Intentionality and Engagement:
The effects of video game engagement on mindreading performance

Giulio Barbero
Graduation Thesis, August 2019
Media Technology MSc program, Leiden University
Supervisors: Max J. van Duijn, Marcello Gómez Maureira

g.eu.barbero@gmail.com

***Abstract* — Recursive mindreading is the human ability to understand and interpret nested mental states and beliefs held by one or multiple agents (e.g.: "A believes that B wants that C thinks X"). While theory of mind represents a second level of intentionality, we can extend this chain to more complex relationships. One of the main issues in the study of recursive intentional states is the difficulty to test human performance using representational stimuli. Current methodology involves several types of questionnaires often based on story vignettes. In these cases the participants are passive observers or listeners, not actively being involved or in control of the actual social context they need to understand. Our research studies whether participants interactively engaged in the social experience reconstructed in a video game, perform better than those who passively watch a video presenting the same story. The results from 30 participants show that when engaged they performed better only on questions involving false beliefs.**

***Index Terms*— intentionality, theory of mind, video game, recursion, social intelligence, engagement.**

I. Introduction

Humans are good mindreaders. Our ability to form an understanding of what is going on in other people's minds, referred to as *intentional reasoning*, has been studied extensively. Most studies on the topic have focussed on second-level intentionality or Theory of Mind [1]. This is the mental ability to hold a belief about another person's belief, *to think that another person thinks X.* It is not strictly limited to the verb *to think*; creating a mental image can involve other *intentional attitudes* (e.g. *to believe* or *to want)* and even emotional ones (e.g. *to love* or *to fear*) [2]. It is arguably one of the essential elements of social intelligence that we develop at the relatively young age of 4-5 years old [3]. Empirical studies in the field is often carried out through false belief tasks, testing the participants' ability to recognise somebody's mental state as false. This test has been used in the past to study whether we share this ability with other great apes such as chimpanzees [4]. However, whether or not great apes show this ability is still debatable; more recent research argues that previous results could have been achieved without mindreading [5] while other testing methods succeeded to find again positive evidence [6]. Even though ToM might be present or have precursors in non-human animals, higher-order intentionality is a feature observed exclusively in humans. A lot is still unclear of how this skill comes about, both evolutionarily and in terms of its development and mechanisms [7]

If we embed more mental states, nesting them within our representation of somebody else's intentionality, we can reach higher levels. For example, we can *think that she thinks that he thinks X* therefore building a chain of recursive mindreading. The counting technique for intentional levels varies between different studies. For the sake of this research we decide to use the enumeration explained by Dennet [3] that considers a simple thought or belief as first level:

2nd level of intentionality: I *think* $_{(1)}$ that you *believe* $_{(2)}$ X

3rd level of intentionality: I *think* $_{(1)}$ that you *believe* $_{(2)}$ that I *think* $_{(3)}$ X

4th level of intentionality: I *think* $_{(1)}$ that you *believe* $_{(2)}$ that I *think* $_{(3)}$ that she *believes* $_{(4)}$ X

5th level of intentionality: I *think* $_{(1)}$ that you *believe* $_{(2)}$ that I *think* $_{(3)}$ that she *believes* $_{(4)}$ that he *fears* $_{(5)}$ X

6th level of intentionality: I *think* $_{(1)}$ that you *believe* $_{(2)}$ that I *think* $_{(3)}$ that she *believes* $_{(4)}$ that he *fears* $_{(5)}$ that she *knows* $_{(6)}$ X

Logically, we can recursively chain other intentional attitudes infinitely but in reality our cognitive abilities limit our mindreading to fifth-level (or sixth for some humans) mental representations [8]. Intentional reasoning is one of our fundamental cognitive abilities. It allows us to understand and manage complex interactions with others inferring their mental states [9]. This set of characteristics does not only influence our sociality but it relates to our ability to understand and create complex stories and narratives. Arguably, mindreading is a necessary component to many social constructs such as religion, mythology and symbolism [10].

