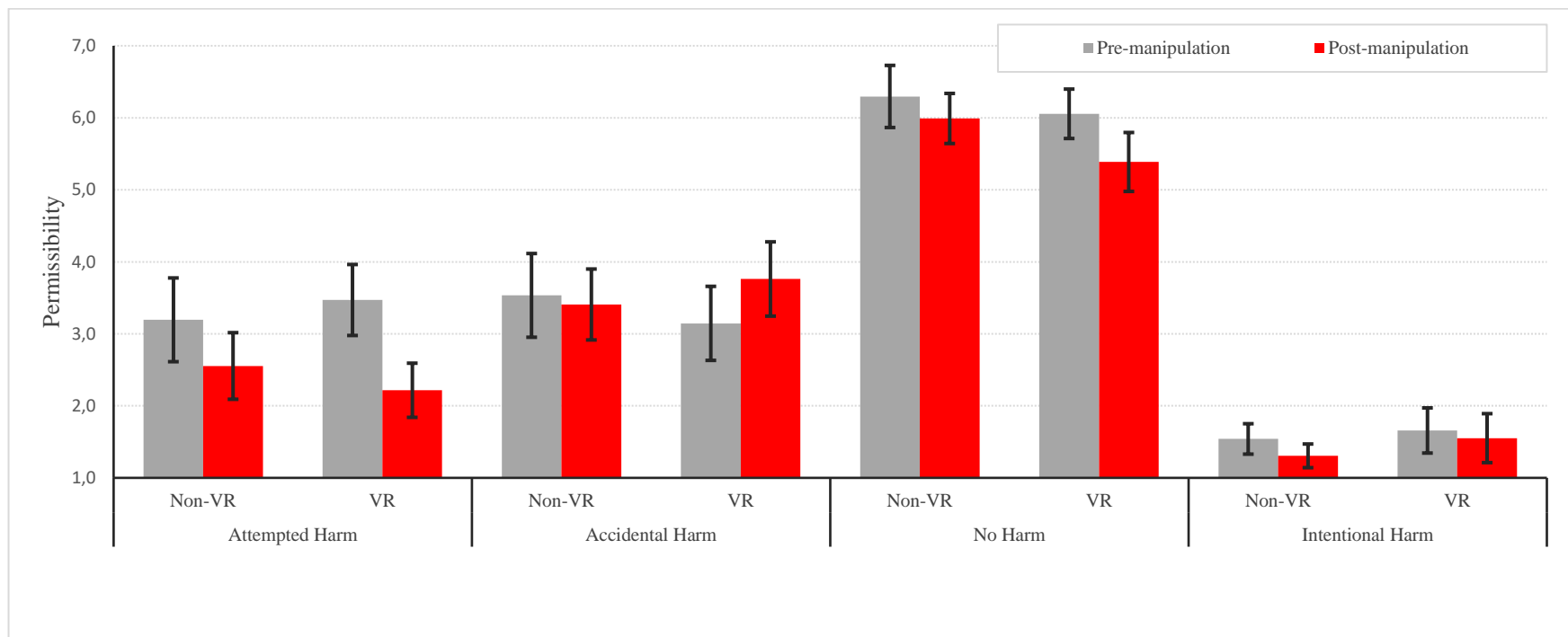|		Pre-manipulation			Post-manipulation		
		N	Mean	SD	N	Mean	SD
Attempted Harm	Non-VR	36	3.14	1.45	35	2.67	1.13
	VR Films	36	3.36	1.36	36	2.26	1.00
	Total	72	3.25	1.40	71	2.46	1.08
Accidental Harm	Lit. Fiction	33	3.50	1.43	34	3.32	1.21
	VR Films	35	3.34	1.46	35	3.86	1.33
	Total	68	3.42	1.44	69	3.59	1.29
No Harm	Lit. Fiction	33	6.18	0.99	36	5.88	1.01
	VR Films	35	6.10	0.87	35	5.37	1.21
	Total	68	6.14	0.92	71	5.63	1.13
Intentional Harm	Lit. Fiction	34	1.58	0.54	34	1.35	0.42
	VR Films	35	1.64	0.81	35	1.52	0.87
	Total	69	1.61	0.69	69	1.43	0.68

Figure 5.7. Mean scores for theory of mind scenarios, pre- and post-manipulation, by media conditions (Confidence Intervals at 95%).

Regarding the results of the mixed ANOVA for the attempted harm scenarios, there was a significant effect for manipulation with a large effect size ($F(1, 69) = 22.58$; $p < .001$, $\eta^2_p = 0.25$), but the main effect of condition resulted non-significant ($F(1, 69) = 0.29$; $p = .60$, $\eta^2_p = 0.00$) as well as the interaction between the two ($F(1, 69) = 2.684$; $p = .11$, $\eta^2_p = 0.04$). Mean scores of the attempted harm scenarios show lower scores in its post-manipulation measurement, meaning that after being exposed to fiction through a VR or a non-VR media, participants judged the protagonist's actions as less permissible. Following the rationale described in the previous set of analyses, a decrease in the permissibility of the protagonists' actions is interpreted as an increase in theory of mind. The non-significant effect of the interaction suggests that the effect of manipulation is present across media conditions. A graph with the pre- and post-manipulation mean scores of the attempted harm scenarios for VR and non-VR conditions can be seen in Figure 5.8.
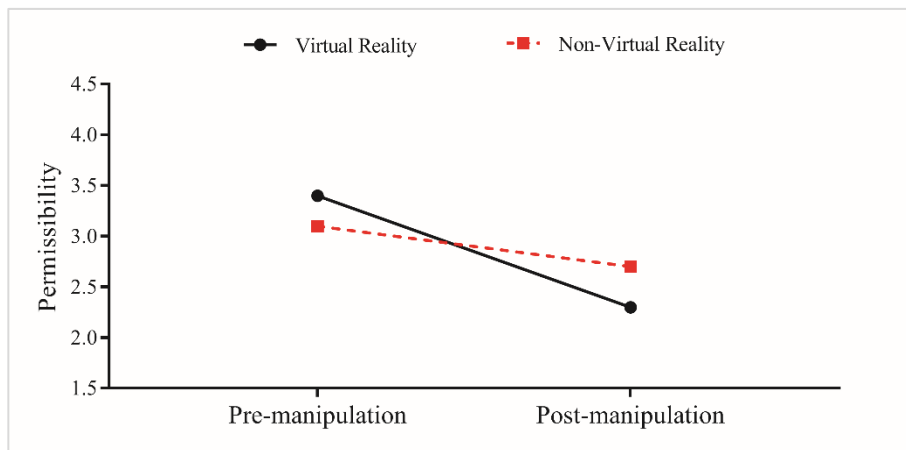

Figure 5.8. Mean scores for the pre- and post-measurements of the attempted harm scenarios, comparing VR to non-VR conditions.

Results of the mixed ANOVA for the accidental harm scenarios show non-significant main effects of manipulation ($F(1, 61) = 0.26$; $p = .61$, $\eta^2_p = .00$), media condition ($F(1, 61) = 0.52$; $p = .47$, $\eta^2_p = .01$), and gender ($F(1, 61) = 0.07$; $p = .79$, $\eta^2_p = 0.00$). In terms of interactions, the following effects resulted non-significant: manipulation and media condition ($F(1, 61) = 1.14$; $p = .29$, $\eta^2_p = .02$), media condition and gender ($F(1, 61) = 2.78$; $p = .10$, $\eta^2_p = .04$), and manipulation with media condition and gender ($F(1, 61) = 0.44$; $p = .51$, $\eta^2_p = .01$). On the other hand, the interaction between manipulation and gender resulted significant with a medium effect size ($F(1, 61) = 6.91$; $p = .01$, $\eta^2_p = .11$).

The significant effect for the interaction between manipulation and gender suggests that the participant's evaluation about the permissibility of the protagonists' behaviour changed after exposure to fiction, depending on the participants' gender but not on the media condition they were assigned to. Results of the simple main effects replicate those described in the mixed ANOVA comparing all three media conditions since they use the same data and design.

The simple main effects show that for male participants, pre- and post-manipulation scores did not differ significantly ($F(1, 27) = 2.02$, $p = .17$, $\eta^2_p = 0.07$), but in female participants there was a significant difference with a large effect size ($F(1, 36) = 7.55$, $p = .01$, $\eta^2_p = 0.17$). Mean scores for the female participants show an increase between the pre- ($M = 3.11$, $SD = 1.39$) and post manipulation measurement ($M = 3.87$, $SD = 1.32$) which, following the rationale described earlier, is interpreted as an increase of theory of mind. Complementary, non-significant interactions suggest that the effect of manipulation did not differ across media conditions. The graphs with the pre- and post-manipulation mean scores for the Accidental Harm scenarios, comparing VR and non-VR conditions and gender can be seen in Figure 5.9.
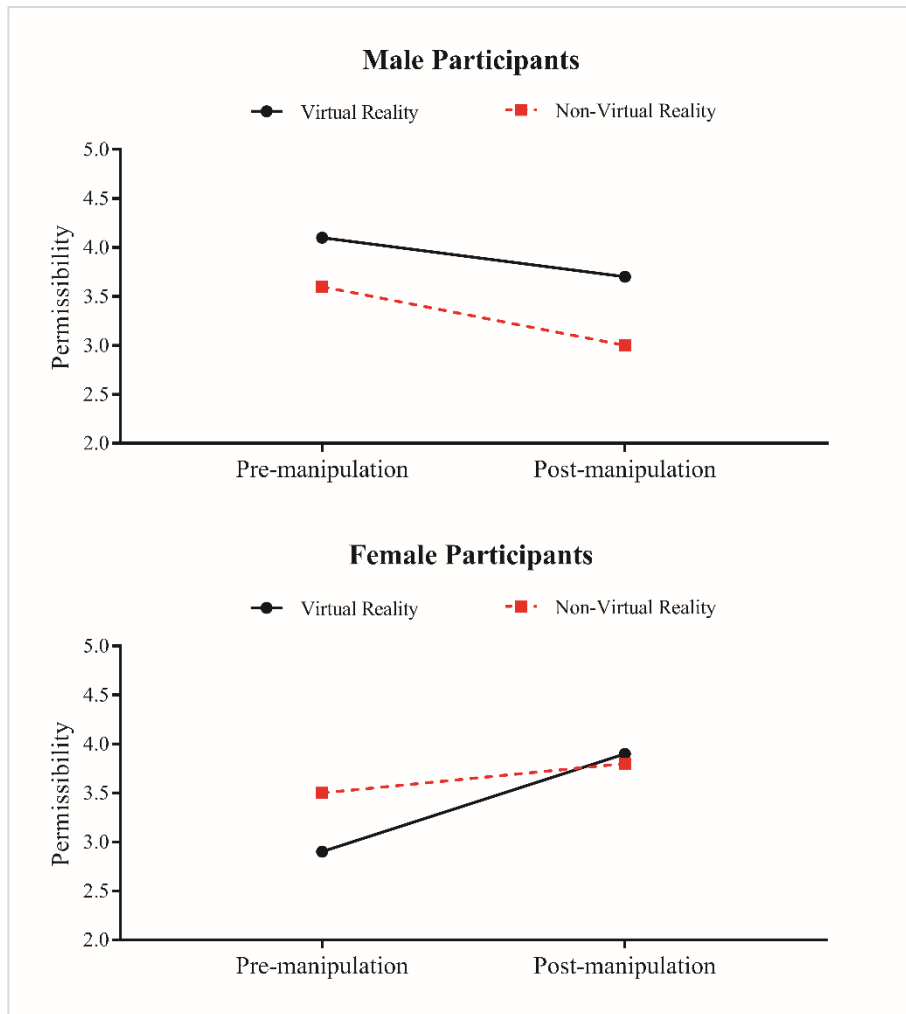
Figure 5.9. Mean scores for the pre- and post-measurements of the accidental harm scenarios comparing VR to non-VR conditions between male and female participants.

Results of the no harm and intentional harm scenarios were similar to those obtained in the previous set of analyses and, thus an abbreviated version of those results is presented below.

Overall results of the mixed ANOVA for the no harm scenarios were similar to those in the previous section in that only the main effect for English as first language resulted significant with a medium effect size ($F(1, 63) = 4.08$; $p = .05$, $\eta^2_p = .06$) as well as the interaction effect between manipulation and English as first language with a medium effect size ($F(1, 63) = 6.35$; $p = .01$, $\eta^2_p = .09$). The remaining main effects and interactions resulted non-significant. It is worth noting a departure from results of the previous section regarding the significant interaction effect between manipulation and media condition which in the current analysis was non-significant.

