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Virtual Attachment: How Attachment Styles Transfer into Virtuality

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Declaration of scientific integrity

The author hereby declares that he has read and fully adhered the Code for Good Practice in Research of the University of Basel.

Abstract

The interactivity of new media makes it possible to establish new kinds of relationships with fictional characters. It enables dialogues between the recipient and the virtual figure as well as interventions in their virtual world. Accordingly, these relationships are no longer one-sided. This study raises the question whether these virtual characters can be used to treat insecure attachment styles. This topic, as well as the general interaction of attachment styles and virtual characters, has been neglected in research until now. To address this research gap, we decided to investigate whether mental relationship models are transferred into virtuality and on which factors this transfer depends. For this purpose, we conducted an online study with 66 subjects. The attachment styles were collected in relation to real persons as well as virtual characters. To be able to query virtual attachment styles, the participants played a video game. Additionally, player-avatar interaction, presence, enjoyment and appreciation were surveyed. The analysis of the descriptive data shows that a transfer occurs in just over half of the cases. Regarding the investigated variables, a significant influence could only be found for presence. Since this influence is limited to two of the eight attachment style dimensions and varies between two subcategories of presence, no pattern can be derived. In summary, this study shows that a transfer of attachment styles from reality to virtuality can and does happen. However, to answer the question whether virtual figures are therefore suitable for therapeutic purposes, further research on determining factors is needed.

Keywords

Attachment Theory • Player-avatar interaction • Presence • Enjoyment • Appreciation • Parasocial interaction

1 Introduction

With the increasing realism of media, its impact on the psyche draws growing attention (Iten, Steine-mann, & Opwis, 2018; Lakhmani & Bowers, 2011; Petralito, Brühlmann, Iten, Mekler, & Opwis, 2017; Tinwell, Grimshaw, Nabi, & Williams, 2011). Questions arise how new media triggers emotions, how it binds us to it and how it affects us. In this respect, this study investigates how people attach themselves to virtual characters and whether or to what extent this attachment differs in relation to attachments in real life. In this study, the term *virtual characer* describes an animated, fictional character that is capable of reacting to external input, that is, real people. A prototypical example are characters in video games. However, these qualities can also occur in simulations, for example, which is why we use a more com-prehensive term.

We know that relationships to fictitious characters, further referred to as parasocial relationships, can be meaningful and serious (e.g. Bopp, Mekler, & Opwis, 2016; Bopp, Müller, Aeschbach, Opwis, & Mekler 2019; Bowman, Oliver, Rogers, Sherrick, Woolley, & Chung, 2012; Coulson, Barnett, Ferguson, & Gould, 2012; Rogers, Woolley, Sherrick, Bowman, & Oliver, 2016). In contrast to other media such as books or films, video game characters do not only offer the possibility of a unidirectional binding. The characters can be programmed to react realistically and, if necessary, positively to players and their actions. Further, digital games enable a special kind of interactivity by providing the player with an avatar, giving them the opportunity to transport their own values and ideas into virtual worlds (Banks & Bowman, 2013, 2016b; Coulson, Oskis, & Gould, 2017). However, attachment to virtual characters can vary, just as it does in real life (Bopp et al., 2019; Coulson et al., 2017; Harth, 2017).

This phenomenon is called attachment style and describes a mental representation or a working model that a person constructs based on relationships to attachment figures (Bowlby, 1988, 1999; Hobson, 2002). Roughly, a distinction can be made between a secure and an insecure attachment style. While the secure attachment style is ideal, an insecure attachment style has potential drawbacks such as a lack of confidence in relationships or difficulties in reading and interpreting emotions in faces (Fralely, Niedenthal, Marks, Brumbau, & Vicary, 2006; Cook, 2000; Kobak & Hazan, 1991). However, these work-ing models are not rigid but are constantly updated with new experience (Bowlby, 1999). Therapies rely on conversations, consistent attention or even aids such as toys and animals. However, certain thera-pies are usually aimed at an older respectively a younger target group. It would be valuable to find pos-sibilities that could be applied to a broader target group. These bridges could possibly be built by virtual characters, since, unlike other methods (e.g. toys), they are not firmly aimed at a younger or older target group but can be programmed accordingly. Another positive aspect of virtual worlds is that the conse-quences of an action are not as profound as they might be in real life. This offers the potential that es-pecially at a stage where an attachment style is still malleable, virtual characters could serve as tools for the revision of internal working models. People could use these tools to explore interactions in vir-tual space, gain positive experiences and work towards a more secure attachment style. Given these arguments and the success of toys, it is even more astonishing that therapeutic approaches with virtual

characters have, to our knowledge, so far received scarcely any attention in research. Due to the lack of research in this specific area, it is unclear how the construct attachment style is reflected in virtual worlds (Coulson et al., 2017).

In order to tackle this lack in research, this study aimed to find out how attachment styles displayed in the real world are reflected in a virtual one. This serves as a first step to find out if virtual characters have the potential to be a tool for therapy. Current research suggests that we can expect a more direct transfer of the attachment style when the players see the avatar as a reflection of themselves (Coulson et al., 2017). To this end, we analyzed and compared the attachment styles of 66 individuals in relation to real attachment figures (e.g. father) as well as in relation to characters in the game *Night in the Woods* (Infinite Fall, 2017). Due to their potential influence, we also assessed the individual manifestations of player-avatar interaction (Banks & Bowman, 2016a; Coulson et al., 2017) and the constructs presence (Jin & Park, 2009), enjoyment (Krakowiak & Oliver, 2012) and appreciation (Rogers et al., 2016). The data were collected via online surveys at two points in time. Between these two points the subjects were exposed to the stimulus. The analysis of the descriptive data shows that just over half of the cases show the same attachment style in reality as in virtuality. No influence on the transfer of attachment styles was found for the variables player-avatar interaction, enjoyment and appreciation. Presence had small influence on certain attachment style dimensions. However, no patterns are observed, and the influence must therefore be neglected. No group differences could be found by performing t-tests. Nevertheless, the results clearly show that a transfer can occur and that this happens relatively often. The study thus lays a foundation for further research in this direction. Since the evidence that a transfer can take place has been provided, future studies should focus on which variables have a determining influence on whether it occurs.

2 Related work

2.1 Attachment style

Attachment style describes a mental representation respectively a working model that a person constructs based on relationships to attachment figures. This working model is then used as a heuristic guide for future relationships (Bowlby, 1988, 1999; Hobson, 2002). An attachment figure can be a mother, father, partner or friend. Usually, the parents are the first attachment figures who shape the attachment style and thus have far-reaching influence on future relationships. As attachment figures they are ideally a safe haven that allows the child to explore with the knowledge that security is always available (Bowlby, 1988, 1999; Coulson et al., 2017; Hobson, 2002). While this first relationship strongly shapes the attachment, it is important to know that attachment styles are still malleable. Thus, subsequent relationships offer the potential to rework internal working models and to ideally arrive at secure attachment (Bowlby, 1999; Fraley, Heffernan, Vicary, & Brumbau, 2011; Wallin, 2007). It is also important to consider that

while there is a global attachment style, there are also relationship-specific styles (Cook, 2000; Fraley et al., 2011). Since this study considers working models of specific relationships, the plural of attachment style is often used.