Testing our mindreading abilities is a very complex task, especially when designing experiments for mental representation. Due to the strong theoretical connection between this ability and storytelling [10, 11] participants are often presented with a narrative and increasingly complex characters relationships. After proposing the story (or stories),

participants are tested on their understanding of the intentional states presented by each character. For example, Stiller and Dunbar [12] proposed as a stimulus the following story:

"Emma worked in a greengrocer's. She wanted to persuade her boss to give her an increase in wages. So she asked her friend Jenny, who was still at school, what she should say to the boss. "Tell him that the chemist near where you live wants you to work in his shop. [...]"

After the story they used a binary choice questionnaire to test participants. For the cited fragment a question could be:

(a) Jenny thought the boss would believe Emma's story
(b) Jenny knew the boss would not believe Emma's story

The participants were asked to select the option they considered correct. This experiment design is very similar to the original Imposing Memory Task (IMT) test used by Kinderman [8] with the same type of medium and a combination of mindreading and memory questions.

Throughout different experiments, several other types of strategies were used to communicate a story to participants. Narrative techniques for instance are studied in correlation to intentionality performance. The presence of certain strategies (such as redundancy, characterisation or focalisation) proved to be effective. Even outside experimental settings, these are essential to many complex stories that are widely understood by the public [11].

The previously cited example by Stiller and Dunbar used prose that was then read out to the participants. However, other forms of the stimulus have been explored during the years. For example, Anneke Haddad's research focusses on dialogues [13]. In her study, she played recordings of scripts with different voices for each character. The participants then answered questions expressed in the classic format "true or false". This method represents a more *implicit* stimulus*:* it is closer to our social ecology and represents the stories as social events to react to [14]. Its opposite, an *explicit* formulation, is well represented by the classic sentence structure "*I think that you think that she believes X"*. This version is more mechanical and not common in our natural language. This distinction can be used for both the stimuli and the testing methods. In this regard, Cathleen O'Grady [14] explored with a 2x2 experimental design the effect of different combinations of implicit-explicit stimuli and questionnaire on the overall performance of the participants. She used theater scripts acted out in movie clips as an implicit representation and the same stories read out in prose as an explicit one. The testing follows a similar path keeping the binary choice structure; for each story she created two alternative endings, one consistent with the story (and therefore correct) and the other incorrect and proposed them again as movie clips or prose. Her research concludes that an implicit-implicit design is the most effective to analyse the full potential of human recursive mindreading. The results are consistent with the idea that intentionality experiments designed closer to our ecology allow participants to perform better. Arguably, implicit methods decrease the magnitude of the reduction problems naturally faced when designing simulations of social interactions.

Notably, the above examples mainly focused on various narrative styles and strategies. In our study we argue that this is just one (even though fundamental) part of how we use mindreading in our social ecology. The ability to understand mental states is strongly linked to perspective taking: the extent by which the recipient is able to place herself in the mental position of others [9]. Previous methods partially disregarded this element and put the participants in a position of *passive observation*. Even though the narrative techniques used attempted to bridge this gap, they can be complemented giving the participants an active role and the possibility of being in control of the experience. In our study we develop more interactive settings using a video game and following the Theory of Engagement, originally a framework for interactions and motivations in learning activities [15]. This has some common strategies to the narrative ones used in the previous researches but it adds many other elements to increase the degree the participant can identify with characters presented by stories [16]. Our hypothesis is that when participants are engaged by the video game they perform better than in a less engaging experience providing the same information and questions.

II. Engagement and Mindreading

The nature of the study makes it necessary to reframe the current narrative approach to intentionality experiments with an engagement oriented perspective. To do so, we introduce one of the components of engagement theory: *narrative engagement*. This analyses narrative in the perspective of stimulating a *deictic shift* [16]. The deictic shift is a theorised phenomenon that allows the recipients of the story to mentally shift their perspective and context (including time and location) to the one represented by the narrative [17]**.** This is surely also one of the interests of traditional narrative strategies but it becomes the central focus of narrative engagement and, in part, of the whole engagement theory. It is a necessary element to not only deeply understand a plot but also to facilitate *emotional perspective taking*. This aids identification which stimulates the recipients to adopt the perspective of one or more characters in the story [18, 19]. In these conditions three results of narrative engagement tend to occur: a) the recipient adopts the cognitive perspective of the characters in the story with their interpretation of the events, b) she can understand and relive the characters' emotions (empathy) and c) she can also understand the emotions of primary characters even without sharing them (sympathy) [17]. These results can be achieved with almost any narrative medium but video games have particularly effective strategies to do so.