Regarding the results for the interaction between manipulation and English as first language, simple main effects show that participant's evaluation about the permissibility of the protagonists actions diminished after being exposed to fiction only if they were native speakers of English. More precisely, simple main effects show that the scores of participants who were native speakers of English decreased with a large effect size ($F(1, 51) = 21.30$, $p < .001$, $\eta^2_{p} = .30$) from the pre- ($M = 6.35$, $SD = 0.72$) to the post-manipulation measurements of the no harm scenarios ($M = 5.59$, $SD = 1.19$) which, following the rationale described earlier, is interpreted as a decrease of theory of mind. For non-native speakers of English, the difference between the pre- and post-manipulation measurement of no harm resulted non-significant. A graph with mean scores of the pre- and post-manipulation measurements of the no harm scenarios, comparing VR to non-VR conditions separately for native and non-native speakers of English, can be seen in Figure 5.10.
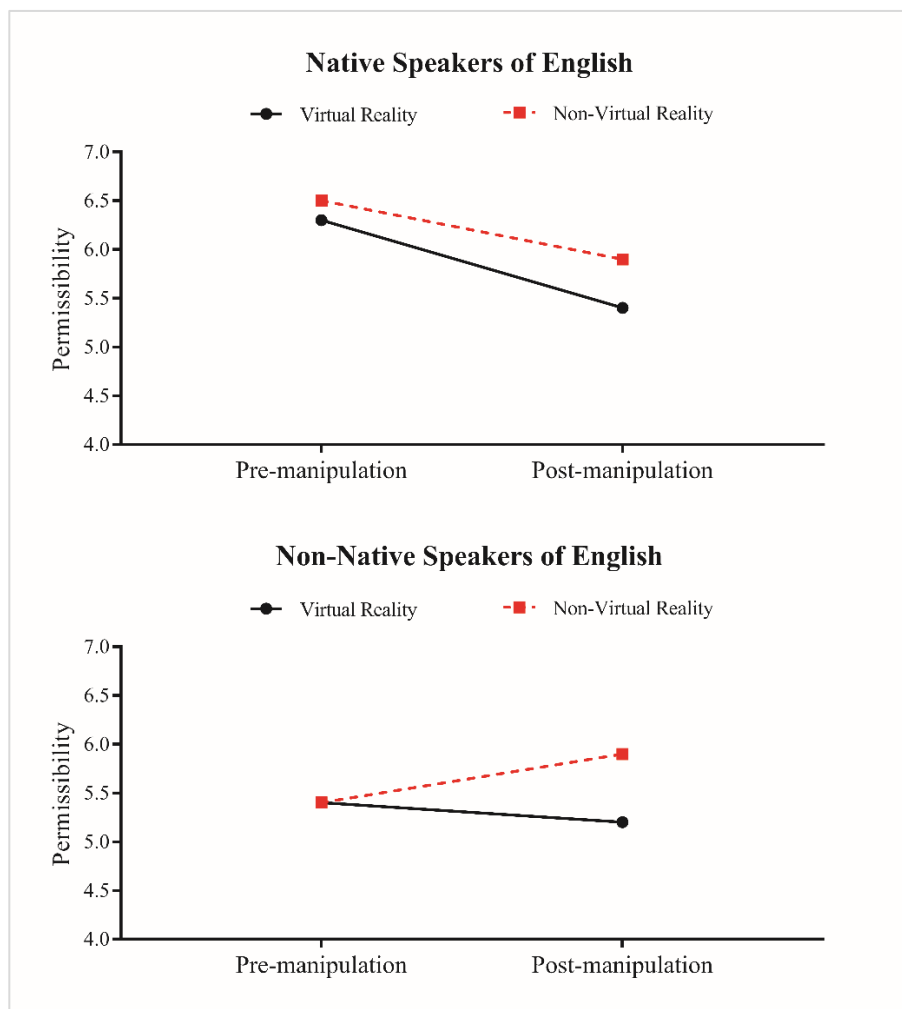

Figure 5.10. Mean scores for the pre- and post-measurements of the no harm scenarios comparing VR to non-VR conditions for native and non-native speakers of English.

Results for the ANOVA analysis of the intentional harm scenarios show non-significant differences for the main effects of manipulation ($F(1, 64) = 2.69$, $p = .11$, $\eta^2_p = .04$) and media condition ($F(1, 64) = 0.76$, $p = .39$, $\eta^2_p = .01$), and the interaction between the two ($F(1, 64) = 0.50$, $p = .48$, $\eta^2_p = .01$). The results suggest a null variation of theory of mind neither when comparing VR to non-VR conditions, nor when looking at exposure to fiction overall. A graph with mean scores of the pre- and post-manipulation measurements of the intentional harm scenarios across media conditions can be seen in Figure 5.11.
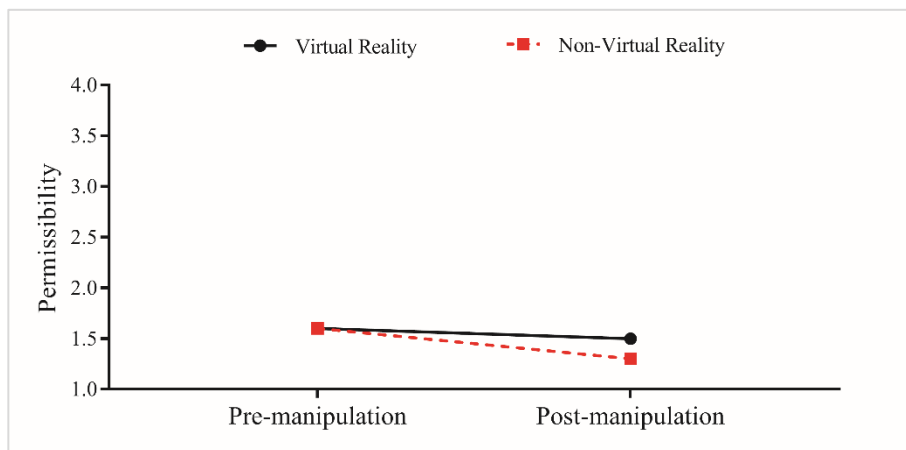

Figure 5.11. Mean scores for the pre- and post-measurements of the intentional harm scenarios comparing VR to non-VR conditions.

As mentioned above, overall results of the second set of analyses are similar to those from the first set. More precisely, results of the attempted harm scenarios are similar to those from the first set of analyses in the pattern of significant main effects and non-significant effects of media condition and the interaction between the two, which suggests an increase of theory of mind after exposure to fiction. In the accidental harm scenarios, only the interaction between manipulation and gender resulted significant, showing that female participants experienced an increase of theory of mind after being exposed to fiction. In the no harm scenarios, the interaction between manipulation and English as first language resulted significant, where only native speakers of English experienced a decrease in theory of mind after being exposed to fiction, which is an unexpected result. Lastly, no variations of theory of mind where found when testing for the intentional harm scenarios. These results were present when comparing all three media conditions (i.e., literary fiction, VR films, and narrative

games) and VR to non-VR media (i.e., comparing VR films to literary fiction and narrative games together).

Do virtual reality films produce greater experience-taking and transportation into the narrative enhancements when compared to written fiction and narrative video games?

Another hypothesis of this study was that, when compared to reading fiction and playing video games, VR films would elicit higher transportation into the narrative and experience-taking. To address the hypothesis regarding differences in experience-taking and transportation into the narrative, two one-way ANOVA analyses were performed comparing the scores in these two measures across all three media conditions. Partial support was found for this hypothesis. Results showed that participants of the VR films condition experienced significantly higher experience-taking and transportation into the narrative than participants of the literary fiction, but not more than participants of the narrative games condition. Detailed results follow below.

Mean scores and standard deviations for experience-taking and transportation into the narrative, across media conditions can be seen in Table 5.6.

Table 5.6. Mean scores and standard deviations for experience-taking and transportation into the narrative across media conditions.

		N	Mean	SD
Experience-Taking	Lit. Fiction	18	4.13	1.45
	VR Films	36	5.12	0.99
	Narrative Games	18	5.13	1.04
	Total	72	4.87	1.20
Transportation into the Narrative	Lit. Fiction	18	4.43	0.88
	VR Films	36	4.93	0.53
	Narrative Games	18	4.70	0.73
	Total	72	4.75	0.70

Homogeneity of variance was tested using Levene's test for experience-taking ($F(2,69) = 1.38$, $p = .26$) and transportation into the narrative ($F(2,69) = 1.29$, $p = .28$), both resulting non-significant. These results lead to the conclusion that in both cases, experience-taking and transportation into the narrative, variance did not differ across media conditions and thus, ANOVA analyses were carried out assuming homogeneity of variance in both cases.

The analysis of variance comparing experience-taking across media conditions resulted in a statistically significant difference with a medium effect size ($F(2,69) =$

5.22, $p = .01$, $\eta^2 = 0.13$). A Bonferroni post hoc test (95% confidence intervals) revealed that participants of the literary fiction condition obtained significantly lower scores in experience-taking ($M = 4.13$, $SD = 1.45$) when compared to participants of the virtual reality ($M = 5.12$, $SD = 0.99$, $p = .01$) and narrative games conditions ($M = 5.14$, $SD = 1.04$, $p = .03$). There was no statistically significant difference between virtual reality and narrative games conditions ($p = 1.000$). Figure 5.12 displays the mean scores for experience-taking across media conditions.
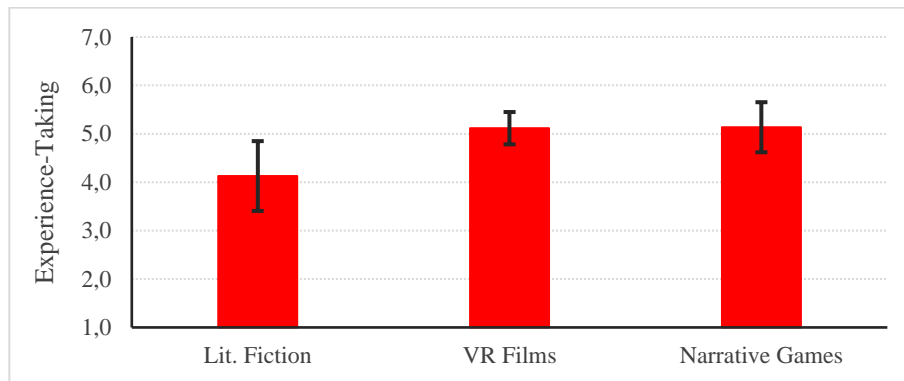

Figure 5.12. Mean scores for experience-taking across media conditions (confidence intervals 95%).

Finally, the analysis of variance comparing transportation into the narrative across media conditions resulted in a statistically significant difference with a medium effect size ($F(2,69) = 3.21$, $p = .05$, $\eta^2 = 0.09$). A Bonferroni post hoc test (95% confidence intervals) revealed that participants of the literary fiction obtained significantly lower scores in the transportation into the narrative measure ($M = 4.43$, $SD = 0.88$) when compared to participants of the virtual reality condition ($M = 4.93$, $SD = 0.53$, $p = .04$), but not when compared to participants in the narrative games condition ($M = 4.70$, $SD = 0.73$, $p = .71$). There was no statistically significant difference between virtual reality and narrative games conditions ($p = .78$). Figure 5.13 shows the mean scores for transportation into the narrative across media conditions.
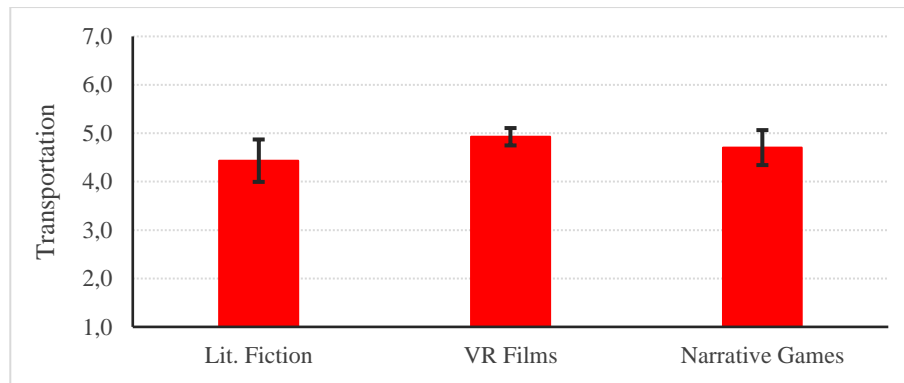
Figure 5.13. Mean scores for transportation into the narrative across media conditions (confidence intervals 95%).

Discussion

To summarize, the study aimed to compare the effects of exposure to fiction through reading fiction, watching VR films, or playing video games on theory of mind, and to compare these different media in terms of the elicitation of transportation into the narrative and experience-taking. The main hypothesis of the study was that exposure to fiction will boost theory of mind. Secondary hypotheses were that, when compared to reading fiction and playing video games, VR films will elicit higher experience-taking and transportation into the narrative, and that VR films will produce higher theory of mind enhancements. This discussion section will focus on the interpretation of results for the main and secondary hypotheses, limitations of the study and ideas and suggestions for future studies.

Partial support for exposure to all three forms fiction –written, video games, and VR films- will boost theory of mind.

Results partially supported the hypothesis that exposure to fiction, through reading fiction, watching a VR film, or playing video games, boosts theory of mind. After being exposed to fiction, participants scored higher on theory of mind in the attempted harm scenarios, but in the accidental harm scenarios there was an increase in theory of mind scores only in female participants. It is also concluded that boosts in theory of mind can be found after fiction exposure through different media. This conclusion is drawn from results showing that boosts in theory of mind did not differ across the three different media included in the study.

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An explanation for this enhancement in theory of mind can be found in Kidd and Castano (2013). These authors proposed that reading high quality fiction forces people to engage in mind-reading and character construction, and this exercise stimulates the psychological processes needed to gain access to characters' subjective experiences. This explanation is consistent with the findings in this study, inasmuch that all the media conditions in it were recognised for their high quality and showcased interactions between two or more characters. In regards to their high quality, the short stories of literary fiction, VR films, and narrative video games used in this study were all nominees or award winners, that is, their quality was acknowledged by other writers, specialised journalists, and the entertainment industry. In terms of social interactions, participants perceived that all stories, films, and video games depicted social interaction in a good manner ($M = 6.86$, $SD = 2.41$), and that these social interactions were important for the plot ($M = 7.96$, $SD = 2.06$). In both variables, the means by subcondition were above the midpoint of the scale (i.e., 5.5).

An important result of this study is that enhancement of theory of mind does not seems to be specific to written media. In both groups of scenarios designed to measure theory of mind, attempted harm and accidental harm scenarios, the effect of media condition was non-significant while the effect of exposure to fiction was significant for the whole sample in the attempted harm scenarios, and for female participants in the accidental harm scenarios. These results replicate those by Kidd and Castano (2013) in terms of literary fiction enhancing theory of mind, but they also show the same effect holds for other forms of high quality fiction, i.e., VR films and narrative video games. Considering this, it is concluded that results support the hypothesis that high quality fiction depicting social interactions boosts theory of mind, independent of the media in which fiction is presented.