Attachment styles consist of an anxiety and an avoidance dimension. Low values in both dimensions mean that the person can be assigned to the category secure which equals the ideal state. Securely attached individuals are comfortable with both intimacy and separation. This is evident from children to adolescents to adults (Ainsworth, Blehar, Water, & Wall, 1978; Bifulco, Moran, Ball, & Bernazzani, 2002; Bifulco, Moran, Jacobs, & Bunn, 2009; Fraley, Roisman, Booth-LaForce, Owen, & Holland, 2013; Oskis, Clow, Hucklebridge, Bifulco, Jacobs, & Loveday, 2013). For example, securely attached children allow and enjoy proximity to the caregiver but are also comfortable to explore their surroundings on their own and are not distressed with this physical distance to the caregiver (Ainsworth et al., 1978). The remaining characteristics are to be assigned to the category insecure. As seen in Figure 1 Bartholomew and Horowitz (1991) divide this category into three subcategories: preoccupied, dismissing and fearful: A high value in the anxiety dimension coupled with a low value in the avoidance dimension speaks for the attachment style preoccupied. Preoccupied people see problems, that do not exist. Distance is interpreted as withdrawal of love and the fear of being abandoned becomes acute. Such people are perceived as clingy and demanding. In contrast, people with a high degree of avoidance and a low one in anxiety are categorized as dismissing and are perceived as cold and distant. They fail to perceive signals that are present and assume that everything is fine in a relationship, even if clearly opposite signals are sent (Ainsworth et al., 1978; Brennan, Clark, & Shaver, 1998). A high expression on both dimensions (anxiety and avoidance) is described as fearful. At this severity, individuals exhibit inconsistent behaviors. In the laboratory study “the Strange Situation” it can be observed how children who were separated from their attachment figure for a certain period, first run towards their attachment figure only to suddenly freeze and run away from them. The child seems to be undecided whether the attachment figure should be perceived as a safe haven or a threat (Ainsworth et al., 1978; Carlson, 1998; Mary & Solomon, 1990).

Given that attachment styles are malleable, a child who has had bad experiences at an early age is not necessarily doomed to fail future relationships. Improvement happens, for example, through a functional partnership or consistent attention in a clinical setting (Anderson & Gedo, 2013; Cook, 2000). However, for traumatized children, this can be too little. Especially for children who were victims of abuse there is often a strong distrust towards adults (Parish-Plass, 2008). Aids such as dolls (Anderson & Gedo, 2013; Sadeh, Hen-Gal, & Tikotzky, 2008) or even animals (Parish-Plass, 2008) can be used to build bridges. For example the Huggy-Puppy doll, a dog-like doll that was given to children with the request to take good care of it and its feelings and needs (Sadeh et al., 2008). Virtual worlds could make direct contact with a real adult person at least partially obsolete. If programmed appropriately, feedback could be provided by virtual entities and progress or behavior could be evaluated in the form of data. This would not be attractive only to victims of abuse. Digitalization could also make sense with other reasons for not using therapeutic services, such as physical distance (Brief, Rubin, Keane, Enggasser, Roy, Helmuth,

Hermos, Lachowicz, Rybin, & Rosenbloom, 2013).

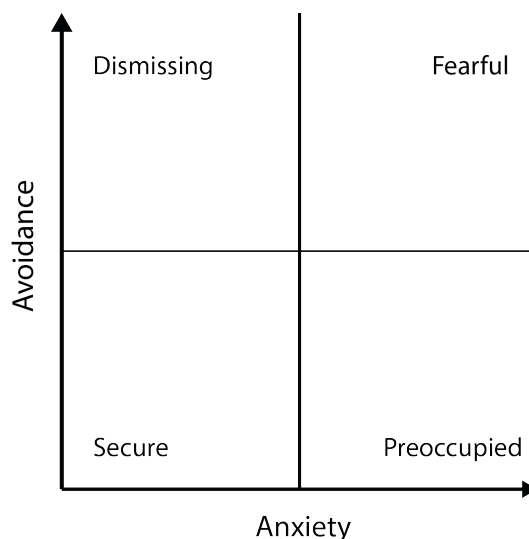


Figure 1: Four-category model (adapted from Bartholomew and Horowitz, 1991).

2.2 Parasocial relationships

One potential aid that, to our knowledge, has not yet been researched for attachment style therapy, are virtual characters. This kind of character we find usually, but not exclusively, in video games and they are no longer just an abstract collection of pixels. They can have complex behavioral options, are often voice recorded by real people and sometimes even visually modeled after real people. But also pixelated 2D characters without voice recording can feature complex background stories, which gives them depth, triggers empathy and leads to a bond with the fictional character which is called parasocial relationship (Bopp et al., 2016, 2019; Horton & Wohl, 1956; Lewis, Weber, & Bowman, 2008; Rubin, Perse, & Powell, 1985). Whether virtual characters are perceived as equal social agents depends on the plausibility of their behavior, how or whether they react to external inputs and interactivity in general (Harth, 2017; Lombard & Ditton, 2006). Accordingly, it is not surprising that meaningful and empathic bonds with such virtual characters, are possible (Bopp et al., 2016; Harth, 2017; Lewis et al., 2008) and we assume that authentic virtual characters are more likely to lead to a transfer of attachment styles.

2.3 Player-avatar interaction

How someone interacts with virtual characters is an individual matter. A person can perceive them as code-limited and more mathematical objects, or they actually attribute temporary "personhood" to them (Harth, 2017). They can be roughly subdivided into the characters whose role the controlling person is taking over (the avatar), characters that are controlled by other people (on the same hardware or via the Internet) and characters that are controlled by the system itself (Meadows, 2008; Rogers, Aufheimer, Weber, & Nacke, 2018). Coulson et al. (2017) see interaction between the player and the avatar as an

important factor in how virtual characters are perceived and treated. The player-avatar interaction can be summarized as the interaction between a real physical person and a digital avatar in a digital world (Banks & Bowman, 2013). Castronova (2007) explains that we can become the characters we are playing and make virtual worlds our home. Furthermore, actions in this virtual world can have feedback loops into the real world and influence us, as the real world does (Coulson et al., 2017). Lewis et al. (2008) further claim that there is a psychological merging of the player's and the avatar's minds, especially if the player engages in role-playing games (RPG), since these games often allow a high level of customization what in turn leads to a higher level of identification with the avatar (Birk, Atkins, Bowey, & Mandryk, 2016) - identification is referring to the sensation of assuming the avatar's identity (Cohen, 2001). However, Coulson et al. (2017) argue, that more recent developments emphasize the multifactoriality of the player-avatar interaction and that therefore Banks and Bowman's (2016a) work captures the relationship between player and avatar much more sensible than the construct identification. With respect to the player-avatar interaction styles, defined by Banks (2015): "avatar as object", "avatar as me", "avatar as symbiote", and "avatar as other", Coulson et al. (2017) assume a merger would mainly take place in the "avatar as me" style. Looking at Table 1, it is noticeable that the style "avatar as me" differs from the other three styles mainly in the two subscales emotional investment and anthropomorphic autonomy. Accordingly, a high degree of emotional investment and a low degree of anthropomorphic autonomy are indicative of this style. It is also this style that Coulson et al. (2017) call the undifferentiated avatar, which above the others holds the potential for a transfer of one's own views and values into the virtual world. They argue that not only relationships to avatars but also through avatars can be established. They further assume that the avatar must become part of the player's self-concept. If this is not the case, they believe that players are immune to a certain degree to the actions of their avatar, meaning they remain separate from it, which they call the differentiated avatar. While the differentiated avatar only allows second-hand observations of relationships, the undifferentiated avatar allows a more direct level of experience. Accordingly, the avatar should not be perceived as a mere play object or as another person with a life of his own. Coulson et al. (2017) argue primarily on a theoretical level and based on previous research. However, they have not collected any data to confirm or contradict their assumptions. This study aims to close this gap.