Designing a video game with the above perspective in mind, we can stimulate engagement (and with it, narrative engagement) in several ways. Dickey [20] identifies three areas of interest for the design of engaging experiences. The first we already mentioned is an engaging narrative that, in the case of a

video game, should be designed around the player (more precisely around the player's character). The second is the player's point of view; in this regard, Riddle [21] shows how a first-person perspective is more engaging than an isometric one. This allows the players to explore the environment as if they were in it, stimulates curiosity and increases identification. Moreover, first-person perspective benefits are shared with a third-person perspective (placing the point of view behind the character and making it visible) [22]. The third and last component that influences engagement is the presence of interactive choices. This is where the video game medium excels and it is the fundamental element of our research. Interactive choices elicit the feeling of being in control and of having agency in the social context the players are placed in. Interaction is also the essential enabler of the previous two engaging components to their full extent [23]. For example, assuming a mental perspective within the game environment is easier when we are able to control the perspective. The same can be said about the narrative. The possibility of interaction is one of the reasons that make video game experiences prone to be analysed by engagement theory. Finally, it is relevant to notice that having agency over the environment we are in is also one of the essential components of our social ecology that was missed by previous studies.

These characteristics make engagement a tool worth of exploration within the study of recursive mindreading. In our experimental stimulus we merge the classic strategies explained by Van Duijn et al. [11] with these elements of engagement theory. The control stimulus will also preserve the classic narrative components but will lack the characteristics that stimulate engagement.

III. Experiment Design

Experimental stimulus — We use the elements we mentioned of engagement theory to design our experimental stimulus. In this regard, the form of a video game provides great freedom and background knowledge. The interactivity of the medium naturally provides a sense of being in control but we need to create a simulated environment that implements a stronger sense of freedom of exploration. We want to stimulate participants to move and discover the surroundings while choosing with whom to interact and where to go. However, it is necessary to limit this freedom with a structure; due to the complexity of the narrative itself, we want the participants to have the *illusion* of freedom and agency while keeping the plot intact. We therefore design a *false* freedom with players being able to move their character but always meeting the different agents with their part of the story in the same order. They are also being limited by "natural" barriers (such as mountains and walls).

We also decided to use a third-person perspective with a visible player character. The reason to include the character in the view is to make the players aware of who represents them in the story. This can arguably increase the identification with the character and place the player "in" the digital environment or, at least, have the same effects of a first-person point of view [22].

All the characters in the story show a zoomorphic appearance and are assigned specific jobs: Bruno Bear the doctor, Charles Crocodile the lifeguard, Monica Monkey the businesswoman, Sarah Squirrel the journalist and Dona Duck the astronaut (their surnames also represent which animal are they shaped as and determines the initial letter of their first name). We also provide instructions and a clear description of the task the player is supposed to complete in the briefing dialogue. This includes indications about how to interact with the environment and an introduction to the story without revealing the actual scope of the experiment. It is divided in an instruction part appearing at the immediate start of the session and a dialogue from the briefing character ("Danny, the President") who introduces the story, the problem and asks for help (for the complete script see in the appendix "Introduction Dialogue").

The dialogues also include classic narrative strategies focussed to elicit empathy and to help to remember the characters and the information connected to them. As seen above, we used characterisation to provide each character with a clear role, a specific animal appearance (a deer in the case of Danny the President) and defined emotions. To facilitate memory and understanding we use this and other strategies present in previous studies and those described by Van Duijn et al. (2015) [11]. Another example, throughout the whole narrative, is the recurrent referring to other characters with their names unless there is no room for misunderstanding. This both helps with defining exactly "who thought what" in a relatively complex social situation and also works in terms of "redundancy", stimulating and refreshing the association of mental states to specific agents.