The difference in results between the attempted and accidental harm scenarios was unexpected, but a possible explanation can be found in Young et al. (2010). These authors argue that the attempted harm scenarios elicit an emotional response in the participants, since these scenarios focus on the protagonists' intentions to harm others. On the other hand, the accidental scenarios are less likely to elicit an emotional response considering that they feature protagonists with neutral intentions to harm others. Young et al. (2010) established this proposal based on patients with damage in the ventromedial prefrontal cortex (VMPC) - known to experience impairments in

emotional responses to inferred events – who evaluated attempted harm scenarios as morally permissible relative to control groups while no differences were found for the accidental harm scenarios thus supporting the proposal that these scenarios differ in emotional elicitation. Considering this, and the results of the current study, it seems possible that the boost in theory of mind produced by exposure to fiction is emotion sensitive. This would mean that after being exposed to fiction, people will experience a boost in theory of mind, regardless of their gender, if the context elicits an emotional response, such as happened in the attempted harm scenarios. However, when the context does not require an emotional response (e.g., the accidental harm scenarios), only women will experience a boost in theory of mind, while men's theory of mind will not be affected. A possible explanation can be found in Baron-Cohen (2010), where is proposed that women are more prone to an empathizing style, i.e., a drive to identify others' mental states, predict their behaviour, and to present an appropriate emotional response to it. Based on this theory, it is speculated that it may be easier for female participants to estimate others' intentions in scenarios without emotional elicitation, such as in the case of accidental harm scenarios. Is worth noticing that these interpretations remain speculative, thus further investigation is required.

Another unexpected result was the decrease in theory of mind scores in the no harm scenarios for participants in the VR films condition, and in participants who were native speakers of English. No variations in the scores for these scenarios were expected, since the neutral outcomes and neutral intentions of these scenarios would translate into neutral consequences and null emotional elicitation which, according to Young et al. (2010), is critical for moral judgement. Even in case of variations in the scores of the no harm scenarios, an increase seems more logical, since neutral intentions and neutral outcomes may elicit moral judgements of permissibility, as opposed to judgements of morally forbidden behaviour. The decrease of theory of mind experienced by native speakers of English and participants of the VR films scenarios may be explained by a heightened sense of suspicion about the protagonists' behaviour in innocuous scenarios such as the ones presented in the no harm vignettes. Additionally, it may also be that the increase in the scores found in the narrative games condition, opposed to the decrease found in the other two media conditions, may have contributed to the interactions that resulted in significant differences for participants of

the VR condition and for native speakers of English. In any case, these explanations remain speculative, and is not clear why it is specific to these groups of participants.

The differences found between native and non-native speakers of English might be explained by the relatively small sample size of non-native speakers of English (N = 15). A small sample size translates into underpowered analyses which, due to sampling error, may fail to detect existing differences in the population. This explanation is supported by the relatively heterogeneous scores obtained by non-native speakers of English in the pre-measurement of the no harm scenarios (see Figure 5.5), which suggests that a larger sample could have provided a more homogenous and accurate representation of the population' scores in the pre- and post-measurements of no harm scenarios. A larger sample size would allow to confirm if the differences between native and non-native speakers of English are due to actual differences in the participants' behaviour, or if the null difference found in the group of non-native speakers of English was due to sampling error.

Finally, the intentional harm scenarios showed no variations in theory of mind scores, supporting the expected results of null variation in theory of mind for scenarios with matching negative intentions and negative outcomes. A floor effect may explain this finding, coming from judgements of extremely low permissibility due to the matching of negative intentions and negative outcomes of these scenarios. This would mean that, even though negative intentions may have elicited emotions in the participants, said elicitation may have been amplified by the matching negative outcomes, producing too strong of an effect and thus making it harder to detect a variation between the pre- and post-manipulation measurements.

The no harm scenarios showing decreases in theory of mind for native speakers of English and for participants of the VR films condition, and the intentional harm scenarios showing no variations on theory of mind, should be further investigated. Further research is needed to clarify if these results are due to sampling error or if score variations in the no harm scenarios are associated with English proficiency and with exposure to fiction via VR films.

A boost in theory of mind was found in the attempted harm scenarios after participants were exposed to fiction, but this boost did not differ across media conditions. Complementary, results for the accidental harm scenarios suggested a boost

in theory of mind only for female participants, but, again, said boost did not differ across conditions. These findings are consistent in both the first set of analyses, which compared all three conditions, and the second set of analyses, which compared VR films to non-VR conditions. Considering this pattern in the results, it is concluded that, when a boost in theory of mind was detected, said boost was present after exposure literary fiction, VR films or narrative video games, without any significant differences between these media conditions.

No support for VR films eliciting higher theory of mind when compared written fiction and video games.

The hypothesis that VR films would elicit a significantly higher boost in theory of mind when compared to written fiction and video games was not supported. As mentioned in the previous section, in the first set of mixed ANOVA analyses, participants scored higher on theory of mind in the attempted harm scenarios, but in the accidental harm scenarios there was an increase in theory of mind scores only in female participants, with no differences across conditions. Similarly, results of the second set of mixed ANOVA analyses showed no differences in boosts in theory of mind when comparing VR to non-VR conditions, with overall results of this set of analyses being similar to results of the first set. Overall, results of the two sets of analyses suggest that fiction presents through VR films boosts theory of mind as well, but not better, than written fiction and narrative video games.

Partial support for VR films eliciting higher transportation into the narrative and experience-taking.

Partial support was found for the hypothesis that VR films would present a higher positive association with experience-taking and with transportation into the narrative (in comparison to literary fiction and narrative video games). More precisely, participants of the VR films condition experienced significantly higher experience-taking and transportation into the narrative than participants of the literary fiction, but not than participants of the narrative games condition. Regarding experience-taking, results suggest that participants in the VR films and narrative video games conditions were able to better simulate the events presented in the narrative as though they were a particular character in the story (Kaufman & Libby, 2012) than participants in the literary fiction condition; no differences were found between VR films and narrative

video games). In terms of transportation into the narrative, results suggest that participants in the VR films were able to better meld attention, imagery, and feelings, focusing on story events (Green & Brock, 2000) than participants in the literary fiction but not than those in the narrative games condition; no differences were found between narrative games and literary fiction conditions.

Possible explanations for the results for this hypothesis can be derived from the correlation analyses. These correlations showed similar patterns for experience-taking and transportation into the narrative, both of which are directly correlated with the elicited mood submeasure of pleasant activation (excitement), and the perceived attributes submeasures of quality, and importance of social interactions. Additionally, experience-taking also correlated with the elicited mood submeasure of pleasure (happiness). These results suggest that the elicitation of experience-taking and transportation into the narrative is associated with exposure to fiction which depicts social interactions in a good manner and these are central to the story, and which evokes excitement and happiness (the latter only in the case of experience-taking).

It is worth noting that these differences across media conditions may be due to the participants' particular responses to the VR films and/or the literary fiction conditions. In this regard, VR is often referred as a highly immersive media which offers its users a sense of being sensory and physically immersed in a virtual world along with the chance of allowing its users to take the point of view of a character inside the virtual world (Krijn et al., 2004). These advantages may be the reason, or part of it, why participants obtained significantly higher scores in experience-taking and transportation into the narrative than participants in the literary fiction condition. Despite of this, is worth mentioning that complementary analyses (not reported in the study) showed that including experience-taking and transportation into the narrative as covariables in the analyses, does not produce a change in results.

Additionally, it may also be that these differences may be specific to the particular stories, films and video games chosen for the study. This issue of the relative limited range of stimuli used in the study will be further explored in the sections regarding the limitations of the study and suggestions for future studies.

In any case, it is worth remembering that power analyses indicated that analyses comparing the effects of media condition on experience taking and on transportation

into the narrative were underpowered. Considering this, further research is needed in order to check whether VR films producing higher experience taking and transportation into the narrative than literary fiction is a result specific to this particular sample, or if it can also be found in other –bigger– samples.

In summary, results offer partial support for the main hypothesis of the study, which states that exposure to fiction boosts theory of mind. Findings show that improvements in theory of mind were found in both sets of scenarios designed to measure variations in theory of mind, but in the case of accidental harm scenarios, boosts were found only in female participants. Conversely, results did not support the hypothesis that VR films would have a higher positive association with theory of mind boosts. The media condition to which participants were assigned–showed non-significant effects for both sets of scenarios designed to measure theory of mind (attempted and accidental harm scenarios), when comparing all three media conditions (first set of analyses) and VR to non-VR conditions (second set of analyses). Lastly, the hypothesis that VR films would present a higher positive association with experience-taking and transportation into the narrative was partially supported. This conclusion is based on results showing that participants exposed to VR films experienced higher experience-taking and transportation into the narrative than participants in the literary fiction, but not than participants in the narrative games condition.

Limitations

A number of limitations were identified for this study. The first limitation comes from the sampling method used in the study. The opportunity sampling method focuses on recruiting possible participants that are available and willing to take part in the study. This sampling method, which was used in the present study, may entail a self-selection bias given that students who feel more drawn to the subject of the study and/or certain elements of it (e.g., use of VR) are more likely to volunteer for it, thus producing results different to those that may have been obtained by including people who are not interested the aims and elements of the study. In a similar line, the study's sample included only university students, which resulted in a relatively young and homogeneous sample in terms of age (M_{age}=21.56 years, SD_{age}=4.31) which, along with the limitations of the sampling method and strategies, restricts the generalizability of the results obtained. Possible solutions for this would be to mask the aims and use of

stimuli in the study, and the inclusion of participants from a broader spectrum in terms of age and educational level. Both strategies will be discussed later on the suggestions for future studies.

A second limitation comes from the restricted range of stimuli used in the study. The inclusion of two subconditions per media condition was intended to provide relatively homogenous stimuli within conditions. This would provide the advantage of making conditions equivalent in terms of high quality and the social elements included in their narrative (of high quality and importance). However, it is impossible to know if results obtained in this study are specific to the stimuli used in it, or if they can also be found in other stimuli of similar characteristics. Hence, results from these specific stimuli cannot be generalised to others of the same kind.

Related to the above, it is worth mentioning that the decision of having two subconditions per condition was influenced by the limited options to choose from in the VR films conditions due to the relative novelty of the media and industry. At the moment of designing the study, few film festivals had VR categories in their awards (e.g., Sundance Film Festival, SXSW, Tribeca Film Festival) with even fewer film festivals being exclusively dedicated to VR (e.g., Paris Virtual Film Festival) and the lack of established platforms for the distribution of VR films. All of this translated into difficulties in identifying and accessing a wider range of VR films that could have been used in the study.

Adding to the limited range of stimuli used, this study omitted using low quality and non-social narrative materials, which resulted in the lack of control groups. This means that, currently, it cannot be determined whether boosts in theory of mind are explained by the specific nature of the stimuli used (high quality and depicting social interactions), or if said boosts can also be found in any other combinations the stimuli's characteristics (i.e., low quality with social elements, high quality without social elements, low quality without social elements). The decision to omit control groups was made considering that previous studies by Kidd and Castano (2013) already included control groups in the form of popular fiction, and non-fiction written literature, thus the present study focused on reproducing and expanding their results. Future studies should aim to test if VR films and narrative games that are labelled as low-quality and non-fiction fail to produce improvements in theory of mind, as Kid and Castano concluded in their research.

As outlined in the previous section, the theory of mind measure that was used in the previous and in the present study may contain ecological validity issues due to its written format and the relatively extreme consequences portrayed in the scenarios. Considering this, it is suggested that future studies use measures of theory of mind that take into account verbal and non-verbal information and that include a broader spectrum of prompts, beyond illness, injury or death. As mentioned in the previous section, an alternative measure of theory of mind to be used in future studies would be the Strange Stories Film Task (SSFT) by Murray et al. (2017).

A final limitation comes from the uneven group sizes for the different media conditions of the experiment, where the literary fiction and narrative games conditions had the same number of participants (18 participants, each), while VR films condition had double the number of participants (36 participants). Having uneven group sizes in ANOVA analyses may generate problems of heterogeneity of variance. To address possible issues of heterogeneity of variance, tests of homogeneity of variance were performed along with the main analyses. No major issues were found when comparing all three media conditions in the first set of analyses, nor when comparing VR to non-VR conditions in the second set of analyses. In any case, it is recommended that future studies guarantee even group sizes for the media conditions to minimize the possibilities of issues with homogeneity of variance.

Considering the findings and limitations of the study, the following suggestions are made for future studies. Firstly, it is suggested that the aims of the study and the stimuli used –i.e., written fiction, VR, and video games– is kept hidden from participants during recruitment. The aims of the study may be presented as a test to evaluate participants' attention after reading a series of vignettes, and the stimuli may be masked as a calibration of equipment, entertainment during a waiting period, or presented as a task for a different study. This would help minimize the self-selection bias that could influence results. Ethical guidelines must be maintained when masking this information, such as informing participants about possible side effects of their participation (e.g., psychological distress and/or motion sickness) and presenting a debriefing sheet to reveal the deception regarding the aims and stimuli, as well as the reasons behind this.

A second recommendation for future studies is to test if the findings of this study can be reproduced with a different set of stimuli. A broader selection of VR

stimuli should be available in the near future, considering the increasing numbers of film festivals that are including VR exhibitions and award categories. In this regard, a paradigm similar to the one used by Kidd and Castano (2013) is suggested for all three media conditions in this study: In a series of studies, some of the stimuli were kept as constant from one study to another, while adding new ones to facilitate generalisation of results.

One last recommendation for future studies is to use a design that includes control groups for each of the media conditions. Such design could be systematized as a 2x2x3 between-subjects, with quality (high and low), social contents (with and without), and media (written, VR and video games) as the independent variables. Considering that this option could become too complex if adding a within-subjects comparison of pre- and post-manipulation measurements of theory of mind, it may prove useful to split this design into three different studies, each aiming to test the effect that quality (low and high) and social contents (with and without) may have on theory of mind for each type of media (written, VR and video games).

Conclusions

To summarize, results of the study offer partial support the hypothesis that exposure to fiction boosts theory of mind. Improvements in theory of mind were found in both sets of scenarios designed to measure variations in theory of mind, but in scenarios without emotional elicitation, boosts were found only in female participants. Results did not support the hypothesis that VR films would have a higher positive association with theory of mind boosts. Lastly, the hypothesis that VR films would present a higher positive association with experience-taking and transportation into the narrative was partially supported.

Chapter 6:
General Discussion

Summary

This chapter provides a review of the aims and findings for each of the studies comprising this thesis in the context of the related scientific literature. Additionally, limitations of the current studies and proposals for future studies are described, as well as possible implications in the use of fiction as possible tools for interventions to enhance empathy and theory of mind.