Table 1: Mean differences for PAX scale dimensions among player-avatar relationships types (adapted from Banks & Bowman, 2016a).

	<i>Object Est. M (SE)</i>	<i>Me</i>	<i>Symbiote</i>	<i>Other</i>	η^2
<i>Sample 1 (MMO players, broadly)</i>					
Emotion	4.07a (.08)	5.62b (.15)	5.96b (.15)	5.50b (.20)	0.273
Anthro	1.29a (.08)	1.78b (.14)	3.31c (.13)	3.45c (.18)	0.352
SoD	3.57a (.12)	4.47b (.20)	4.86b (.21)	4.50b (.28)	0.077
Control	6.51a (.07)	6.48a (.12)	5.80b (.12)	5.78b (.16)	0.079
<i>Sample 2 (WoW-only players)</i>					
Emotion	4.62a (.07)	5.81b (.11)	6.09b (.11)	5.75b (.18)	0.269
Anthro	1.49a (.08)	2.60b (.13)	3.55c (.13)	3.48c (.20)	0.343
SoD	2.88a (.11)	3.87b (.16)	4.31c (.16)	4.42c (.25)	0.146
Control	6.12a (.07)	6.24a (.10)	6.08a (.10)	6.12a (.16)	0.005

3 Aim of the study

Regarding the previously discussed research gaps and the potential of virtual characters in attachment style therapy, we would like to find out whether attachment styles that exist in relation to real persons are transferred to virtual persons. In addition, we want to investigate which factors influence this transfer and how. To this end, the study will record the real and virtual attachment styles of the subjects based on the four category system (Bartholomew & Horowitz, 1991) and compare whether they transfer their attachment styles into virtuality or whether they change.

3.1 Player-avatar interaction

Based on the assumption that player and avatar can merge to a certain degree (Castronova, 2007; Lewis et al., 2008) and that this merging is influenced by the player-avatar interaction (Coulson et al., 2017), we assume that belonging to the PAX style "avatar as me" leads to a more direct transfer of attachment styles respectively of the anxiety and avoidance dimensions. As already mentioned, the PAX style "avatar as me" is characterized by a high degree of emotional investment and a low degree of anthropomorphic autonomy (Banks, 2015; Banks & Bowman, 2016a). This in turn corresponds to the undifferentiated avatar, in which Coulson et al. (2017) see particularly great potential for a transfer. This leads us to the following hypothesis.

H1: The higher the emotional investment and the lower the anthropomorphic autonomy, the more similar are real life and virtual attachment style dimensions.

3.2 Presence

Defined as the experience of finding oneself in a virtual form presence can be a physical representation or the representation in a third-person or first-person perspective (Bailey, Wise, & Bolls, 2009; Lakhmani & Bowers, 2011). In their study about interdependent self-construal, Jin and Park (2009) found that presence was a significant mediating factor and shows a positive correlation with avatar interaction. Accordingly, presence seems worth exploring in the context of this study and we aim to answer the following research question.

RQ1: How do individual manifestations of presence affect the transfer of attachment style dimensions into virtuality?

3.3 Enjoyment and appreciation

Enjoyment and appreciation both potentially influence how players perceive virtual characters and thus impact the transfer of individual viewpoints and attitudes into the virtual world (Krakowiak & Oliver, 2012; Rogers et al., 2016). While Bopp et al. (2016) found a significant link between enjoyment and character attachment, Banks and Bowman (2013) as well as Bowman et al. (2016) found that game experiences that foster a sense of appreciation seem to stimulate feelings of responsibility towards the avatar. Furthermore, these experiences are often described in terms of connections with in-game characters and should therefore also be of interest for explorative research (Rogers et al., 2016). Based on this we propose the following research questions.

RQ2: How does the individual perception of enjoyment affect the transfer of attachment style dimensions into virtuality?

RQ3: How does the individual perception of appreciation affect the transfer of attachment style dimensions into virtuality?

4 Method

In order to answer the previously defined research questions, a within-subject design was developed. The data was conducted in the form of a two-part online study. Between the two survey dates, the subjects played a video game on their own hardware that served as a stimulus. In the screener (first survey), the subjects could choose when to play the game. The final survey (second survey) was done immediately after they finished the game. The method of stimulus execution was chosen, since a relatively high investment of time by the participants was necessary and we therefore wanted to offer the greatest possible flexibility. Accordingly, we decided to conduct the corresponding survey online.

4.1 Participants

The participants were psychology students at the University of Basel. They were recruited via flyers and a recruiting system of the University of Basel (BAPS). A total of 70 participants completed the study. Four participants were excluded because they responded incorrectly to the bogus item, contained in the final survey (“This is a bogus item, please select the option ‘Strongly disagree’”). This resulted in a final sample of 66 participants (64% women), ranging from 18 to 46 ($M=22.5$) years of age. On average, participants reported playing digital games between one and three hours a week (ranging from less than an hour to more than 10 hours a week). In return for their participation, they received signatures according to the time spent with the stimulus up to a maximum of 28 signatures if they completed the study. Signatures are awarded at the University of Basel for participation in psychological studies and are required to complete the bachelor’s degree.

4.2 Procedure

As shown in Figure 2 the participants completed online surveys at two points in time. First, they filled out a screener to ensure that they were able to complete the study. If the respondents met the necessary criteria, possible time slots were recorded, and attachment styles in relation to real people were assessed. In the next step, the participants were exposed to the stimulus and then asked again about their attachment styles in the final survey, but this time, referring to the virtual characters of the stimulus. Exposure to the stimulus lasted nine days, followed by a one-day break after each time slot to give the researchers time to prepare for the next group. A total of eight time slots was performed. Accordingly, the interval between screener and stimulus varied between three and fourteen weeks.

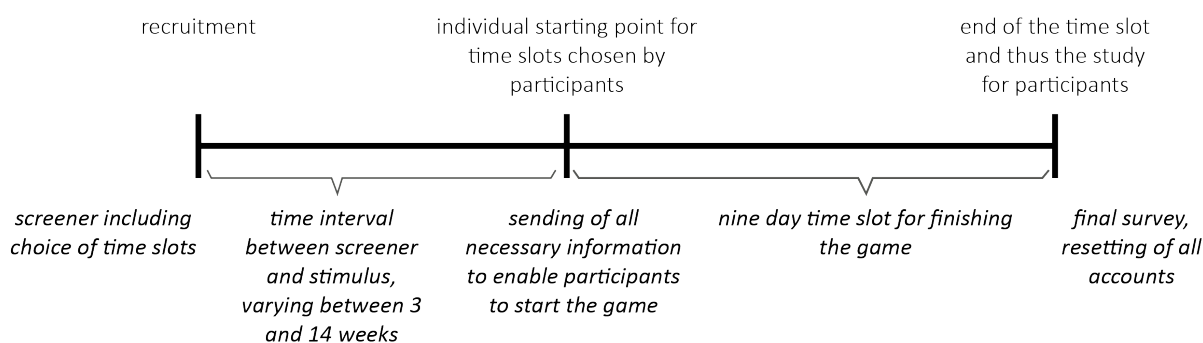


Figure 2: Visualised procedure of the study.