As a result, the design preserves the main narrative components of the previous studies while expanding the medium ability to trigger engagement with more specific elements described above. In order to stimulate interest and curiosity the whole story is set in the imaginary country of "Greenhills" that presents itself as a large hilly environment with mountain ranges separating several locations and different characters. The player will access these characters through doors placed at the starting location where also Danny, the President, can be found (see Figure 1). Regardless of which door is chose initially the player will always interact with the first character (Bruno Bear, the doctor) and this repeats for all the doors (five in total). With the progressing of the interactions the agents will talk to the player about their beliefs, demonstrate how previous agents beliefs are wrong in a chain of increasing complexity. This is the social environment the player is challenged to understand.

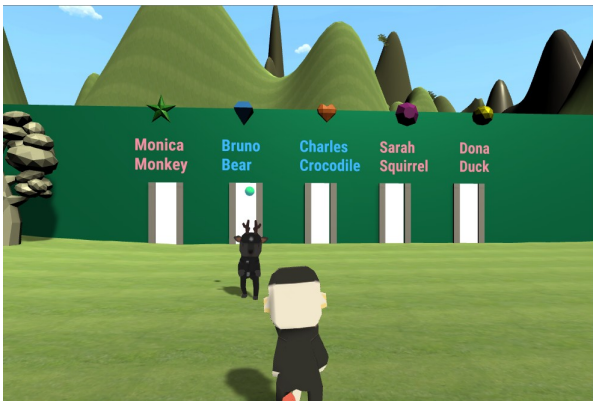

Figure 1: View of Danny the President and the doors

Control stimulus — As a control, we create similar but less engaging settings. Movie clips are a reasonable choice as a medium; it has been used in previous studies and it easily preserves the classic narrative elements of the video game. However, it also lacks of interaction, feeling of control and agency which makes it less engaging. In order to create a comparable stimulus to the video game we use an exact recording of a typical play session and we propose that as a medium to the participants. There are also some types of freedom we should preserve. For example, in the video game, players are able to return to talk with the met characters. We need to mimic this to make the stimuli truly comparable so we explicitly allow watchers to replay parts of the video in case they need to refresh the memory. Both groups will take part in a questionnaire and we will compare the result to check the validity of the hypothesis.

Testing method — We use implicit stimuli for both the experimental and the control groups. According to the study performed by O'Grady et al. [14] the preferable choice would be to use an implicit testing method to achieve the best performance. However, there are important elements to take into consideration; in order to increase the diversity and numbers of the participants we decided to make the experiment available online. This setting has less control over the participants and it makes it impossible to answer possible questions or doubts about the procedures. In order to compensate this downside we need to design clear instructions and a clear formulation. According to the different examples above, our choice is to use a true or false questionnaire with explicit formulation for the statements. O'Grady et al. [14] showed that such a combination of implicit stimulus and explicit testing presents many weaknesses. However, we argue it grants more control over the correctness of the proposed mental states. Additionally, this study focuses on finding relevant differences between the scores of the two groups which makes the issues of the explicit formulation less influential.

We decided to add an extra measure for each question: the confidence in the answer provided [14]. The reason to add this is to take into account possible difficulties with the explicit formulation and with remembering part of the story. The level of confidence can be used to keep track of both the understanding of the statement and the actual memory of the participants. It also provides a measure for "lucky guesses" which are a possible effect in a true or false questionnaire form.

The relative simplicity of the questionnaire also suits the purpose of the study. The results are provided through a very typical test, are easier to compare to other studies and they can confidently be used to confront the experimental and control groups.

In the questionnaire we decide to use three true or false questions per level of intentionality, the orders of mental representation taken into consideration range from the 2nd to the 6th (for the complete list of questions see Appendix). Another important decision relates to what value to give for propositional (for example "to believe" or "to think") and for emotional ("to love", "to like") intentional verbs. In this case the main choice is whether to consider them equally marking one representational level or with different values [2]. However, there would not be enough ground to define specific separate values for both of them and excluding one category would further detach the dialogues and the statements from natural language. We decided to consider them both equally important markers of mental representations.