Aims of the thesis

This thesis had two purposes. First, it aimed to conceptually replicate previous research suggesting that reading high quality fiction enhances peoples' abilities of estimating others' intentions, knowledge and emotions, and of experiencing said emotions themselves. Secondly, it aimed to explore if these enhancements are also present after people are exposed to fiction in modern media, such as video games, and VR films.

Study 1 used an online survey, aiming to explore the association between reading literary fiction, and playing video games, with empathy, and theory of mind. A

secondary aim of this study was to explore the influence that different video game genres may have on empathy, and theory of mind. This study used a broad approach measuring frequency of reading fiction and playing video games (i.e., weekly time spent in these activities) while addressing written fiction and video games genres but without distinguishing their quality or specific contents.

Study 2 followed a more targeted approach by using an experimental design with random assignment. This study aimed to evaluate short-term effects of exposure to fiction that met certain criteria of quality and contents on theory of mind. More precisely, the study compared the effects of award winning short stories of fiction and video games that depicted social interactions between characters (experimental conditions), and of puzzle video games of lower quality and without social contents (control condition). This study also aimed to test the possible mediation roles of transportation into the narrative, and experience-taking and possible moderation roles of imagery ability, and need for cognition. Finally, this study examined the effect that exposure to fiction may have on prosocial behaviour.

The third study followed a similar design to the one on Study 2, but addressed its main limitation by including pre-manipulation measurements of theory of mind, as well as VR films as a third experimental group (while omitting the use of a control group). This study used an experimental design comparing the effects award winning short stories of fiction, video games, and VR films that depicted social interactions between characters, on theory of mind, transportation into the narrative and experience-taking. This study also aimed to compare the effect that VR films may have on theory of mind, in contrast to the other two conditions grouped as non-virtual reality conditions.

Summary of findings

The empirical studies comprising this thesis provide evidence to address its aims. The following sections offer a summary of findings for each study and a discussion of how they fit within the relevant scientific literature.

Study 1: Reading Fiction and Playing Video Games as Leisure Activities and Its Association with Empathy and Theory of Mind

Study 1 is a survey study that explored the association between reading literary fiction, and playing video games with empathy, and theory of mind. A secondary aim of this study was to explore the influence that different video game genre may have on empathy and theory of mind. Participants of this study were asked to estimate how much time they spent in a regular week reading fiction and playing video games as leisure activities. Participants were later asked to complete measures of empathy, and of cognitive and affective theory of mind.

Results of this study partially support the primary hypothesis that reading fiction and playing video games will be positively associated with cognitive and affective theory of mind and with empathy. Reading fiction –measured as estimations of average weekly hours spent reading domestic fiction, romance, science-fiction and fantasy, and suspense and thrillers– was directly and positively associated only with two of the four subscales comprising empathy: perspective taking and fantasy. On the other hand, reading fiction presented only moderated effects with the other two subscales (empathic concern: reading moderated by age; and personal distress: reading moderated by pleasant activation). Reading fiction was not associated with cognitive nor affective theory of mind. Playing video games was not directly associated with any of the mentioned variables, but this activity presented moderated effects for perspective taking (game-playing moderated by gender), empathic concern (game-playing moderated by pleasant activation) and fantasy (game-playing moderated by pleasant deactivation). The results did not support the secondary hypothesis of the study which was that video games rated by participants as complex and also having a social component (e.g., the need to be played with other people) will present a higher positive association with theory of mind and empathy, when compared to video games rated as simple and non-social.

Overall, results show direct associations between reading fiction with only two of the four subscales of empathy, and no direct associations with cognitive nor affective theory of mind. The fact that reading fiction was not consistently associated with all subscales of empathy and with theory of mind can be explained by the idea that being exposed to fiction may boost theory of mind and empathy as long as the person is cognitively and emotionally engaged with the narrative and immersed in it. In this

regard, Bal and Veltkamp (2013), and Kaufman and Libby (2012), suggested that transportation into the narrative and experience-taking may moderate the association between exposure to fiction with theory of mind and with empathy. By not including these variables in the study, nuances in the relationship between exposure to fiction with empathy and with theory of mind may have been missed.

A complementary explanation for the inconsistent associations between reading fiction with empathy and with theory of mind comes from the idea that people with different dispositional traits may be more prone to feel engaged with fiction presented through different media. This is the case for need for cognition (Appel & Richter, 2007; Green & Brock, 2000) and imagery ability (Green et al., 2008), variables that have been proposed as moderators between exposure to fiction and transportation into the narrative. According to this proposal, people who are better at forming mental images in their minds' eye and people who enjoy being challenged cognitively, may feel more engaged with fiction when it is presented in written form as opposed to film. This would be because when fiction is presented in written form, they are able to exercise their imagery ability and are cognitively more challenged by it, thus experiencing higher engagement when stories are presented in this medium. In contrast, people with lower imagery ability and need for cognition may experience higher engagement with films since this medium already provides visual representations of the stories that are being told and are –arguably– less challenging cognitively. Given the similarities in terms of visual stimulation for film and video games, it was estimated that similar effects may be at play when people play video games. Nevertheless, similar to the omission of transportation into the narrative and experience-taking, by not including these variables in the study, nuances may have been missed in regards to the effects of fiction when presented through different media.

A final explanation for results showing only partial support for the primary hypothesis of the study comes from the use of raw measurements of exposure to fiction (i.e., weekly hours of reading fiction and playing video games) that did not differentiate written fiction nor video games by their quality. Research suggest that enhancements in theory of mind and empathy may be specific to high quality literature, as opposed to popular fiction or non-fiction (Kidd & Castano, 2013; Mar et al., 2006), but the present study did not differentiate written fiction nor video games by quality.

Overall, two main conclusions can be drawn from the findings of this study. First, associations between exposure to written fiction and empathy are present but they may be more complex than initially thought. This is considering results showing direct associations between exposure to written fiction with only two of the four subscales of empathy and no direct associations with cognitive nor affective theory of mind. Additionally, there's scientific literature suggesting that exposure to fiction may enhance empathy when immersed in the narrative (Bal & Veltkamp, 2013); and that it may promote behavioural and attitudinal change when the reader is able to situate herself/himself inside the narrative as if they were part of it (Kaufman & Libby, 2012). Similarly, it has been suggested that people who are better at forming mental images in their mind's eye (Green et al., 2008) and who enjoy the cognitive exercise (Appel & Richter, 2007; Green & Brock, 2000), may benefit more from fiction that is presented in written form (as opposed to film).

The second conclusion refers to the need to further specify the elements of fiction that may be responsible for empathy and theory of mind enhancements when evaluating the effects of fiction in written form and in video games. This conclusion is based on the scientific literature suggesting that is not any piece of fiction that boosts people's empathy and theory of mind, but fiction that is of high quality (Mar et al., 2006) and that depicts social interactions between characters (Oatley, 1999; 2002). According to the literature, high quality fiction challenge people's preconceptions while cognitively and emotionally stimulating them (Mar et al., 2006). Likewise, depictions of social interactions between characters serve as simulations of real world scenarios, from which people can learn vicariously (Oatley, 1999; 2002). The study did not ask participants specifically about time spent reading fiction and playing video games of high quality depicting social interactions, which means that participants' answers may have, and probably did, encompass written fiction and games of low and high quality, and video games with and without depictions of social interactions in them. In conclusion, the broad approach used in the study may explain the results showing only partial support for the primary hypotheses of the study.

Based on these conclusions, it was decided that future studies should use an experimental design with random assignment to either read fiction or play video games that are of high quality and that depict social interactions between characters. Benefits of this chosen design included evaluating a causal model between fiction exposure with

empathy and theory of mind, which could not be achieved with a correlational study. Secondly, evaluating possible boosts of empathy and theory of mind right after fiction exposure allowed the comparison of reading fiction and playing video games under stricter conditions regarding the setting (e.g., immediate surroundings, time spent) and stimuli (i.e., equivalent in terms of quality [high] and contents [social]). Thirdly, the random assignation to different media meant that the effect of preference for a certain media would be controlled since all conditions would have similar distribution of participants who enjoy one form of fiction or the other (i.e., written fiction, or video games). Lastly, an experimental design made it possible to evaluate possible mediation effects of transportation into the narrative and experience-taking, and of moderation effects of imagery ability and need for cognition, thus addressing what has been proposed in the scientific literature.

Study 2: Effect of Reading and Playing Video Games on Theory of Mind

Study 2 followed the suggestions made after the previous study, using an experimental design comparing possible enhancements in theory of mind after reading literary fiction (i.e., high quality literature depicting social interactions between characters), playing narrative video games (i.e., high quality video games depicting social interactions), and playing puzzle video games as a control condition (i.e., lower quality games without depictions of social interactions). This study examined mediation effects of transportation into the narrative and experience-taking in the association between exposure to fiction and theory of mind, and moderation effects of imagery ability and need for cognition for the relationships between fiction exposure and transportation into the narrative and experience-taking. Additionally, the study explored the effect of exposure to fiction on prosocial behaviour, a measure that was estimated would reflect the possible benefits of being exposed to fiction on everyday behaviour.

Overall, the results do not support the primary hypothesis of the study that exposure to fiction, through reading fiction and playing narrative video games is positively associated with theory of mind, when compared to puzzle video games. These results align with recent studies which failed to replicate Kidd and Castano's (2013) finding that exposure to high quality written fiction boosts individuals' theory of mind (Djikic et al., 2013; Panero et al., 2016; Samur et al., 2018). Nevertheless,

since the study only used post-manipulation measurements of theory of mind, only comparisons across conditions could be conducted, which means that no conclusions can be drawn about possible changes within each condition.

Results of this study do not support the hypothesis that experience-taking and transportation into the narrative mediate the relationship between exposure to fiction and theory of mind. Participants who were exposed to fiction through reading fiction and playing video games experienced higher transportation into the narrative and experience-taking when compared to participants who played puzzle video games, but transportation and experience-taking were not associated with theory of mind. Thus, these results do not support previous research linking transportation into the narrative to empathy (Bal & Veltkamp, 2013) and experience-taking to behavioural and attitudinal change towards minority groups depicted in fiction (Kaufman & Libby, 2012).

Regarding results not supporting the hypothesis that experience-taking and transportation into the narrative mediate the relationship between exposure to fiction and theory, an explanation can be found in the difference between concepts and measures that were used in the present study and the studies that motivated the inclusion of these variables. For instance, Bal and Veltkamp (2013) focused on the effects that fiction, mediated by transportation into the narrative may have on empathy, while the present study focused on possible effects on theory of mind. This difference in constructs and measures, may help explain results since, according to recent literature (Bird and Viding, 2014) despite empathy and theory of mind being associated concepts, they may not be interchangeable. In a similar fashion, the present study took Kaufman and Libby's (2012) proposal that experience-taking may have a mediation effect in the association between fiction and attitudinal changes towards others, but focused on the association between fiction and theory of mind boosts instead. This change was made since, arguably, the ability to estimate others' mental states could be associated with developing more positive attitudes towards a specific group. In this case, being able to infer the mental state of an individual, may not necessarily translate into attitudinal change towards a group.

Other secondary hypotheses were that imagery ability and need for cognition would moderate the relationships between exposure to fiction and transportation into the narrative and experience-taking when comparing video games to written fiction.

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No support was found for these hypotheses, thus failing to replicate previous findings in the scientific literature regarding the association between fiction and transportation into the narrative being moderated by imagery ability (Green et al., 2008) and by need for cognition (Appel & Richter, 2007; Green & Brock, 2000).

Likewise, results not supporting the hypotheses regarding imagery ability and need for cognition could be explained by the differences between past and current research. Past research (Appel & Richter, 2007; Green & Brock, 2000; Green et al., 2008) focused on the comparison of narrative films and written fiction, while the current study focused on the comparison of written fiction and narrative video games. This difference in the media used suggest that fiction in films and video games may not be as similar as this thesis initially proposed which may be due to their differences (e.g., interactivity) being more salient than their similarities (e.g., visual stimulation) when comparing both media. It may be that the cognitive load of having to interact with the video game (e.g., control inputs, decision making) make people, overall, less invested in the narrative, and/or less susceptible to the moderation effects of imagery ability and need for cognition. Arguably, this effect may have been even stronger in participants who do not play video games regularly and were thus subject to the novelty of having to use a keyboard and mouse to interact with the game, as well as the experience of playing video games itself. Considering this, it may be possible that differences in transportation into the narrative appear after a learning period in which participants get accustomed to interacting with the video game thus reducing the cognitive load, thus being able to focus more on the narrative of the video game. Lastly, it is worth noting that despite this study providing short videos (3 minutes long) demonstrating the video game controls to participants, they may not have been effective enough in demonstrating and practicing controls.

Lastly, the hypothesis that exposure to fiction is positively associated with prosocial behaviour when compared to non-narrative video games was not supported by the results. These results do not support results of meta-analyses linking prosocial behaviour to different forms of social cognition such as: theory of mind (Imuta, Henry, Slaughter, Selcuk, & Ruffman, 2016), perspective-taking (Carlo, Knight, McGinley, Goodvin, & Roesch, 2010), and empathy (Eisenberg & Miller, 1987). A possible explanation comes from the significant but weak associations found in the aforementioned studies linking prosocial behaviour to theory of mind ($r = .19$), to

perspective-taking ($r = .16$), and to empathy ($r = .10$ through $r = .36$ when measures of empathy were other than picture-story format; when measures were in this format, the associations were non-significant). These results along with the non-significant associations found in the present study for the two groups of scenarios measuring theory of mind ($r = -.201$, $p = .086$ for attempted harm; $r = .136$, $p = .247$ for accidental harm scenarios) suggest a low shared variance between theory of mind and prosocial behaviour, which puts doubt on the hypothesised association between these two variables.

It is worth clarifying that in the present study the results show correlations that are opposite in direction for the associations between prosocial behaviour and theory of mind scenarios: negative for attempted harm scenarios ($r = -.201$, $p = .086$) and positive for accidental harm scenarios ($r = .136$, $p = .247$). Both correlations reflect a positive association between theory of mind and prosocial behaviour (although non-significant). This is considering that lower scores in the attempted harm scenarios indicate that participants evaluated the characters' actions as less permissible, which implies an enhanced focus on the characters intentions to hurt others, which in turn is interpreted as higher theory of mind. Conversely, higher scores for accidental harm scenarios demonstrate enhanced theory of mind since participants evaluated characters' behaviour as more permissible, since they focused on the lack of intention to hurt others.