4.2.1 Screener

Participants were required to read and sign a consent form before they were allowed to start. If consent was given, they generated a personal code that allowed us to connect the results of the screener with the results of the final survey. It was also necessary to provide an email address so that the respondents could be contacted. This was unavoidable as the three-part study would not have been possible without contact data. As the video game was only available in Japanese and English, the participants were asked about their language skills. We also needed some information about the hardware of their personal computers, as this was not a laboratory study and we had to ensure that the hardware was powerful enough to play the game. If either of these two criteria was considered insufficient, the respective participants were excluded. If the language skills and hardware met our requirements, participants were asked to choose all time slots that were available to them for playing the game and completing the final survey. The time slots were each nine days long and the prerequisite for participation was that the respondents had at least 10 hours time to play the game within their chosen time slots. The respondents were also asked about their age, gender and video game experience. Finally, they completed the attachment style scales. A screener was necessary to recruit people who met the inclusion criteria (language skills and hardware requirements), to minimize the influence of the stimulus on the real life attachment style data and to keep the length of the final survey economical.

4.2.2 Chosen time slot

At the start of a participant's time slot, they received all the information needed to begin the study. This included the login data for an account on the Steam gaming platform (Valve Corporation, 2003) with which they were able to install and start the game. The participants needed to complete the game within nine days and then log off from their Steam account and report to the test supervisors.

4.2.3 Final survey

After finishing the game, a link to the final survey was sent to the participants. In this questionnaire they first generated their personal code to link the survey results. Then, they rated their game experience according to appreciation, enjoyment, presence, player-avatar interaction and attachment styles. In addition, two short questions were asked about their behavior towards the virtual father and mother figure. Finally, the respondents were again given the opportunity to withdraw consent, to assess whether they had filled out the survey honestly and seriously and to leave comments. Participants still received compensation, even if the seriousness check was denied or consent was withdrawn. In case of a denial, the data would not be included in the evaluation. In the case of a withdrawal, the data would be deleted from the data set. Neither of these cases occurred in this study.

4.3 Stimulus game

To find out how attachment styles translate into virtuality, we needed an appropriate stimulus. It was important that there was a wide range of potential attachment figures and that the relationships to these characters as well as the dialogues were the main focus of the game. The searching procedure for a suitable game included extensive research of articles and videos as well as active participation in discourses in online forums. A list of possible candidates was drawn up and further examined. The game *Night in the Woods* (Infinite Fall, 2017) of the studio Infinite Fall was chosen, because it fulfils the requirements very well. Not only are dialogues and relationships an essential part of the gameplay, but the game also offers the opportunity for lengthy conversations with the protagonist's parents. The website "HowLongToBeat" (How long is *Night in the Woods*?, 2019) gives a benchmark of 10.5 hours for playing through the game. We estimated this to be doable for a period of 9 days, which further encouraged us in our choice. *Night in the Woods* (Infinite Fall, 2017) is a 2D, single-player adventure game. The game was developed by Infinite Fall and published by Finji. In this story-and-character-focused game, players take on the role of the young woman Mae. All characters in the game are humanized animals. The protagonist Mae, for example, resembles a humanized cat. Mae dropped out of college and just arrived back in her hometown at the beginning of the game. There is a bigger mystery that players must clarify, but they still spend most of the time in dialogues that are realistic, understandable and mostly revolve around characters' everyday problems. Players are also often given the choice of whether and with which characters they want to interact and with which not. During the course of the game, the player encounters a variety of characters with different connections to the protagonist. However, the game focuses mainly on the relationship between the protagonist and three of her closest friends, as seen in Figure 3, (Gregg Lee, Bea Santello, Angus Delaney) and the relationship between the protagonist and her parents (Candy and Stan Borowski). On average, the participants needed 10.5 hours to finish the game.

The participants were given access to the game via the Steam gaming platform (Valve Corporation, 2003). Ten Steam accounts were created in advance, each with a license for *Night in the Woods* (Infinite Fall, 2017). At the start of the time slot, the participants received all the information they needed to download, install and log in to Steam. They were also given access to a GMX email account to activate Steam. On completion of the game, respondents were asked to log out of all accounts and not to log in again under any circumstances, as the accounts had to be prepared for the next participant. As a control on the progress of the game, the play time indicated on Steam and the unlocked achievements were mainly taken into account. Since a certain achievement is unlocked at the end of the game, the control mechanism functioned generally well. In a few cases Steam did not seem to award the achievement. In these cases the savegame was downloaded via the Steamcloud and checked. After checking, the achievements were reset using the Steam Achievement Manager software (version 6.3). Furthermore, all emails on the GMX account were deleted.

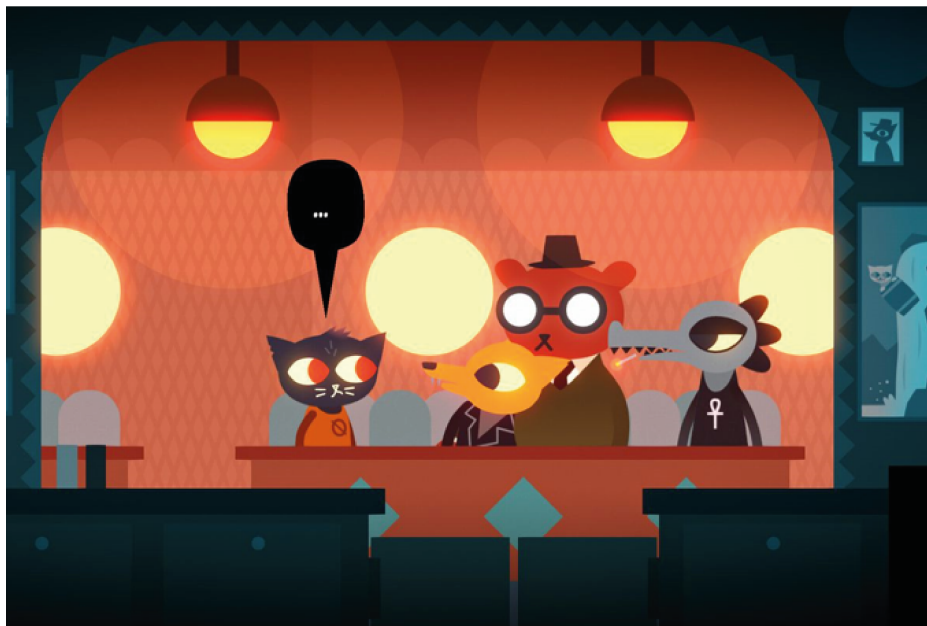


Figure 3: Characters of the game *Night in the Woods*. From left to right: Mae Borowski, Gregg Lee, Angus Delaney, Bea Santello (Infinite Fall, 2017).

4.4 Measures

4.4.1 Attachment style

Various methods are available for capturing attachment styles. These can be roughly divided into interviews and scales (Ravitz, Maunder, Hunter, Sthankiya, & Lancee, 2010). The aim of this study was to record attachment styles at two points in time and with a number of subjects that enables statistical evaluations. For these reasons, we chose scales. To assess both real life (RL) and virtual (V) attachment styles, we opted for the Relationship Structures questionnaire of the Experiences in Close Relationships-Revised (ECR-RS), developed and validated by Fraley et al., (2011). The questionnaire contains nine items per attachment style, which are queried via 7-point Likert scales (1 = strongly disagree; 7 = strongly agree). Fraley et al., (2011) developed the ECR-RS specifically for use in multiple contexts and the measurement of relationship-specific attachment styles. This allowed us not only to measure the global attachment style of the participants but also to ask them specifically about their relationships to their mother, father and best friend. Romantic relationships were not captured because they are not depicted in the video game *Night in the Woods* (Infinite Fall, 2017). To determine the attachment styles with reference to the virtual attachment figures, certain formulations in the ECR-RS were slightly modified in consultation with R. Chris Fraley to make sense in the context of the game. For example, the original introductory text for the friendship attachment scales reads: "Please answer the following questions about your best friend" (Fraley et al., 2011). These have been modified as follows: "Think briefly about which character you would call your best friend in the game and answer the following questions about the character you are thinking of".