Data analysis — The 2 variables we use for our analysis are the error rate in the true/false questions and the confidence level connected to each of them. We use a t-test to check for correlation between the error rate of the experimental group and of the control. Then we repeat the operation partially, testing the error rate relative to only true questions and then only false ones. We also confront the results of the confidence level between the two groups. Due to the increasing complexity of the questions, for all these operations the scores are confronted with their exact correspondent in the other group.

IV. Experiment and Results

We tested a sample of 30 participants from 14 to 56 years old (median age = 25.5). The demographic data collected before the questionnaire shows that they had different types of education from high school diploma to bachelor or master degree. They were instructed only with the title of the experiment post "Understanding social relationships in a video (game)". The post is mainly spread through the social network Reddit in the Subreddit r/SampleSize. The research involves people from several countries with at least 2 participants for each continent and a slight bias towards Europe and South America. The value of diversity consists in reducing the influence possible cultural differences reflected in the performance (mindreading is hypothesised to be affected by cultural background [24]).

15 participants watched the video while the other 15 played the video game before taking the same questionnaire. The error rate is for both consistent with typical intentionality performance, raising more steeply at the 5th and 6th level (see figure 2). The results do not show any statistical correlation between the total performance of both groups ($p > 0.1$). However, they show a weak correlation between the groups if only false statements are considered ($p = 0.1$) with the video game group performing significantly better. Within each group, the performance in false question improved only in the video game group ($p = 0.0135$). The same effect is not observed in the control group ($p = 0.5083$).

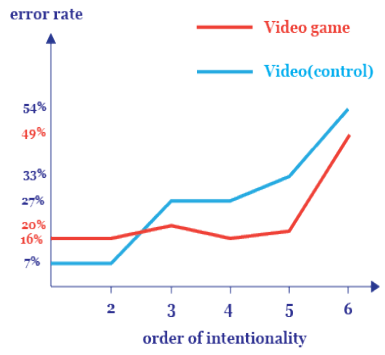

Figure 2: Error rate depending on order of intentionality

Regarding the confidence level we cannot observe correlations.

V. Discussion and Conclusions

The statistical analysis suggests that the expected effect on performance only occurs when the participants are analysing false statements. It is fundamental to point out how the statements can be interpreted as false beliefs. We have ground to suggest that our use of mindreading is biased towards spotting false beliefs [7]. It is necessary to explore the matter further with experimental settings focussed on testing this hypothesis. We need to keep in consideration that the effect only occurred weakly in the engaged experimental group which highlights a connection between engagement level and *false belief bias*. Such difference in performance has been observed also in other settings. For example, Bio et al. [25] studied how we project our spatial bias in a variation of the false-belief task using cartoons as stimulus. Their results showed that, when prompted to take the perspective of one of the characters, participants tended to retain their own spatial bias only in case the character held a false belief. Even though this study is not directly related to the topic of our research it also shows that there can be differences in the way we process false or true beliefs.

It is important to wonder what conditions created this false belief bias. Applying a logical interpretation (perhaps too logical) we can explain it analysing the benefits that can arise from spotting a false belief. Recognising someone's belief as incorrect allows us to have a greater advantage on that person than spotting a true belief which can be beneficial from an evolutionary perspective in a context of competition for resources or social statu. More basically we would *know something that the other person does not know.* However, we should also take into consideration that the effect was observed only with an engaged group. This would suggest that there are elements in an engaging experience that generate the bias. Probably the stronger of these elements is *sympathy.* Sympathy is, with empathy, strongly stimulated and elicited by engagement. It is essential part of being able to take a character's perspective. We defined it earlier as the third objective of narrative engagement: being able to understand the emotions of primary characters even without sharing them. Spotting a false belief in a character makes us feel sympathy for her, we realise that her emotions derive from something that is wrong [26]. In our story this could have happened in the case of Bruno Bear, unaware of being cheated on, or Monica Monkey, being worried because of her own false belief. Sympathy occurs more often for characters that hold false mental representations and can be the element that justifies the better performance in these cases.