In conclusion, the main results of this study show no differences in theory of mind performance between participants who were exposed to either literary fiction, narrative video games or puzzle video games. However, due to limitations of the study it is not possible to conclude whether variations in theory of mind occurred in all three conditions or not, and if they did, in which direction (i.e., boosts or decreases). To address this limitation, it was decided that the next study should include pre- and post-manipulation measurements of theory of mind which would permit the evaluation of possible variations in theory of mind within each condition over time.

Study 3: Effect of Reading Fiction, Playing Video Games and Watching Virtual Reality Films on Theory of Mind

Study 3 followed the proposal made after the previous study by implementing an experimental design with pre- and post-manipulation measurements of theory of

mind, comparing the effect that reading literary fiction, playing high quality narrative video games and watching high quality VR films may have on this ability. The inclusion of pre- and post-manipulation measurements made it possible to evaluate possible variations of theory of mind within each condition over time.

Study 3 also included VR films as the third experimental condition in light of: 1) previous research showing mediation effects for transportation into the narrative (Green & Brock, 2000) and experience-taking (Kaufman & Libby, 2012) in the association between exposure to written fiction with empathy and attitudinal change; 2) virtual reality being considered as a particularly immersive media thus, possibly, producing higher levels of transportation and experience-taking; 3) and the growing interest in virtual reality by the entertainment industry and gaming community. All of this, raises the possibility of virtual reality being a particularly effective media in regards of facilitating the take of a fictional character's point of view and mindset, while also extending the reach of fictional narratives to new audiences.

The primary hypothesis of the study was that exposure to fiction (through reading fiction, playing video games and watching VR films) will boost theory of mind, with results partially supporting this hypothesis. After being exposed to fiction, participants in all conditions scored higher in the theory of mind subscale designed to elicit emotional responses (attempted harm scenarios). However, in the subscale that did not provide emotional stimulation (accidental harm scenarios), there was an increase in theory of mind scores only in female participants. These effects were found in all three conditions of the study, thus it was concluded that boosts in theory of mind can be found after fiction exposure through different media. Overall, these results support the literature linking boosts in theory of mind to literary fiction (Black & Barnes, 2015b; Kidd & Castano, 2013; Pino & Mazza, 2016), television series (Black & Barnes, 2015a), and video games (Bormann & Greitemeyer, 2015).

Overall, results of this study support the literature suggesting that not all pieces of fiction boost peoples' theory of mind, but fiction that is of high quality (Mar et al., 2006) and that depicts social interactions between characters (Oatley, 1999; 2002). Following these suggestions, the present study used short stories of fiction, narrative video games and VR films that were recognized for their high quality by their industry or specialized media, and that depicted social interactions between two or more characters. Boosts in theory of mind were found in all three conditions suggesting that

indeed quality and contents play a relevant role in theory of mind enhancements. Nonetheless, since the study did not include control conditions, is not possible to conclude if these enhancements are exclusive to high quality fiction depicting social interactions. This limitation will be further explored in the *Limitations and future research* section.

Additionally, results showing boosts in theory of mind in all three conditions, suggest that effects are not media dependent. Despite initial research focusing on written fiction (Black & Barnes, 2015b; Kidd & Castano, 2013; Pino & Mazza, 2016), later studies found enhancements in theory of mind linked to watching award-winning television shows (Black & Barnes, 2015a), and to playing video games after participants were asked to focus on the games' narrative elements (Bormann & Greitemeyer, 2015). Results of these studies suggest that exposure to fiction, independent of the media it is presented on, can boost people's theory of mind, with results of the present study supporting said suggestion. In any case, more research is suggested so the limits of this proposal can be explored by –for example– presenting fiction through media that have not been tested yet, such as live or recorded music, opera, theatre plays, and graphic novels, to name a few.

A secondary hypothesis of Study 3 was that, when compared to reading fiction and playing video games, VR films will elicit higher transportation into the narrative and experience-taking. Partial support was found for this hypothesis, since participants in the VR films condition experienced significantly higher transportation into the narrative and experience-taking than participants in the literary fiction condition, but not higher than those in the narrative games condition. These results suggest that participants of the VR films, and narrative video games conditions were able to better simulate the events presented in the narratives, as if they were a particular character in the story (Kaufman & Libby, 2012), and to better meld attention, imagery, and feelings, focusing on story events (Green & Brock, 2000) than participants of the literary fiction condition.

It was also hypothesized that VR films will elicit a significantly higher positive association with theory of mind. Nevertheless, no support was found for the hypothesis that VR films would elicit a significantly higher positive association with theory of mind. Participants of the VR films condition did not perform significantly better in the theory of mind task than participants of the literary fiction and narrative video games

condition. It can be concluded that VR films do elicit higher experience-taking and transportation into the story when compared to literary fiction but not higher than narrative video games, but this does not translate into higher theory of mind boosts.

In summary, results of Study 3 show enhancements in participants' theory of mind after they were exposed to fiction in all three conditions: reading literary fiction, playing narrative video games, or watching VR films. Additionally, results show that these effects may be affected by gender. More precisely, boosts were found in male and female participants in the subscale of theory of mind that according to the literature (Young et al., 2010), tends to elicit emotional response. On the other hand, in the subscale that is less likely to elicit an emotional responses, boosts were found only in female participants. Regarding the secondary hypotheses, despite VR films eliciting higher experience-taking and transportation into the narrative than literary fiction (but not more than narrative video games), VR films did not produce significantly higher theory of mind enhancements than literary fiction and narrative video games.

Implications

Findings of this thesis contribute to both the fields of social psychology and media psychology. Specifically, this thesis examined the potential to influence social-cognitive skills (i.e. abilities that help individuals estimate and understand others' intentions, emotions, and knowledge) via social stimuli channelled through different– modern– media: video games and virtual reality films.

Overall, the main contribution of this thesis refers to exploring whether watching and playing commercially available virtual reality films and video games can foster people's abilities to estimate other's intentions, emotions and knowledge. This contribution is linked to previous studies investigating –mainly– the effects of written literature (Black & Barnes, 2015b; Kidd & Castano, 2013; Pino & Mazza, 2016) and of television series to some extent (Black & Barnes, 2015a). Thus, by exploring the effects of fiction delivered through other media, this thesis contributes to the argument that fiction's boosting effects on social cognition are not media-specific. Lastly, this suggests that leisure activities that are part of some people's daily life, such as reading fiction, playing video games, and watching films, may briefly boost people's social cognitive skills, which may be particularly relevant for video games given its

pervasiveness as a medium. The specific implications of this thesis' results involve theory and past research, as well as practical applications for the use of video games and virtual reality for training and therapeutic purposes.

The main implication for theory and research relates to video games and VR films producing boosts in theory of mind, along with literary fiction. Results of Study 3 partially replicate findings by Kidd and Castano (2013) suggesting that literary fiction enhances theory of mind, while also extending these findings to narrative video games and VR films. Overall, extending these findings to other media contributes to previous evidence linking theory of mind enhancements to exposure to literary fiction (Black & Barnes., 2015b; Pino & Mazza, 2016) and to television series (Black & Barnes, 2015a). This findings also contribute to the research linking playing narrative video games to theory of mind enhancements, when playing focuses on the narrative elements of games as opposed to ignoring them (Bormann & Greitemeyer, 2015). Overall, these findings suggest that fiction facilitates the understanding of others, independently of the media it is presented on.

A second implication for theory and research relates to quality (high) and content (social) of fiction, playing a relevant role in the stimulation of social cognition abilities. Results of all three studies partially support the proposals that is not any form of fiction that boosts people's theory of mind, but fiction that is of high quality (Mar et al., 2006) and that depict social interactions (Oatley, 1999; 2002). More precisely, when quality and contents were not specified for written fiction and video games in Study 1, only partial associations were found between exposure to written fiction and empathy, and no significant associations between exposure to fiction with cognitive and affective theory of mind. Conversely, boosts in theory of mind were found when quality (high) and contents (social) were constricted for written stories, video games and RV films in Study 3. Overall, these results are consistent with Kidd and Castano's study (2013) showing that high quality fiction (i.e., literary fiction) boosts theory of mind, relative to low quality fiction (i.e., popular fiction) and non-fiction (e.g., scientific news articles), thus suggesting that boosts in theory of mind are produced by fiction, as long as fiction is of high quality and depicts social interactions between characters.

A third implication for theory and research derives from findings of Study 3 showing gender differences in theory of mind when emotional elicitation was not

provided. More precisely, enhancements in theory of mind were found in both male and female participants when emotional elicitation was provided (i.e., attempted harm scenarios), but when no emotional elicitation was provided, enhancements were found only in female participants. These findings suggest a moderating role for gender in the association between exposure to fiction and theory of mind which can be explained by Baron-Cohen's (2010) empathizing–systemizing theory. This theory suggests that women tend to be more oriented and skilled at inferring others' mental states, as well as triggering appropriate emotional reactions to them, which may have made female participants able to focus more and better understand the behaviour of the characters presented in the fictional stories, boosting their performance in both subscales of theory of mind. Conversely, men's tendency to focus on analysing systems and extracting the underlying rules that govern their behaviour (instead of empathizing with others), may have made them less responsive to the simulation of social interactions presented in the fictional narratives, which translated into boosts in theory of mind only when emotional elicitation is provided. These findings suggest that gender may moderate the association between exposure to fiction and theory of mind boosts, but further investigation is suggested since these results were unexpected.

Regarding practical implications, results showing enhancements in theory of mind after being exposed to fiction through different media suggest possible uses of fiction in therapeutic settings. Research shows that theory of mind plays an important role in social functioning, and impairments in this ability are linked to clinical populations such as individuals with autism spectrum disorders, schizophrenia, and traumatic brain injury (Byom & Mutlu, 2013). In a similar line, the latest version of the Diagnostic and Statistical Manual of Mental Disorders -DSM-5- (American Psychiatric Association, 2013) proposes a new trait model in which empathy deficits are assumed to be core to all personality disorders (Vachon & Lynam, 2016). With this in consideration, interventions to train theory of mind and empathy could be used to improve mental health and quality of life in clinical populations.

Evidence in the scientific literature show relative levels of success in the implementation of training programs for social cognition and social cognition related variables. A meta-analysis (Roelofs, Wingbermühle, Egger, & Kessels, 2017) conducted with 41 interventions aiming to improve social cognition in patients with schizophrenia, autism spectrum disorders or acquired brain injury (N = 1.508) reports

moderate-to-large effect sizes for interventions in general (d = .71), and a large effect size for interventions targeting theory of mind (d = .89). Similar results were found in a meta-analysis (van Berkhout & Malouff, 2016) conducted with 18 randomized controlled trials of empathy training programs (N = 1.018), where a medium effect size is reported after being adjusted for publication bias (g = 0.51). Overall, results of these meta-analyses show that training programs aiming to improve peoples' social cognition, theory of mind, and empathy, tend to be effective, thus supporting the proposal of developing and testing such programs.

Additionally, support for the use of video games and virtual reality in empathy and theory of mind training programs can be found in the literature that have explored the use of these media for training and therapeutic purposes. In the field of video games, studies have reported relative levels of success when using commercial and serious video games (i.e., developed for a specific educational or therapeutic purpose) in therapy and training settings, such as in programs for self-awareness and social skills training in patients with traumatic brain injury (Llorens et al., 2015), for emotional regulation and impulsivity control in gambling disorder (Tárrega et al., 2015), and treatment of bulimia nervosa (Fernandez-Aranda et al., 2015).

Additional support for the use of video games in empathy and theory of mind training programs comes from the literature reporting showing enhanced adherence to treatment. In this regard, there is evidence showing that using video games in therapy setting enhances motivation and adherence, (Coyle, Doherty, & Sharry, 2009; Kato et al., 2008; Tárrega et al., 2015) as well as facilitating therapeutic success (Fernandez-Aranda et al., 2015; Tárrega et al., 2015) which, arguably, could also apply to other interactive or novel ways to support treatment such as written fiction and virtual reality.

Lastly, further support for the use of video games in empathy and theory of mind training programs comes from the reach of this media. Authors have highlighted video games' ubiquity, affordability, and popularity as a media (for a systematic review see Pallavicini et al., 2018) which may translate into interventions using this media as supporting tools that are less threatening to people who are already accustomed to playing video games, thus facilitating the adherence to such interventions in this population.

Regarding support for the use of virtual reality, recent studies have explored possible uses of this technology for empathy training. Embodied virtual reality is a technique that allow users to virtually experience the body of another person (Schoeller et al., 2019), with recent studies examining its uses for increasing altruistic intentions (Rosenberg, Baughman, & Bailenson, 2013), reducing short-term implicit racial bias (Banakou et al., 2016), and reducing aggressive behaviour (Seinfeld et al., 2018). These studies show overall promising results in regards of virtual reality being capable of fostering empathy, but the more compelling evidence comes from the study of Seinfeld et al. (2018). In said study, offenders developed higher ability to recognize fearful female faces after they experienced the perspective of a female victim of domestic abuses by using embodied virtual reality. These results suggest that by allowing to virtually assume the position of another, virtual reality could foster empathic abilities in the real world.

Additionally, support for the use of virtual reality as a tool to train theory of mind and empathy in therapeutic setting comes from the growing body of research documenting the potential benefits of using this media as a tool for the treatment of mental disorders such as anxiety and depression (Fodor et al., 2018), eating disorders (Clus et al., 2018), and for physical rehabilitation (Tieri et al., 2018). Overall, the scientific literature suggest that virtual reality is an acceptable and promising tool in therapeutic setting, given that virtual reality is often recognized as a particularly immersive media which allow users to adopt the point of view of a character in the virtual world while being sensorially and physically immersed in it (Krijn et al., 2004).

In conclusion, it seems suitable to explore the potential benefits of using commercial video games and virtual reality experiences for theory of mind and empathy training in therapeutic settings. This is considering: results of this thesis suggesting that fiction, when presented in written form, video games and VR films, can enhance theory of mind. Support for this proposal come from the scientific literature showing: the overall effectiveness of theory of mind and empathy training programs; the effectiveness of using video games and virtual reality in therapeutic settings; and the specific strengths of each media (ubiquity of video games, and immersion of virtual reality).