4.4.2 Player-avatar interaction

Coulson et al.'s (2017) definition of differentiated and undifferentiated avatar styles is strongly based on Bank's (2015) player-avatar interaction styles. For this reason, we used their scales to measure the participants' player-avatar interaction styles (PAX; Banks & Bowman, 2016a). The PAX questionnaire contains a total of 15 items. Six items are part of the subscale emotional investment, four of the subscale anthropomorphic autonomy, three of the subscale suspension of disbelief and two of the subscale sense of control. All items are queried via 7-point Likert scales (1 = strongly disagree; 7 = strongly agree). Similar to the ECR-RS scales, some wording has been slightly adapted to make sense in the context of the game. The word avatar was replaced by the word character. This served the purpose to avoid confusion, because the protagonist Mae is not a self-created avatar but a predefined character. For example the item "This Avatar is very special to me" (Banks & Bowman, 2016a) was changed to "This character is very special to me".

4.4.3 Presence

Presence is described as the experience of feeling oneself transported into a virtual self (Bailey et al., 2009; Lakhmani & Bowers, 2011). This can, in the case of a first-person perspective, be a fully psychological representation. It can also be a physical representation of the self in a third-person perspective (Lakhmani & Bowers, 2011). In their study on parasocial interaction with avatars, Jin and Park (2009) found a significant relationship between the construct presence and the closeness of parasocial interaction. The fact that there is a connection with the intensity of presence and the degree of transfer of attachment styles seems to be quite possible and seemed worth closer examination. To capture presence, we used the corresponding subscale of the Player Experience Need Satisfaction (PENS) questionnaire (Ryan, Rigby, & Przybylski, 2006). With nine items this subscale offers an economical way to measure presence in video games. All items are measured via a 7-point Likert scale (1 = strongly disagree; 7 = strongly agree).

4.4.4 Appreciation and enjoyment

Rogers et al. (2016) found that the description of meaningful games often included statements concerning the relationships between players and in-game characters. Meaningfulness, again, is strongly associated with appreciation (Oliver & Bartsch, 2010). The recording of this construct was therefore interesting for the topic of this study. We also recorded enjoyment as Bopp et al. (2016) showed, there exist significant correlations between enjoyment and character attachment. To capture both constructs, we used the appreciation and enjoyment subscales of the audience response scales developed by Oliver and Bartsch (2010). Both subscales consist of three items each, which are measured using 7-point Likert scales (1 = strongly disagree; 7 = strongly agree).

4.4.5 Additional questions

The game regularly offers the possibility to watch TV with the father figure and to have detailed conversations with the mother figure. With a 5-point Likert scale (1 = never; 5 = always), we asked the participants how often they used these opportunities (“How often did you watch TV with Stan Borowski (Mae’s Father) when the game gave you the opportunity?”; “How often did you voluntarily engage in further discussions with Candy Borowski (Mae’s Mother)?”). By collecting this data, we wanted to check whether a more frequent use of these options is positively related to a secure attachment style referring to the respective person.

5 Results

We divide the presentation of the collected data into five chapters. While the first chapter is devoted to the analysis of the descriptive results, the following four chapters deal with the results concerning the hypothesis and research questions. All data was analyzed using Rstudio (version 1.2.5033). For the statistical tests, a α -level of .05 was used.

5.1 Descriptive data

Table 2 shows the mean values, standard deviations and medians of all attachment style dimensions in direct comparison between real life and virtual. It is particularly noticeable that all mean values except global anxiety are higher in the virtual setting than in the real one. This means that the participants felt less secure about their virtual attachment figures than about their real counterparts.

Table 2: Mean, standard deviation and median of attachment style dimensions.

<i>Scale</i>	<i>Mean</i>	<i>SD</i>	<i>Median</i>	<i>Mean</i>	<i>SD</i>	<i>Median</i>
	Attachment style dimension real life			Attachment style dimension virtual		
<i>Global anxiety</i>	4.121	1.569	4.333	3.97	1.557	3.667
<i>Mother anxiety</i>	1.616	0.84	1.333	2.273	1.233	2
<i>Father anxiety</i>	2.258	1.486	1.667	2.884	1.453	2.667
<i>Friend anxiety</i>	2.773	1.542	2.333	3.303	1.492	3
<i>Global avoidance</i>	3.222	0.981	3.167	3.374	1.065	3.5
<i>Mother avoidance</i>	2.77	1.455	2.167	3.237	1.157	3.083
<i>Father avoidance</i>	3.803	1.634	3.833	4.008	1.167	4
<i>Friend avoidance</i>	2.363	1.109	2.167	2.46	0.728	2.25

Table 3 shows the mean values, standard deviations and medians of all variables except the attachment style dimensions. It is noteworthy that the difference variables are all relatively close to zero, which indicates a small difference between the real life dimension and the virtual dimension. For both the anxiety and the avoidance dimension, the father variable shows the highest difference. This means that for the attachment style father the fewest transfers are to be expected, as Table 5 confirms. The detailed derivation of the difference variables can be found in the following chapter. A complete overview of means, standard deviations and medians can be found in the appendix A.

Table 3: Mean, standard deviation and median of measured variables except attachment style dimensions.

<i>Scale</i>	<i>Mean</i>	<i>SD</i>	<i>Median</i>
Player-avatar interaction (PAX)			
<i>Emotional investment</i>	3.95	1.321	3.833
<i>Anthropomorphic autonomy</i>	4.345	1.062	4.375
<i>Suspension of disbelief</i>	4.126	1.275	4.333
<i>Sense of control</i>	4.023	1.272	4
Player experience of need satisfaction (PENS)			
<i>Presence</i>	4.082	1.109	4.111
<i>Physical presence</i>	3.813	1.355	3.667
<i>Emotional presence</i>	4.237	1.421	4.333
<i>Narrative presence</i>	4.197	1.233	4.333
Audience response			
<i>Appreciation</i>	4.763	1.171	5
<i>Enjoyment</i>	4.556	1.548	5
Difference variables anxiety			
<i>Global anxiety</i>	-1.171	0.963	-1
<i>Mother anxiety</i>	-1.02	1.128	-0.667
<i>Father anxiety</i>	-1.273	1.158	-0.833
<i>Friend anxiety</i>	-1.15	0.998	-0.833
Difference variables avoidance			
<i>Global avoidance</i>	-0.929	0.663	-0.833
<i>Mother avoidance</i>	-1.341	0.901	-1.167
<i>Father avoidance</i>	-1.477	1.166	-1.25
<i>Friend avoidance</i>	-0.843	0.743	-0.667
Difference variable emotional investment, anthropomorphic autonomy (PAX)			
<i>Difference PAX</i>	-0.395	1.301	-0.292

As a first step, we were interested in finding out how many participants transferred their attachment style from real life to virtuality and how many changed their style. The ECR-RS allows the calculation of an

overall score for the dimensions anxiety and avoidance. However, there is no direct classification into one of the four attachment styles. According to Figure 1 we therefore categorized the participants into four quadrants (Table 4). Since the dimensions are measured via 7-point Likert scales, a value below four means that the respondent falls into the secure quadrant in both, the anxiety and avoidance dimension. A value above four means that the respondent belongs to the preoccupied quadrant for anxiety respectively dismissing quadrant for avoidance. If both values were above four the respondent was categorized as fearful. If one score fell exactly to four, the category was named after both quadrants with a slash in between. For example, a value of four in the anxiety dimension and a value of three in the avoidance dimension led to classification in the category secure/preoccupied. If both values fell to four, the participant was placed in a category called middle.