Interpretations of the false belief bias such as these are very relevant because they relate to an innate characteristic of our mindreading abilities. These are the characteristics that can shed light on the debate about the origin of our mindreading abilities. Currently it is unclear whether we originally developed these skills as a competitive or cooperative tool. The competitive view (that refers to mindreading also as *Machiavellian Intelligence*) points out how we can use these skills to deceive others. Studies in animals, primates in particular, support this hypothesis, showing how they can demonstrate Theory of Mind abilities in competitive contexts that they seem to lack in cooperative ones [27]. On the other hand other studies support the opposite view, showing how Theory of Mind in humans is fundamental to cooperation [28]. In this debate our two interpretations position themselves quite oppositely. The first one, following a strictly logical reasoning, describes mindreading as biased towards achieving an advantage on others. This would be in line with the Machiavellian Intelligence explanation and support a competitive origin of intentional reasoning. The second interpretation identifies in sympathy an element that improves the performance in intentional tasks. This would go to support a cooperative origin in which our abilities are stimulated by reciprocal understanding and prosocial emotions.

The results also show that video games are a valid tool to study recursive intentionality. Thanks to this medium we observed effects strictly related to engagement that would have not necessarily appeared with other implicit representations. It contributes to the idea that we need to create more ecologically valid techniques, not only with regard to narrative or presentation strategies but also taking into consideration the positioning of the participants within the social context we are representing.

VI. Further Studies

The results are promising and worth of further investigation. A finding that needs more exploration is the false belief bias, in particular when does it occur and in which conditions. This requires an experiment design focussed on the topic which will need to include engagement techniques to test how do they relate to the bias. Regarding engagement, in this study we assumed it as natural part of the experimental stimulus. However, to gather more reliable data we suggest to use an engagement questionnaire to correlate with the performance. In this way the variations in the results can be related to the extent the participants were engaged and they can be more confidently compared between different stimuli. Another relevant datum that can be gathered is the amount of times different characters have been listened to. This can be then related to both the results and the confidence level and constitutes another comparison point between experimental group and control.

To increase the ecological validity and engagement level we recommend further studies to incorporate stimulus and testing. This another great advantage of video games since they allow interaction during the presentation of the story. For example, participants can be granted more agency over the social interactions, having to pick replies and actions that conform with their understanding of the characters' mental states. This would incorporate the questionnaire in the dialogues of the game. It would also make the game more challenging and therefore more engaging. Additionally, it would require to react accordingly to the information gathered,

similarly to how we use mindreading in everyday life. Finally, another great advantage of this system is to easily adapt to implicit testing that, as O'Grady [14] found in her research, is the preferable choice when using an implicit stimulus.

REFERENCES

[1] Apperly, I. A., Warren, F., Andrews, B. J., Grant, J., & Todd, S. (2011). Developmental Continuity in Theory of Mind: Speed and Accuracy of Belief-Desire Reasoning in Children and Adults. Child Development, 82(5), 1691–1703. doi: 10.1111/j.1467-8624.2011.01635.x

[2] Mitchell, J. (2019). Emotional Intentionality and the Attitude-content Distinction. Pacific Philosophical Quarterly. doi:10.1111/papq.12270.

[3] Baillargeon, R., Scott, R. M., & He, Z. (2010). False-belief understanding in infants. Trends in Cognitive Sciences,14(3), 110-118. doi:10.1016/j.tics.2009.12.006

[4] Premack, D., & Woodruff, G. (1978). Does the chimpanzee have a theory of mind? Behavioral and Brain Sciences, 1(4), 515-526. doi:10.1017/S0140525X00076512

[5] Call, J., & Tomasello, M. (2008). Does the chimpanzee have a theory of mind? 30 years later. Trends in Cognitive Sciences,12(5), 187-192. doi:10.1016/j.tics.2008.02.010

[6] Kano, F., Krupenye, C., Hirata, S., & Call, J. (2017). Eye tracking uncovered great apes ability to anticipate that other individuals will act according to false beliefs. Communicative & Integrative Biology,10(2). Doi:10.1080/19420889.2017.1299836

[7] Duijn, M. J. van. (2016). The lazy mindreader: a humanities perspective on mindreading and multiple-order intentionality. Netherlands: Koninklijke Wöhrman.