One final implication of this thesis' results relates to the contribution of this research towards the notion that research on video games' effects should follow a more

balanced approach between possible beneficial and harmful effects. As highlighted by Granic et. al. (2014), most of the research on video games' effects had focused on their potential harmful effects related to aggression, addiction and depression (e.g., Anderson et al., 2010; Ferguson, 2013; Lemola et al., 2011) and while this research is relevant, a more balanced approach –one that includes the possible benefits of playing video games– can provide a deeper understanding on how this media affects people's behaviour. The contribution of this thesis comes from findings suggesting that playing video games (as well as reading fiction and watching VR films) can enhance peoples' understanding of others', showcasing emotional and social benefits of playing video games.

From a historic point of view, research of the possible harmful effect of video games has been used by the press, and in some cases by people in government, to associate mass killings in the United States with playing violent video games (Ferguson, 2007; Granic et al., 2014). Examples of this are mass killings in Columbine High School (1999), Virginia Tech (2007), Sandy Hook (2012), and Parkland (2018) all of which have been prominently portrayed by the media as linked with playing violent video games. By putting video games in the public eye, research into this matter been requested (and funded) by the government, with Bill Clinton ordering a study on the marketing of violent media aimed at children (movies, music and video games) in 1999, and more recently in 2013 Barack Obama allocating $10 million for research on the effects of violent media, especially video games. As previously mentioned, while research in this topic is useful and valuable, by focusing on one aspect of the video game playing experience, other aspects of the phenomena may be ignored which may be especially detrimental, considering the changes that the video game industry has gone through during the last 20 years.

According to some authors (e.g., Ferguson & Olson, 2013), video games have become progressively more complex, diverse, realistic, and social in nature. Only between 2012 and 2018, the video game industry grew from $70.6 to $137.9 billion dollars in terms of global revenues (Newzoo, 2018d), reaching an estimated 2.3 billion gamers across the globe as of 2018. These numbers depict video games as a strong industry in the field of entertainment in which, video games development is considered a valid career option with universities offering specialized education in this area in most western countries. Alongside this, more powerful home computers, video game

consoles and even mobile phones, support more realistic video games with higher quality graphics. Lastly, game development tools becoming more accessible (e.g., Unreal Engine, Unity, GameMaker Studio) and commercialization and distribution platforms going online (e.g., Steam, Green Man Gaming, Epic Games Store) have opened the door to independent developers with ideas that usually go beyond the more mainstream (and often more violent) titles.

In this context of increasing quality, diversity and complexity in video games, focusing on their possible harmful effects is telling a partial story of a complex phenomenon. There is a growing body of research documenting the benefits of playing video game (for reviews see Grande de Prado, 2018; Granic et al., 2014), including the use of video games in training and therapy settings (e.g., Fernandez-Aranda et al., 2015; Llorens et al., 2015; Tárrega et al., 2015), but media coverage of these studies is not as prominent as the coverage given to studies of the harmful effects of video games.

In conclusion, considering results of this thesis suggesting that playing high quality narrative video games may boost peoples' theory of mind, there is a need to raise awareness amongst the scientific community, policy makers, and consumers in regards of a more balanced approach to research of video games' effects, one that includes not only its possible harmful effects, but also its possible benefits. Additionally, awareness should be raised amongst video game designers and developers regarding the possible benefits of video games, so that intentional efforts are made to mix these elements with the main goal of commercial video games, to entertain.

Limitations and future research

The main limitations of each of the studies in this thesis are addressed in this section to improve future research. The main limitation of Study 1 comes from the failure to acknowledge in advance differences between reading fiction and playing video in terms of their social aspects, namely: their contents, and how people interact with these media. Regarding content, written fiction tends to focus on interactions between characters as it is the norm of this media genre (Oatley, 2016). Conversely, contents in video games tend to be more diverse, where social interactions between characters may or may not be present, and when they are there is a wide range of possibilities in terms of how prominent they are for the story of the video game.

Another difference comes from the expected social interactions while reading fiction and playing video games. More precisely, while the activity of reading is considered mostly an individual activity, playing video games can be done alone or with other people, either face-to-face or online, to either compete, collaborate, or both. These differences in contents (with or without social interactions between characters), and the way people interact with these media (solo or with other people) and with what purpose (to collaborate, compete or both), mean that the experiences of reading fiction and playing video games may be too different to establish a direct comparison with written fiction without acknowledging said differences. It is recommended then that future studies minimize the differences between written fiction and video games in order to establish more direct comparisons in terms of their fictional elements and its possible association with theory of mind and empathy enhancements. By doing so, ecological validity of the stimuli and study design may be affected, but it would allow focusing on the effects of contents (fictional narratives) on possible theory of mind and empathy boosts by subtracting the possible effects that may come from specific characteristics of each media (e.g., the aforementioned expected social interactions in video game playing).

Study 2's main limitation was its design which did not use a pre-manipulation measurement of theory of mind, and thus conclusions could only refer to comparisons across conditions, but not about changes in time within conditions. With this limitation, it is not possible to conclude if there were changes in theory of mind after participants were exposed to the control and experimental conditions, and if there were changes, in which direction (either boosts or decreases in theory of mind). Opting for this design was a decision based on the practical reason of keeping experiment sessions under 60 minutes, with the ultimate goals of increasing participants' motivation and, when participation was done in exchange for credits, using credits efficiently.

It seems unlikely that the control group of Study 2 had a boosting effect on theory of mind since that would contravene the literature suggesting that theory of mind enhancements are specific for fiction that is of high quality (Mar et al., 2006); and the experimental evidence showing theory of mind enhancements when reading literary fiction, as opposed to reading popular and nonfiction (Kidd & Castano, 2013), and when watching high quality television dramas as opposed to television documentaries (Black & Barnes, 2015a). In any case, the control group producing boosts in theory of

mind (along with the experimental groups), or experimental and control groups hindering theory of mind performance, or having no effect at all, would be unexpected results which would require further exploration.

Other limitations of Study 2 were the generalisability of results due to sampling method, and to the stimuli shown to participants. This study used a sampling method by opportunity which may have entailed a self-selection bias since participants may have opted to take part in the study based on their interest in reading fiction or in playing video games, thus producing results that may differ to those that would be produced by people who are not interested in these activities (and that opted to not take part in the study). Similarly, the limited range of stimuli used in the study, only two subconditions per condition (i.e., two short stories of written fiction, two narrative video games, and two puzzle video games), restricts the generalisability of results to other pieces of fiction, since there is a possibility that results may have been specific to the stimuli chosen for this study.

Another limitation of Study 2 refers to the theory of mind measure it used. The Moral Judgement Test is a text-based task which differs from everyday life scenarios where people respond to multiple stimuli, not only to written information. Additionally, this test uses serious consequences as prompts (e.g., illness or death) which may not be representative of everyday-life scenarios which include a wider range of social situations and not necessarily so skewed towards negative consequences of others' behaviour. Hence, the ecological validity of this theory of mind measure must be taken in consideration when interpreting findings of the study. Furthermore, it is recommended that future research use theory of mind measures that are more ecologically valid in order to explore if results found in the current studies can be found in measures and conceptualizations of theory of mind that are more representative of real-world scenarios.

It is worth mentioning that the selection of the Moral Judgement Test was informed by results of Study 1 and the piloting of Study 2 (Appendix B). In detail, results of the piloting of Study 2 for the Moral Judgement Test (Young et al., 2010), showed distributions of responses resembling a normal curve in the submeasures of interest (i.e., accidental, and attempted harm scenarios) which suggest a balanced performance of participants. In contrast, participants' performance in the other measures of theory of mind tested in Study 1 and in piloting of Study 2 resulted in

notably skewed distributions towards the high values, indicating that they may have posed too low of a challenge for participants, suggesting that these measures may not be able to capture possible variations of theory of mind in a non-clinical sample of university students. Participants performing exceptionally well in these measures may be explained by these measures being adaptations from instruments intended to be used with children and adolescents (False Belief Test, by Converse et al., 2008) and in populations with impaired theory of mind such as with adults with Asperger Syndrome (Reading the Mind in the Eyes Test) and with acquired brain injuries (Yoni Test, by Shamay-Tsoory & Aharon-Peretz, 2007). Considering these results, it was estimated that the Moral Judgement Task would better capture possible variations in theory of mind, thus making it the best option among the tests being considered at the time.

One final limitation of Study 2 refers to the relatively small sample size of this study, which translates into underpowered analyses. Ultimately, this means that no definite conclusion can be drawn regarding results not supporting the hypotheses of this study, which could be due to this study not having enough participants to detect small effects sizes, or to a genuine lack of a true effect. Considering this limitation, it is recommended that future studies consider a combination of larger samples sizes, the use of a within-subjects design, and testing simpler models in order to reduce the total number of participants required.

From the limitations of Study 2, a series of recommendations were made for future research. Firstly, it was recommended that future studies include pre- and post-manipulation measurements of theory of mind, so possible changes within conditions can be addressed. Secondly, it was recommended to mask the use of fiction during recruitment of participants to minimize self-selection bias. Thirdly, it was recommended to broaden the selection of stimuli using the same criteria used for the present studies (high quality with social contents). Lastly, it was recommended to explore whether effects found in Studies 2 and 3 can be replicated with other measures of theory of mind that are more ecologically valid, which will aid in the generalisability of results to other measures and conceptualizations of theory of mind.

Study 3 answered the main limitation of Study 2 by implementing pre- and post-manipulation measurements of theory of mind, thus offering an insight into possible changes within each condition. Nonetheless, other limitations of Study 2 remain unanswered along with newly emerging limitations.

The main limitation of Study 3 relates to its design which did not include control conditions. The decision to opt for this design was taken in an effort to achieve a sample size that was possible to test within a limited timeframe (7 months) given the experience in data collection for the previous study which took 13 months. It is worth mentioning that in both studies data collection was delayed by the piloting of measures and laboratory setting (e.g., sitting arrangement, script with instructions to participants), and by constraints in the amount of credits the experimenters could offer to participants given the rules of the university where the studies took place. Additionally, data collection of Study 2 was affected by difficulties in gaining access to the equipment needed to run the video games condition (i.e., laptop with dedicated graphics card). Similarly, data collection of Study 3 was affected by difficulties in gaining access to the films of the virtual reality condition due to them not being commercially available at the time the study was intended to start, and to the need of having to space the experiment sessions so the equipment could cool down and be charged between sessions. Nevertheless, opting for this design in Study 3, meant that no definite explanation can be provided for results of Study 2 showing no differences in theory of mind when comparing puzzle video games (the control group), to literary fiction and narrative video games (experimental groups), which in turn, suggest a cautious approach is warranted in interpreting the results of Study 3.

In detail, results of Study 3 showing boosts in theory of mind for its three experimental conditions suggest that the results of Study 2 could be the product of enhanced performance in theory of mind for its experimental and control conditions (since no differences were found between them). Nevertheless, the control condition of Study 2 (puzzle video games) producing theory of mind enhancements would contravene the literature suggesting that theory of mind enhancements are specific for fiction that is of high quality (Black & Barnes, 2015b; Kidd & Castano, 2013; Mar et al., 2006). This contradiction between results of this thesis and the scientific literature suggest that unexpected elements of the puzzle video games (e.g., interactivity, cognitive engagement) may have made them behave differently to the control conditions used in the studies of written fiction (i.e., written pieces of popular fiction, or non-fiction), in regards to their (non-)effects on theory of mind.

Alternatively, it may be that extraneous variables such as stress or learning effects influenced the results of Study 3, suggesting fiction having an effect on theory

of mind when in fact there is not, which in turn would affect the interpretation of results of Study 2. More precisely, in Study 3, stress may have hindered participants' performance in the pre-manipulation measurement of theory of mind, later as participants grew more comfortable with the experiment setting, their performance became less influenced by stress, thus producing higher scores in the post-manipulation measurement of theory of mind. In a similar line, it may have been that participants performed better in the post-manipulation measurement due to them being exposed repeatedly to the measure of theory of mind (in the pre- and post-manipulation measurements), thus producing learning effects. Nevertheless, since Study 3 did not include control conditions, and Study 2 did not include pre-manipulation measurements of theory of mind, these explanations remain speculative, and thus, more research is needed.

To address the main limitation of Study 3, it is recommended that future studies incorporate active control conditions presented in the same media as the experimental conditions, and a passive no-intervention control group. This would make it possible to compare experimental and control conditions within media (e.g., literary fiction versus nonfiction, narrative video games versus puzzle video games), and experimental conditions between media (e.g., literary fiction versus narrative video games), thus addressing possible unforeseen factors that may be media specific (e.g., interactivity in video games). Additionally, the inclusion of a no-intervention control group, would make it possible to evaluate the effect of possible extraneous variables such as stress or learning effects, which may cause variations in theory of mind instead, or in addition, to being exposed to fiction. Lastly, it is recommended that future studies include pre- and post-manipulation measurements of theory of mind to address possible variations within experimental and control conditions.

Another limitation of Study 3 relates to its focus on short-term effects of fiction exposure on theory of mind, which limits the interpretation of results and possible practical applications derived from its findings. As it was previously mentioned in the *Implications* section of this chapter, it is necessary to explore if lifelong exposure to fiction presented through different media could produce long-term enhancements in theory of mind (and empathy), before exploring possible applications of fiction in training and therapy settings. In this regard, Kidd and Castano (2013) proposed the use of the Author Recognition Test, a performance measure of lifetime exposure to fiction,

but more research would be needed considering that this test focuses on written fiction and does not distinguish between fiction by quality (e.g., literary versus popular fiction). Considering this, further research would be needed to develop a refined version of the Author Recognition Test that focuses on high quality pieces of fiction of different media (e.g., written, video games, virtual reality). Alternatively, longitudinal research methods could help shed light in regards of the possible long-term effects of exposure to fiction. A longitudinal experimental study could record participants' variations in theory of mind as they consistently read fiction, play narrative video games or watch VR films during a certain period of time (e.g., weeks or months), while follow-up measurements could help determine how long effects last after exposure to fiction has ceased. Nonetheless, due to the long-time commitment these studies require, challenges in the implementation of these designs should be taken in consideration such as difficulties in the recruitment of participants, high desertion rates, and potential learning effects (i.e., the improved performance in a test due to repeated administrations of a measure, which may elicit false positive results).