Table 4: Categorization based on mean values of the anxiety and avoidance dimensions.

Scores	Attachment style quadrants			
	<i>Secure</i>	<i>Dismissing</i>	<i>Preoccupied</i>	<i>Fearful</i>
<i>Anxiety dimension score</i>	<4	<4	>4	>4
<i>Avoidance dimension score</i>	<4	>4	<4	>4

As Table 5 shows, 29 participants (44%) transferred their global attachment style into the virtual setting. In relation to the mother, 41 participants (62%) transferred. 20 participants (30%) displayed a transfer related to the father and 44 participants (67%) to friend relationships. The remaining participants either changed from a secure attachment style to an insecure, from an insecure to a secure one or switched within the insecure attachment style segments. If these values are taken together, this shows that in 51% of cases a direct transfer takes place. Detailed tables for all four relationship-specific attachment styles can be found in the appendix B.

Table 5: Overview of the transferring or changing of attachment styles between the settings.

Scales	Transferring		Changing	
	<i>n</i>	%	<i>n</i>	%
	Attachment style categorization			
<i>Global Attachment</i>	29	44	37	56
<i>Mother Attachment</i>	41	62	25	38
<i>Father Attachment</i>	20	30	46	70
<i>Friend Attachment</i>	44	67	22	33

5.2 Impact of player-avatar interaction on attachment style transfer (H1)

We aimed to find out what influence emotional investment and anthropomorphic autonomy have on the transfer of attachment styles. To this end, we used multiple regression analyses to examine the relationship between the dependent variable anxiety dimension respectively avoidance dimension and the inde-

pendent variables the PAX subscales emotional investment and anthropomorphic autonomy. To make the transfer from real life to virtuality measurable, two difference variables were created. For this purpose, the value of the virtual anxiety respectively avoidance was subtracted from its real life equivalent (e.g. difference global anxiety). For example, if a participant had the value three for global anxiety real life and the value five for global anxiety virtual, there was a difference of minus two. Positive values were then recoded into negative ones so that the value zero could be used as the absolute maximum. The information, in which direction a potential shift occurred, was lost by this recoding, but our interest in this question was only whether a shift occurs, not in which direction. Accordingly, the closer the value of this variable was to zero, the more similar the real life and virtual dimensions were. The further the value is in minus, the greater the difference between real and virtual values. These variables were necessary so that the difference between real life and virtual could be included in the calculation as a single value. After it was clarified that all requirements for the calculation of multiple regression analyses were fulfilled, they were performed for all attachment styles (global, mother, father, friend). No significant relationship for either of the subscales and the difference variables was found. An overview of all results can be found in appendix C.

In a second step we intended to find out whether there are significant differences in emotional investment and anthropomorphic autonomy depending on whether people showed the same attachment style for real life and virtuality (transferring) or changed between the settings (changing). Since the mentioned subscales only provide information about the PAX style “avatar is me” when combined, again a difference variable was created. The PAX style mentioned is expressed by a high degree on the emotional investment scale and a low degree on the anthropomorphic autonomy scale. Accordingly, the value of the scale anthropomorphic autonomy was subtracted from emotional investment to create a difference variable (Difference PAX). For example, if a participant had the value five for emotional investment and the value two for anthropomorphic autonomy, there was a difference of three. In this case, the higher the value of the variable difference PAX, the stronger the tendency to see the avatar as a reflection of oneself. Again, this variable was necessary so that we could calculate the tendency to see oneself reflected in the avatar as a single value. All requirements for conducting t-tests were met. They were then executed with the group variable (e.g. global transfer; 1 = transfer; 2 = change) and the variable difference PAX as dependent variable for each attachment style. The number of participants that transferred respectively changed can be found in Table 5. However, no significant differences were found. Emotional investment was overall medium ($M=3.95$, $SD=1.321$), so was anthropomorphic autonomy ($M=4.345$, $SD=1.062$). A closer look at Figure 4 shows that the combination of a high emotional investment and a low anthropomorphic autonomy was not to be found in our sample. This indicates that the PAX style “This avatar is me” was not represented in this study. An overview of the t-test outputs can be found in appendix D.

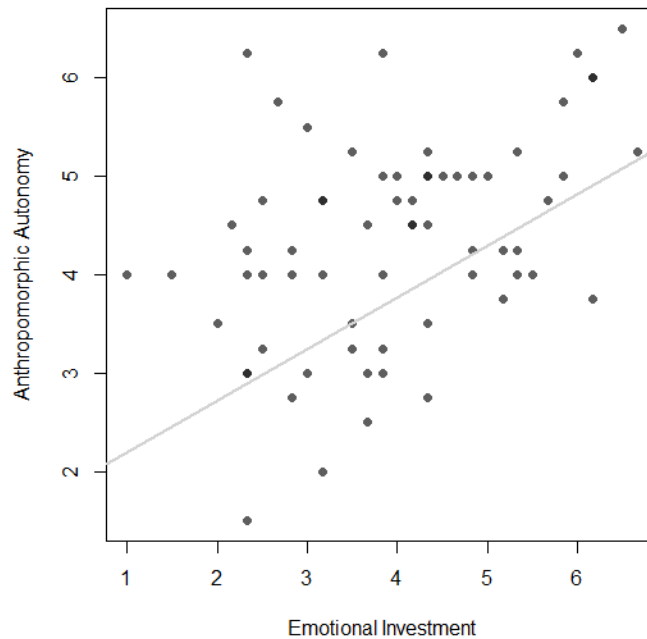


Figure 4: Scatterplot showing combination values of the PAX subscales emotional investment and anthropomorphic autonomy. The combination of a high value in emotional investment and a low value in anthropomorphic autonomy points to the PAX style "avatar as me".

5.3 Impact of presence on attachment style transfer (RQ1)

We carried out simple linear and multiple regression analyses in order to find out what influence individual manifestations of presence have on the transfer of attachment styles. First the influence of presence on the variables difference global anxiety, difference mother anxiety, difference father anxiety and difference friend anxiety were investigated. Then we examined the influence of presence on the difference variables of according avoidance scales. At last, we divided presence into its three subcategories: physical, emotional and narrative, and examined their influence on all difference variables of the anxiety and avoidance scales via multiple regression analyses. A significant relationship was found between presence and difference mother anxiety ($\beta = -.274$, $\Delta R^2 = 0.058$, $F = 5.022$, $p < .05$) indicating, that the feeling of being present in the virtual world reinforces an attachment style change. For presence as a whole, no other significant connections could be found. However, if the three subcategories of the PENS subscale presence (physical, emotional, narrative) are included as separate variables in a multiple regression analysis, it becomes clear that the variable physical presence seems to be particularly important for the above mentioned relationship ($\beta = -.246$, $\Delta R^2 = 0.063$, $F = 2.461$, $p < .05$) as none of the other subcategories was significant. This means that the mentioned change is at least partly dependent on the feeling of being physically present in the virtual world while an emotional and narrative presence do not seem to have any influence. Furthermore, a significant correlation between difference friend avoidance

and the variable emotional presence could be observed ($\beta = -.18$, $\Delta R^2 = 0.0433$, $F = 1.981$, $p < .05$). In contrast to difference mother anxiety, here an emotional presence in the virtual world seems to favour an attachment style change. Detailed statistical data can be found in Table 6. An overview of all results concerning presence can be found in appendix E.