[8] Kinderman, P., Dunbar, R., & Bentall, R. P. (1998). Theory-of-mind deficits and causal attributions. British Journal of Psychology,89(2), 191-204. doi:10.1111/j.2044-8295.1998.tb02680.

[9] Conway, J. R., & Bird, G. (2018). Conceptualizing degrees of theory of mind. Proceedings of the National Academy of Sciences,115(7), 1408-1410. doi:10.1073/pnas.1722396115

[10] Gamble, C., Gowlett, J., & Dunbar, R. I. (2018). Thinking big: How the evolution of social life shaped the human mind. London: Thames & Hudson.

[11] Duijn, M. J., Sluiter, I., & Verhagen, A. (2015). When narrative takes over: The representation of embedded mindstates in Shakespeare's Othello. Language and Literature,24(2), 148-166. doi:10.1177/0963947015572274.

[12] Stiller, J., & Dunbar, R. (2007). Perspective-taking and memory capacity predict social network size. Social Networks,29(1), 93-104. doi:10.1016/j.socnet.2006.04.001

[13] Haddad, H. *Unpublished manuscript.*

[14] O'Grady, C., Kliesch, C., Smith, K., & Scott-Phillips, T. C. (2015). The ease and extent of recursive mindreading, across implicit and explicit tasks. Evolution and Human

[15] Kearsley, G., & Shneiderman, B. (1998). Engagement Theory: A Framework for Technology-Based Teaching and Learning. Educational Technology, 38(5), 20-23.

[16] Busselle, R. & Bilandzic, H. (2009) Measuring Narrative Engagement. Media Psychology, 12:4, 321-347, DOI: 10.1080/15213260903287259

[17] Segal, E. M. (1995). Narrative comprehension and the role of Deictic Shift Theory. J. F. Duchan, G. A. Bruder, & L. E. Hewitt (Eds.), Deixis in narrative. A cognitive science perspective (pp. 3–17). Hillsdale, NJ: Erlbaum.

[18] Cohen, J. (2001). Defining identification: A theoretical look at the identification of audiences with media characters. Mass Communication & Society, 4, 245–264.

[19] Zillmann, D. (1994). Mechanisms of emotional involvement with drama. Poetics, 23, 33–51.

[20] Dickey, M. D. (2005). Engaging by design: How engagement strategies in popular computer and video games can inform instructional design. Educational Technology Research and Development,53(2), 67-83. doi:10.1007/bf02504866

[21] Riddle, J. (2002). Cameras and Point-of-view in the gamespace. SIGGRAPH2002 Proceedings, ACM, 155.

[22] Black, D. (2017). Why Can I See My Avatar? Embodied Visual Engagement in the Third-Person Video Game. Games and Culture,12(2), 179-199. doi:10.1177/1555412015589175

[23] Whitton, N. (2010). Game Engagement Theory and Adult Learning. Simulation & Gaming,42(5), 596-609. doi:10.1177/1046878110378587.

[24] Heyes, C. M., & Frith, C. D. (2014). The cultural evolution of mind reading. Science,344(6190), 1243091-1243091. doi:10.1126/science.1243091.

[25] Bio, B. J., Webb, T. W., & Graziano, M. S. (2018). Projecting one's own spatial bias onto others during a theory-of-mind task. Proceedings of the National Academy of Sciences,115(7). doi:10.1073/pnas.1718493115

[26] Oatley, K. (1999). Meetings of minds: Dialogue, sympathy, and identification, in reading fiction. Poetics,26(5-6), 439-454. doi:10.1016/s0304-422x(99)00011-x

[27] Hare, B., & Tomasello, M. (2004). Chimpanzees are more skilful in competitive than in cooperative cognitive tasks. Animal Behaviour,68(3), 571-581. doi:10.1016/j.anbehav.2003.11.011.

[28] Sylwester, K., Lyons, M., Buchanan, C., Nettle, D., & Roberts, G. (2012). The role of Theory of Mind in assessing cooperative intentions. Personality and Individual Differences,52(2), 113-117. doi:10.1016/j.paid.2011.09.005