A further limitation of Study 3 relates to the representativeness of the VR films that were used. VR is a relatively young media is that is still trying to find its place between the video game and film industries. Mainstream virtual reality headsets (i.e., Oculus Rift, HTC Vive and PlayStation VR) were launched in 2016, just a year before Study 3 started data collection. Considering this, it could be argued that the two VR films used for Study 3 may not be good representatives of the media since the virtual reality industry and its products (films and video games) may change significantly as this technology becomes more accessible and the industry matures in terms of content development.

Another reason why the VR films used in Study 3 may not be good representatives of the media, relates to the wide variety of "products" that can be found in this media in terms of quality, themes, levels of interactivity, and development techniques (e.g., 3D rendered, filmed, motion capture). As an example of this, the term *virtual reality experiences* was coined in the recent years as a way to encompass narrative films, documentaries, video games, and art installations, that are presented through virtual reality. In any case, this variety of virtual reality experiences makes it difficult to establish products that are characteristic to this media and so, results of Study 3 should be taken as limited to non-interactive virtual reality narrative films.

Considering this, further investigation is recommended on the effects that other virtual reality experiences may have on theory of mind, experiences that may vary in content, interactivity and development techniques.

Other limitations of Study 3 include limitations of Study 2 that weren't addressed, and thus remain unanswered. These limitations refer to generalisability issues due to: (1) sampling method, which may have entailed self-selection bias; (2), the limited range of stimuli used in the study, i.e., only two short stories of written fiction, two narrative video games, and two VR films, which raises the possibility that results are specific to the stimuli; (3) and the low ecological validity of the theory of mind measure used, the Moral Judgement Task, which uses written stimuli and focuses on negative consequences, thus limiting the generalizability to other conceptualizations and measures of theory of mind. Recommendations to address these limitations remain the same, namely: (1) masking the use of fiction during recruitment, (2) to broaden sampling criteria to explore generalisability of results to other populations, (3) broaden the selection of stimuli, (4) and use other measures of theory of mind that are more ecologically valid.

Regarding overall limitations of the studies, there is the limitation of the conceptual gap between theory of mind and empathy that was not fully addressed in all studies of this thesis. More precisely, empathy was not measured in Studies 2 and 3 due to time limitations (trying to keep experiment sessions under 60 minutes) and the possibility that results of a self-report measure of empathy may be affected by social desirability. In consequence, despite some conceptual overlaps between empathy and theory of mind, results of these studies focus on theory of mind, with possible extrapolations of results to empathy remaining speculative.

Despite theory of mind and empathy sometimes being used interchangeably, recent conceptualizations of empathy (Bird and Viding, 2014) propose a model in which theory of mind (the cognitive representation of the mental states of others) and emotional contagion (the act of matching the affective state of another after being exposed to it) are the two main components of empathy. Under this model, theory of mind would be a process subordinated to empathy thus should not be used interchangeably. The limitation then comes from studies of this thesis measuring empathy at different point of this thesis (only in Study 1) and by theory of mind being measured with different instruments (Studies 1, versus Studies 2 and 3). This means

that results and conclusions of this thesis are based mainly on the effects of fiction on theory of mind, while effects on empathy remain mostly speculative.

A way to address this limitation would be for future studies to explore the effects of fiction on empathy while using objective and ecologically valid measures. A specific proposal is that future studies explore the effects of fiction on empathy using a combination of methods and measures which would boost the validity by facilitating the comparison of results among different conceptualizations of empathy. Such design could include a combination of self-report measures (e.g., Toronto Empathy Questionnaire by Spreng et al., 2009), behavioural measures (e.g., Picture Vieweing Paradigm by Westbury & Neumann, 2008), and neuroscientific measures (e.g., MRI/fMRI, EEG, ERPs). Nevertheless, cost and time constraints associated with a multi-methods approach should be taken in consideration, as well as the complexities of such design.

Lastly, there is the general limitation that studies of this thesis used samples of university students, thus limiting the generalizability of results, and possible practical applications of its findings. More precisely, the grand majority of participants of the three studies were university students, who were selected since it was estimated that this population was the more likely to be exposed to reading fiction and playing video games as leisure activities (necessary for Study 1), as well as being more open to use virtual reality (in Study 3).

Nevertheless, focusing on university students translated into a relatively homogenous sample in terms of age, occupation and educational level, while other populations with impaired theory of mind and/or empathy were omitted. Such populations include patients with a diagnosis within the autistic spectrum, personality disorders, schizophrenia, or acquired brain injuries; as well as non-clinical groups of participants with different levels of theory of mind and empathy. Considering this, in order to explore if exposure to fiction can be used in theory of mind training programs, further investigation would be required to explore if people with impairments in this skill benefit from exposure to fiction as non-clinical populations do.

Conclusions

Study 1 of this thesis showed that exposure to fiction in the form of written fiction and video games, without distinctions of quality and content, was not associated with the ability to infer accurately others' cognitions and emotions, and only partially with being able to experience them oneself after inferring them.

Study 2 showed no differences in people's ability to infer others' experience when comparing participants that were exposed to high quality pieces of fiction that depicted social interactions through written fiction and video games (experimental groups) nor when comparing them with participants that played puzzle video games (control group).

Study 3 showed that high quality fiction depicting social interactions through written fiction, video games and VR films, boosts peoples' ability to infer others' experience, independently of the media fiction it is presented on. Complementary findings of Study 3 pointed at nuances in terms of the effects of fiction on people's theory of mind, which may depend on the participant's gender, and on the nature of the theory of mind elicitation (which may or may not include emotional stimulation).

Nevertheless, limitations of Studies 2 and 3 suggest a more cautious approach to the main results of this thesis. In Study 2, the control condition having an (unexpected) effect on theory mind performance could be explained by specific characteristic of video games (e.g., interactivity) which could make these control conditions behave differently to those used in previous studies (e.g., written pieces of nonfiction). In Study 3, the results may have been affected by extraneous variables such as stress or learning effects, instead or additionally to the effects of exposure to fiction.

Overall, the central conclusion of this thesis is that the ability to infer others' cognitions and emotions can be boosted for brief periods of time after being exposed to fiction in the form of literary fiction, narrative video games and VR films. These boosts occurred in response to high-quality fiction depicting social interactions, which suggests that high quality and social contents may be necessary preconditions for these effects to occur. Nevertheless, further research is needed to examine whether these effects are exclusive to fiction that is of high quality depicting social interactions, or they can be found in a wider range of fictional content and quality.

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Appendix A

Definitions of Written Fiction and Video Games Genres

Genres	Definition
Written fiction	
Domestic fiction	Containing realistic characters and scenarios or settings.
Romance	Containing plots that are largely focused on romantic relationships.
Science fiction / fantasy	Including futuristic, fantasy, or otherwise unrealistic elements.
Suspense / thriller	Containing plots that are intended to build mystery, anxiety, or suspense.
Non-fiction literature	Literature that is typically factual in nature (e.g., essays, biographies, history books).
Video games	
Action – Adventure	The player controls a character with a puzzle-solving and/or combat tasks, eg. Rise of the Tomb Raider, Batman: Arkham Knight, Metal Gear Solid V: The Phantom Pain.
Adventure	Players are assigned roles and the game is based on puzzle-solving, eg. Tales From the Borderland, The Evil Within, The Wolf Among Us.
Fighting	A video game in which the player controls an on-screen character and engages in close combat with an opponent, eg. Mortal Kombat X, Killer Instinct, Persona 4 Arena.
Massive Multiplayer Online Game	Massively Multiplayer Online gaming, where up to thousands of players from all over the world can join in the same game via the Internet and play each other, eg. World of Warcraft, Final Fantasy XIV, H1Z1.
Massive Online Battle Arena	Multiplayer Online Battle Arena, a game in which the player controls a single character in one of two teams with the objective to destroy the main structure of the opposite team, eg. League of Legends, Heroes of the Storm, Defence of the Ancients 2 (DotA 2).
Platform/Platformer	Revolves around players jumping from platform to platform, eg. Broforce, Shovel Knight, Ori and the Blind Forest.
Puzzle	Easy to play, usually available on handheld consoles or PC via the Internet, eg. Pokemon Shuffle, Scribblenauts Unmasked, The Unfinished Swan.
Role Playing Game	Role Playing Game involving turn-based combat, eg. Lightning Returns: Final Fantasy XIII, The Witcher 3: Wild Hunt, Fallout 4.
Racer	A driving game involving completing courses in a given time or against other competitors, eg. Forza Motorsport, Project CARS, Mario Kart 8.
Rhythm/Dance	Player moves in time with game/music, eg. Rocksmith 2014, Singstar, Theatrhythm Final Fantasy.
Shoot 'Em Up	Gameplay revolving around shooting objects and game characters, eg. Call of Duty: Black Ops III, Halo 5 Guardians, Helldivers.
Simulators	Simulations of real activities, eg. Cities: Skylines, Kerbal Space Program, The Sims.
Sports	Simulation of sport, eg. Rocket League, NBA 2K16, Pro Evolution Soccer 2016.
Strategy	Games that require careful and skilful thinking and planning in order to achieve victory, eg. StarCraft II: Legacy of the Void, Homeworld Remastered, XCOM: Enemy Unknown.

Appendix B

Study 2's Pilot Study

Aims and Objectives

This pilot study had two aims. First, it aimed to test two measures of theory of mind in terms of their distribution of responses. The two measures are the Yoni Test (Shamay-Tsoory & Aharon- Peretz, 2007), and the Moral Judgement Task (Young et al., 2010). The second aim was to test the equivalency of stimuli in terms of elicited mood, positive or negative message, complexity, and social interactions depicted in them. This stimuli include three short stories of literary fiction, three high quality narrative video games, and three puzzle video games.

Design

This pilot study followed a two-part experimental design in a laboratory setting. The first part consisted of an online questionnaire that collected the participants' sociodemographic information, time availability for the experiment (second part) and contact information. The second part was a laboratory experiment where participants were randomly assigned to one of nine conditions: read one of three short stories of literary fiction, play one of three high quality narrative video games, or play one of three puzzle video games. Participants also answered a questionnaire that assessed their performance on two theory of mind tasks and how they perceived different attributes of the stimuli they were assigned to.

Participants

Fourty-seven participants took part in this study (11 males, 36 females: $M_{age}=23.00$ years, $SD_{age}=6.6.45$). All participants were students at the University of Sheffield Participants were recruited through the distribution of flyers on university public spaces (opportunistic), through the mailing list of volunteer students (self-selection), and through the Department of Psychology volunteer scheme in exchange for credits (self-selection). Participants were selected by age (18 years old and above), occupation (university students), and English proficiency (English as first language, or at least ten years of proficiency when English is a second language).

Materials

Stimuli

Short stories of literary fiction were selected based on their high quality and on the depiction of social interactions between two or more characters. High quality of the short fiction stories was ensured by selecting stories winners of the O. Henry Awards, an award given to short stories of exceptional merits. The short stories were: 1) "Corrie" by Alice Munroe, 2) "The Vandercook" by Alice Mattinson, and 3) "The History of Happiness" by Brenda Peynado. These short stories were selected from the 2012 and 2015 winners of the PEN/O. Henry Award for short literary fiction.

High quality of the video games was ensured by selecting video games that had been nominated or awarded for their story by the game developer community or specialized media. The high quality narrative video games were: "Everybody's Gone to the Rapture" (The Chinese Room, 2015), nominated for best story in a game by the 12th British Academy Games Awards (2016); "Life is Strange" (Dontnod Entertainment, 2015), awarded for best story in a game by the 12th British Academy Games Awards (2016); and "That Dragon Cancer" (Numinous Games, 2016) awarded in the category of games for impact of The Game Awards 2016.

Puzzle video games were: Bejeweled 3 (PopCap Games, 2010), Peggle Deluxe (PopCap Games, 2007), and Candy Crush (King, 2012).

Measures

The Yoni Test (Shamay-Tsoory & Aharon-Peretz, 2007) is a measure of cognitive and affective theory of mind with first order (tracking one target's mental state) and second order items (tracking two targets' mental states). For each trial, participants are shown four images surrounding a central character (usually named Yoni) on which participants must identify, based on visual and linguistic cues, which of the four surrounding images the central character is thinking about or wants (for cognitive theory of mind) or which image the central character likes, loves, dislikes, or does not love (for affective theory of mind). Scores reflect proportion of correct responses.

The Moral Judgement Task (Young et al., 2010) assess the extent to which participants spontaneously think about intentions when judging an individual's behaviour. In this task participants must read a series of vignettes in which an actor engages in a behaviour with either a negative or neutral outcome, on the basis of either a negative or a neutral intention. The negative and neutral intentions are fully counterbalanced with the negative and neutral outcomes across 48 stimuli, resulting in 12 vignettes of four types: (i) no harm –neutral intention/neutral outcome, (ii) intentional harm – negative intention/negative outcome, (iii) accidental harm –neutral intention/negative out- come and (iv) attempted harm –negative intention/neutral outcome. After reading each vignette, participants judged the permissibility of the actor's behaviour on a scale from 1 (forbidden) to 5 (permissible). Given that the intention differs from the outcome in the accidental and attempted harm scenarios, judgments of moral permissibility reflect the extent to which participants take into account the actor's intention as opposed to the outcome.

Perceived Attributes of the stimulus were measured using four 10-point scale bipolar items that asked the participants to evaluate the message of the story/game (positive or negative), the complexity of the story/game (simple or complex), the quality of the social interactions in the story/game (poorly/in a good manner) and how important they were to the plot (unimportant/very important).

Mood elicited by the stimuli was assessed as proposed by Poerio et al. (2015), with three 10-point scale bipolar items that asked how sad-happy, bored-excited and anxious-calm participants felt (after being exposed to the stimuli). These items were chosen to measure the pleasure (valence) and arousal (activation) dimensions of core affect (Remington et al., 2000); specifically, pleasure (sad-happy), pleasant activation (bored-excited) and pleasant deactivation (anxious-calm).