Table 6: Linear regression analyses of the measure of presence with the outcome measures difference mother anxiety and difference friend avoidance. Additional multiple regression analyses with the measures of presence split into its three subcategories physical, emotional and narrative.

	Difference mother anxiety					Difference friend avoidance				
	β	R^2	ΔR^2	F	p	β	R^2	ΔR^2	F	p
Player Experience of Needs Satisfaction (PENS)										
<i>Presence</i>	-0.274	0.073	0.058	5.022	0.0285	-0.006	<0.001	-0.016	0.005	0.945
<i>Physical</i>	-0.246	0.106	0.063	2.461	0.0489	0.098	0.085	0.043	1.981	0.2367
<i>Emotional</i>	0.033	0.106	0.063	2.461	0.7866	-0.18	0.085	0.043	1.981	0.0287
<i>Narrative</i>	-0.07	0.106	0.063	2.461	0.6448	0.094	0.085	0.043	1.981	0.3569

5.4 Impact of enjoyment on attachment style transfer (RQ2)

Linear regression analyses were performed to reveal potential connections between the difference anxiety respectively avoidance variables and enjoyment. No significant correlations were found. An overview of all results concerning enjoyment can be found in appendix F.

5.5 Impact of appreciation on attachment style transfer (RQ3)

Linear regression analyses were performed aiming to reveal possible connections between the difference anxiety respectively avoidance variables and appreciation. No significant correlations could be detected. An overview of all results concerning appreciation can be found in appendix F.

In summary, it can be said that a transfer occurs in just over half of all cases (51%). The frequency varies between the different relationship-specific attachment styles and ranges from 30% (father) to 67% (friend). Of the variables studied, only presence has a significant influence. There are negative connections between physical presence and the dimension mother anxiety as well as between emotional presence and the dimension friend avoidance.

6 Discussion

With an increasing presence of interactive media and thus virtual characters in everyday life, it is essential to explore how people interact with these characters and how this interaction affects them in return. In this study we explored which variables influence the transfer of attachment styles from the real world into virtuality. While the attachment style construct is relatively well studied (e.g. Ainsworth et al., 1978; Bifulco et al., 2002; Bowlby, 1988, 1988, 1999; Fraley et al., 2013) and research on parasocial relationships is increasing (Biocca, 2006; Bopp et al., 2019; Bowman et al., 2016; Lombard & Ditton, 2006), to our knowledge there exists no research on how these two topics relate. On the basis of Coulson et al's (2017) theoretical work we therefore wanted to explore how these two topics are related, and use our results as a first step to find out whether virtual characters could be used as a tool to treat insecure attachment styles. In the course of this study, no variable was found that had a distinct influence on the transfer of attachment styles. However descriptive results indicate that a direct transfer does indeed happen in about half of the cases.

Descriptive data show that a transfer does take place. In just over half of the measurements (51%), the same attachment style was shown in real life as in virtuality. If the different attachment styles are examined separately, the attachment style mother (62%) and friend (67%) are much more likely to transfer, while global (44%) is slightly less and father (30%) is much less likely. A reason why the transfer for the attachment style father is less constant turns out to be difficult to derive. A closer look at the switching of styles reveals that the number of participants who change from real life secure to virtual insecure ($n=22$) and the number of participants who change from real life insecure to virtual secure ($n=17$) differ only slightly. Accordingly, it cannot be assumed that either the real or virtual father figure will trigger more anxiety or avoidance. However, remarkable are the high avoidance mean values regarding the relationship with the father. The real life avoidance mean is 0.581 points higher than global avoidance, which has the second highest value. In the virtual setting the difference to the second highest value, again global avoidance, is even higher at 0.634 points. The fact that in both settings global avoidance has the second highest value and that it is also global avoidance that shows the second least transfers reinforces the assumption of a possible connection. It would be interesting to see whether a high level of avoidance in future research generally has a negative impact on a transfer.

No connection was found between player-avatar interaction and the transfer of attachment style dimensions. Accordingly, the hypothesis that a specific combination of emotional investment and anthropomorphic autonomy impacts the transfer of attachment styles into virtuality has to be rejected. These results contradict the claims of Coulson et al. (2017) who assumed that an undifferentiated avatar favors the transfer of the attachment styles into virtuality. However, as shown in Figure 4, none of the participants showed a particularly high emotional investment value in combination with a low anthropomorphic autonomy value. Therefore, it must be assumed that the PAX style "avatar as me" (Banks, 2015) was not represented in our sample. One possible explanation for this phenomenon is the type of avatar assigned to the participants. While *Night in the Woods* (Infinite Falls, 2017) offers a relatively large freedom of choice

in some areas, it is severely restricted in others, such as customization. The appearance, age and gender of the avatar are predetermined by the game, and character traits can only be controlled indirectly through choices in dialogues. Since customization options are indeed relevant for identifying with an avatar (Birk, Atkins, Bowey, & Mandryk, 2016), and identification possibly plays a bigger role than Coulson et al. (2017) assumed, it is quite possible that depriving the player of these very options weakens a potential influence of the player-avatar interaction. Another possible explanation for the non-existing influence of the player-avatar interaction is that the PAX style cannot easily be deduced from the characteristics of the subscales emotional investment and anthropomorphic autonomy. The hypothesis should therefore be rejected in the context of this study, but it cannot be claimed with certainty that the player-avatar interaction plays no role at all in the transfer of attachment styles.

Concerning the question how presence impacts the transfer of attachment style, a negative correlation could be found between the attachment style variable difference mother anxiety and presence or more specific the subcategory physical presence. In concrete terms, this means that with the increasing feeling of being physically present in the virtual world, anxiety values, related to the mother, differ more for the real and the virtual world. The same phenomenon is found in the variable difference avoidance friend and the subcategory emotional presence. One possible explanation for this would be that the virtual world has fewer consequences and therefore allows for a more carefree discovery (Coulson et al., 2017) which in turn could lead to a more secure attachment style in virtuality. However, a look at the mean values of the variable anxiety mother real life and anxiety mother virtual contradicts this interpretation, since the participants show a lower anxiety value on average in real life. Similarly, the mean value for the dimension avoidance friend real life is lower than the virtual one. Comparing all attachment style means with each other, an even more dramatic picture emerges. The only mean value that is lower in virtuality than in real life is the dimension global anxiety. This indicates that people feel generally less secure in the virtual environment. These results are as interesting as they are surprising because they support the statement that virtual characters are actually more than just pixels on our screens (Bopp et al., 2016; Bowman et al., 2012, 2016; Coulson et al., 2012). If these characters had been perceived as mere piles of pixel, there would be no reason for insecurity. Regarding the presentation of the characters, these results also supported Harth's (2017) statement that the perception of virtual characters as equal social agents is more dependent on the plausibility of the behavior than on the graphical depiction. While the results show that more insecurity prevailed in virtual space, they do not give us any indication as to why this was the case. One possible explanation might be that time is an essential factor for security in relationships (Duemmler & Kobak, 2001). Thus, if certainty is gained through time, it can be assumed that new relationships (in this case the virtual ones) are more affected by insecurity. Accordingly, it would be fascinating to observe the development of virtual relationships over time. This could be explored, for example, by monitoring and regularly interviewing participants over the entire course of a longer video game. Another factor worth considering is the personality of the virtual characters. It is possible that due to their programming they induce more insecurity than other characters would. On this issue, Yannakakis and Paiva (2015) argue that games should have a certain dynamic so that characters can respond flex-

ibly to the emotions of the players. This would certainly be an important factor for the design of virtual therapy environments, as it would allow for individual responses to the reactions of a virtual character and on the other hand would enable the character to either reinforce secure behavior or respectively intercept and redirect insecure behavior.