Results

To address the first aim of the pilot study, descriptive analysis and Kolmogorov-Smirnov test of normality were conducted over the participants' responses to the two theory of mind measures, The Yoni Test and The Moral Judgement Task. Results of the tests of normality show that all four subscales of the Yoni Test significantly deviate from a normal distribution ($p < .001$). Conversely, tests of normality show that the main subscales of interest of the Moral Judgement Task follow a normal distribution ($p = .200$ for both the Accidental Harm Scenarios, and the Attempted Harm Scenarios). See Table 1 for descriptive analyses and normality tests of the theory of mind measures.

Table 1. Descriptives and normality tests.

| | | | Mean | S.D. | Skewness | Kurtosis | Kolmogorov-Smirnov | | |
							Statistic	df	Sig.
Yoni Test	Cognitive Theory of Mind	1st Order	4.574	1.098	-3.180	9.839	0.438	47	.000
		2nd Order	11.191	2.173	-1.849	3.850	0.203	47	.000
	Affective Theory of Mind	1st Order	5.532	0.975	-2.594	6.678	0.408	47	.000
		2nd Order	5.085	1.213	-2.079	6.006	0.243	47	.000
Moral Judgement Task[+]	Accidental Harm Scenarios		3.623	1.230	0.064	-0.599	0.060	47	.200[*]
	Attempted Harm Scenarios		2.866	1.040	0.367	-0.012	0.071	47	.200[*]

[+] Only Accidental Harm and Attempted Harm scenarios were included in the analyses since only these are used as measures of theory of mind.

The second aim of the pilot study was to test equivalency of stimuli in terms of elicited mood, positive or negative message, complexity, and social interactions depicted in them. To address this aim, a series of one-way ANOVA analyses were conducted comparing the subconditions within each condition (i.e., literary fiction, narrative games and puzzle games). Results would allow the identification of subconditions that may be too different to the other subconditions, while trying to equate each condition with the remaining subconditions. Results of these comparisons suggest the omission of "Corrie" in the literary fiction condition, and "That Dragon, Cancer" in the narrative games condition. See Table 2 for a summary of the comparisons of perceived attributes and elicited mood within each condition.

Table 2. Comparison of mean scores and standard deviations within each condition for perceived attributes and elicited mood.

	Message	Complexity	Depiction of social interactions	Quality of social interactions	Current mood: Anxious - Calm	Current mood: Bored - Excited	Current mood: Sad - Happy
Corrie	5.00 (2.34)	4.80 (2.59)	7.60 (1.82)	7.80 (1.79) [ab]	7.75 (1.89)	3.60 (2.30) [a]	5.00 (1.15)
The Vandercook	4.40 (1.52)	5.00 (2.55)	5.40 (2.30)	7.60 (0.89) [a]	6.00 (1.87)	6.00 (0.71) [ab]	5.80 (1.10)
The History of …	6.20 (2.95)	6.40 (0.89)	7.80 (0.84)	9.80 (0.45) [b]	8.00 (2.35)	6.60 (1.14) [b]	6.20 (1.92
Everybody's gone…	5.80 (1.30)	5.80 (2.39)	6.80 (3.27)	8.60 (2.07)	6.80 (3.11)	7.20 (1.48) [a]	7.40 (1.95) [a]
That Dragon…	5.17 (2.56)	3.17 (2.04)	6.67 (2.73)	6.33 (2.58)	6.67 (2.16)	4.33 (1.37) [b]	3.17 (1.17) [b]
Life is Strange	5.80 (1.64)	6.60 (2.30)	4.80 (3.63)	8.00 (1.22)	6.60 (2.79)	6.40 (1.82) [ab]	6.00 (2.35) [ab]
Bejeweled 3	6.83 (0.98)	1.67 (1.21)	2.67 (2.25)	1.83 (2.04)	6.83 (3.06)	5.00 (1.87)	6.80 (1.30)
Peggle Deluxe	7.00 (1.73)	2.40 (1.14)	2.80 (2.49)	1.20 (0.45)	9.80 (0.45)	6.40 (1.52)	8.00 (1.00)
Candy Crush	8.20 (1.64)	2.20 (1.30)	4.40 (2.70)	2.20 (2.17)	7.80 (1.30)	6.00 (2.24)	7.80 (1.92)

Different letters indicate significant differences in scores (within each condition).

Following on the abovementioned results and suggestions, a one-way ANOVA analysis was conducted comparing the three conditions of the study after omitting "Corrie" and "That Dragon, Cancer" from the analyses. Results show that the literary fiction and narrative games conditions did not differ significantly in terms of perceived attributes and elicited mood (see Table 3).

Table 3. Comparison of mean scores and standard deviations between each condition for perceived attributes and elicited mood (after omitting "Corrie" and "That Dragon, Cancer").

	Message	Complexity	Quality of social interactions	Importance of social interactions	Current mood: Anxious - Calm	Current mood: Bored - Excited	Current mood: Sad - Happy
Literary Fiction	5.30 (2.41)	5.70 (1.95) [a]	6.60 (2.07) [a]	8.70 (1.34) [a]	7.00 (2.26)	6.30 (0.95)	6.00 (1.49)
Narrative Games	5.80 (1.40)	6.20 (2.25) [a]	5.80 (3.43) [a]	8.30 (1.64) [a]	6.70 (2.79)	6.80 (1.62)	6.70 (2.16)
Puzzle Games	6.91 (1.30)	2.00 (1.18) [b]	2.73 (2.24) [b]	1.55 (1.51) [b]	8.18 (2.68)	5.70 (1.77)	7.40 (1.26)

Different letters indicate significant differences in scores (within each condition).

These results suggest that the remaining subconditions could be used as a way to expose participants to fiction, through short stories and video games, without them being outstandingly different in terms of their attributes and the mood elicited by them.

Conclusion

Based on the results of the test of normality, the use of the Moral Judgement Task is recommended for the measurement of theory of mind, over the use of the Yoni Test.

Based on the comparisons of stimuli within conditions in terms of perceived attributes and elicited mood, it is recommended that future studies use "The Vandercook", "The History of Happiness", "Life is Strange", and "Everybody's Gone to the Rapture", while omitting "Corrie" and "That Dragon, Cancer".

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Appendix C

Scenarios and item examples of the Moral Judgement Test[+].

Attribution		
	Accidental	**Intentional**
Neutral	**No harm** Jacob and his friend are rafting down the Colorado River. Jacob's friend is a novice. They stop by the bank to have a swim. Jacob's friend starts to swim downstream. The next segment of the river is very tame this year. It is very easy to swim through, and the scenery is particularly nice. Because Jacob has rafted down this part of the Colorado River before, he believes the next segment is very tame and gentle. He thinks his friend will be able to enjoy the scenery. Jacob silently watches as his friend swims downstream. He swims safely down the next segment of the river.	**Attempted harm** Jacob and his friend are rafting down the Colorado River. Jacob's friend is a novice. They stop by the bank to have a swim downstream. Jacob's friend starts to swim downstream. The next segment of the river is very tame this year. It is very easy to swim through, and the scenery is particularly nice. Because Jacob has rafted down this part of the Colorado River before, he believes that the next segment is very rough and dangerous. He thinks that the current will be too strong for his friend. Jacob silently watches as his friend swims downstream. He swims safely down the next segment of the river.
Negative	**Accidental harm** Jacob and his friend are rafting down the Colorado River. Jacob's friend is a novice. They stop by the bank to have a swim. Jacob's friend starts to swim downstream. The next segment of the river is very rough and fast this year. It is full of gigantic boulders that make it very dangerous to swim through. Because Jacob has rafted down this part of the Colorado River before, he believes the next segment is very tame and gentle. He thinks his friend will be able to enjoy the scenery. Jacob silently watches as his friend swims downstream. He gets thrown by the current and crashes into a gigantic boulder.	**Intentional harm** Jacob and his friend are rafting down the Colorado River. Jacob's friend is a novice. They stop by the bank to have a swim. Jacob's friend starts to swim downstream. The next segment of the river is very rough and fast this year. It is full of gigantic boulders that make it very dangerous to swim through. Because Jacob has rafted down this part of the Colorado River before, he believes that the next segment is very rough and dangerous. He thinks that the current will be too strong for his friend. Jacob silently watches as his friend swims downstream. He gets thrown by the current and crashes into a gigantic boulder.

(The left margin contains the vertical label **Outcome** spanning both Neutral and Negative rows.)

[+] From the Moral Judgement Task proposed by Young, Camprodon, Hauser, Pascual-Leone and Saxe (2010).

Appendix D

Pre-registration of Study 3 at AsPredicted.org

Exposure to fiction and Theory of Mind (#8429)

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Created: 02/14/2018 03:00 AM (PT)

Public: 02/27/2018 03:53 AM (PT)

1) Have any data been collected for this study already?

It's complicated. We have already collected some data but explain in Question 8 why readers may consider this a valid pre-registration nevertheless.

2) What's the main question being asked or hypothesis being tested in this study?

Does the exposure to fiction by reading short stories, playing video games or watching virtual reality films improve theory of mind? Participants will be randomly assigned to one of three experimental conditions: reading a short story of literary fiction, playing a narrative video game or watching virtual reality film. Participants will also complete pre- (T0) and post-intervention measures (T1) of theory of mind. We will test whether the exposure to fiction in the form of written short stories, narrative video games and virtual reality films increases theory of mind.

3) Describe the key dependent variable(s) specifying how they will be measured.

Theory of Mind will be measured with a Moral Judgment Test (MJT) as proposed by Young et al. (2010). This test evaluates to what extent individuals think spontaneously about intentions when judging an individual's behavior. The full scale comprises 48 scenarios with four different variations by combining two story elements: (i) either a negative or neutral outcome and (ii) either an intentional or accidental attribution to the outcome. The resulting variations are: intended harm (negative outcome with intentional attribution), accidental harm (negative outcome with accidental attribution), attempted harm (neutral outcome with intentional attribution), and no harm (neutral outcome with accidental attribution). Individuals are asked to make judgments for each scenario on a scale of 1 to 7 about how forbidden or permissible were the protagonists' actions.

The study used a subset of 24 scenarios that were randomly selected prior data collection, all participants answered the same 24 scenarios, 12 at T0 and the other 12 at T1, although variations of these scenarios were presented at random to each participant (1 variation per scenario).

The instrument provides four average scores, one for each scenario variation. Given that the intention differs from the outcome in the accidental and attempted harm scenarios, variations of judgment about how forbidden/permissible the protagonist's intentions in these scenarios are, reflect the extent to which participants take into account the protagonist's intention as opposed to the outcome. That is, participants considering the protagonist's intention in their judgments should evaluate the actions in the accidental harm scenarios as more permissible and the actions in attempted harm scenarios as less permissible. Previous researchers have shown that responses to these two scenario variations provide a sensible measure of theory of mind (Young et al., 2010; Moran et al., 2011).

4) How many and which conditions will participants be assigned to?

The study includes three conditions: short stories of literary fiction, narrative video games, and virtual reality films with two subconditions for each, that is: two short stories, two video games and two virtual reality films. Each participant will be randomly assigned to one subcondition.

5) Specify exactly which analyses you will conduct to examine the main question/hypothesis.

We will conduct two mixed ANOVA with pre- (T0) and post-intervention (T1) measures of Theory Mind as the within subjects factor. One mixed ANOVA will consider all 3 conditions as the between subjects factor (short stories of literary fiction, narrative video games, and virtual reality films) while the other will compare virtual reality films (VR condition) versus short stories and narratives games (non-VR conditions) as the between subjects factor.

6) Describe exactly how outliers will be defined and handled, and your precise rule(s) for excluding observations.

We will exclude participants in the short stories condition who do not engage in the experience of reading, that is that took too little or too much time to read the story they were assigned to by excluding outlier reading times. Similarly, responses will be excluded for participants with outlier responses in the Moral Judgment Test subscales. In both cases, we will follow the outlier labelling rule with a 2.2 multiplier (Hoaglin & Iglewicz, 1987).

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.

We aim to recruit 56 participants, 14 for the short stories of literary fiction condition, 14 for the narrative video games condition and 28 for the virtual reality films condition. This will allow two sets of comparisons: (1) between the three conditions and (2) between virtual reality films condition versus the short stories and video games conditions.

Sample size was calculated with the software g*power, with a significance level of 0.05, estimated effect size of 0.25 (intermediate), a power of 0.8, for 3 groups and 2 measurements.

8) Anything else you would like to pre-register? (e.g., secondary analyses, variables collected for exploratory purposes, unusual analyses planned?)

Data collection started in October 2017. At the time of submitting this application, data has been collected for 54 of 56 participants. We consider that this may be considered a valid pre-registration because despite having started data collection, no data analyses have been performed yet and because a first version of this study proposal was approved on August 16th, 2017 by the Ethics Committee of the Department of Psychology at The University of Sheffield which includes the study's design, key dependent variable (Theory of Mind) and other variables of interest (detailed below). This version of the study proposal included just two conditions (short stories and virtual reality films) but was modified prior data collection to include narrative video games with the sample size increased to accommodate that extra condition.

At T0, the study includes measures of age, gender, years of English fluency, ethnicity, and occupation for sociodemographic characterization. Additionally, age, fluency in English and history of epilepsy will used to ensure the sample meets inclusion criteria (see below).

At T1, the study includes measures of transportation into the narrative and experience-taking, both of which will be compared between conditions as secondary analyses. Also, participants will be asked to evaluate the perceived attributes of the stimuli through a series of bipolar items regarding the message (positive/negative), complexity (simple/complex), and social interactions depicted in the stimuli (quality of the interactions portrayed in the stimuli and relevance to the plot). Finally, a measure of the mood elicited by the stimuli will be assessed as proposed by Poerio et al. (2015), with three bipolar measures: sad-happy, bored-excited and anxious-calm.

The following variables will be used as control in case they significantly correlate with theory of mind: age, gender, fluency in English, perceived attributes of the stimuli, and mood elicited by the stimuli.

Inclusion criteria for the study are that participants: 1) must be at least 18 years old, 2) must be native speakers of English or, in cases where English is a second language, participants must have at least 10 years of proficiency in it and 3) should not have a history or diagnosis of epilepsy and/or blackouts.

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