Our second and third research questions dealt with the influence of enjoyment respectively appreciation on the transfer of attachment style dimensions. Neither enjoyment nor appreciation seem to have any meaningful impact on the transfer of attachment styles. The mean values of both variables can be regarded as medium with a slight tendency to high. This means that the subjects generally had fun while playing and would probably also classify the experience as somewhat meaningful. While other research emphasizes the importance of enjoyment for character attachment (Bopp et al., 2016; Rogers et al., 2016) and appreciation for responsibility towards the avatar (Banks & Bowman, 2013; Bowman et al., 2016), it must be concluded that neither character attachment nor sense of responsibility are essential for the transfer of attachment style values.

6.1 Limitations and future research

The results of the study allow us to state that a transfer of attachment styles into virtuality occurred for just over half of all cases. Furthermore, the applied test design worked well, and the abort rate was very low ($n=10$). However, while the results of this study demonstrate a transfer of real life attachment styles into virtuality, they do not provide any information about why this is the case or why a transfer can fail to occur. To address this problem, further variables should generally be investigated, or the variables investigated in this study should be surveyed differently. For example should future studies have a close look into identification and player-avatar interaction and, if necessary, use a questionnaire that inquires rather identification than the whole multifactoriality of player-avatar interaction. This would also eliminate the need for relatively complex calculations of the PAX subscales, which made it difficult to interpret the results. For example, the player identification scale (PIS) (Van Looy, Courois, De Vocht, & De Marez, 2012) is an interesting alternative to consider. Another important limitation concerning the topic of player-avatar interaction is the lack of customizability in the chosen video game. An essential part of this study was based on the assumption that putting yourself in the shoes of an avatar favours the transfer of attachment styles. However, it was not taken into account that customization options can have a significant influence on the identification with an avatar and therefore maybe on the player-avatar interaction as well (Birk et al., 2016). *Night in the Woods* (2017) does not offer any such options but presents the player with a character that is predefined in age, gender, appearance, background story, and at least in part personality traits. If the variable of player-avatar interaction should be considered again in future studies, it would be advisable to choose a game in which the avatar can be designed to a large extent by the player.

Due to the methodology used, it was unfortunately not possible to clarify in advance to which PAX style the participants tend. If a different methodology were used, for example a survey on games already played,

a much larger sample could be questioned, or a corresponding pre-analysis would be possible. Further for the analyses of our results, we have limited ourselves to statistical methods that should allow a first look at the topic. Because of this, dependencies between the different relationship-specific attachment styles as well as the anxiety and avoidance dimensions could not be investigated (Fraley, et al., 2011). This made sense for building a foundation and formulating questions for further research. However, future studies should use statistical methods that also take into account the addressed dependencies.

Another topic that should be considered is the target group. We discussed the success of various aids such as toys, dolls or even animals in therapeutic settings with children (Anderson & Gedo, 2013; Parish-Plass, 2008; Sadeh et al., 2008). However, the present study conducted all surveys on adults. Accordingly, the results are not immediately applicable to a younger target group. While these aids are applied to children other methods like interviews and questionnaires are usually used for adults (Bifulco et al., 2002; Ravitz et al., 2010). It is possible that virtual characters offer the potential here to close this gap with a method that is appropriate for both groups. A comparison with regard to age groups should be sought in the future to further clarify the potential therapeutic value of virtual characters. Another aspect about the sample that should be kept in mind is the homogeneity of it. The complete sample consisted of psychology students from the University of Basel in Switzerland. Therefore, the results cannot easily be applied to other target groups.

Future studies may also try to keep the time interval between the two survey points standardized for all subjects. Due to the limited number of game licenses this was unfortunately not possible within this study. However, it should be pointed out that attachment styles are relatively resistant to change over time (Ainsworth et al., 1978; Zhang & Labouvie-Vief, 2004), and that the time interval should therefore not have had much of an impact in this case. At last, an interesting addition to the quantitative data collected in this study would be the gathering of qualitative data. This would allow a more precise analysis of the behaviour of individuals. For example, how they react to certain responses of virtual characters, what decisions they make in dialogues and much more.

6.2 Conclusion

This study investigated the transfer of real life attachment styles into virtuality. We aimed to find out how attachment styles shown in the real world are reflected in virtual worlds. Therefore, we not only examined whether a transfer took place, but also which factors could contribute to it. Our research clearly illustrates that a transfer from real life attachment styles into virtuality does happen in about half of the cases. However, it leaves open the question of which factors are responsible for whether this transfer takes place. To create a virtual environment where there is certainty that it is optimally suited for a therapeutic approach, it is absolutely necessary to know and control potential influencing factors. If the determining variables can be identified, this would have the potential for a completely new approach to treat insecure attachment allowing to try out new behavior without the worries of real life consequences. To our knowledge, this is the first study that has collected and analyzed data on this topic. The results pro-

vide a first insight but raise new questions as well and we hope that both will support and inspire further research.

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Appendix

Appendix A

Complete output of all means, standard deviations and medians.

Table A1: Mean, standard deviation and median of attachment style dimensions.

<i>Scale</i>	<i>Mean</i>	<i>SD</i>	<i>Median</i>	<i>Mean</i>	<i>SD</i>	<i>Median</i>
	Attachment style dimension real life			Attachment style dimension virtual		
<i>Global anxiety</i>	4.121	1.569	4.333	3.97	1.557	3.667
<i>Mother anxiety</i>	1.616	0.84	1.333	2.273	1.233	2
<i>Father anxiety</i>	2.258	1.486	1.667	2.884	1.453	2.667
<i>Friend anxiety</i>	2.773	1.542	2.333	3.303	1.492	3
<i>Global avoidance</i>	3.222	0.981	3.167	3.374	1.065	3.5
<i>Mother avoidance</i>	2.77	1.455	2.167	3.237	1.157	3.083
<i>Father avoidance</i>	3.803	1.634	3.833	4.008	1.167	4
<i>Friend avoidance</i>	2.363	1.109	2.167	2.46	0.728	2.25

Table A2: Mean, standard deviation and median of measured variables except attachment style dimensions.

<i>Scale</i>	<i>Mean</i>	<i>SD</i>	<i>Median</i>
Player-avatar interaction (PAX)			
<i>Emotional investment</i>	3.95	1.321	3.833
<i>Anthropomorphic autonomy</i>	4.345	1.062	4.375
<i>Suspension of disbelief</i>	4.126	1.275	4.333
<i>Sense of control</i>	4.023	1.272	4
Player experience of need satisfaction (PENS)			
<i>Presence</i>	4.082	1.109	4.111
<i>Physical presence</i>	3.813	1.355	3.667
<i>Emotional presence</i>	4.237	1.421	4.333
<i>Narrative presence</i>	4.197	1.233	4.333
Audience response			
<i>Appreciation</i>	4.763	1.171	5
<i>Enjoyment</i>	4.556	1.548	5
Engagement			
<i>Mother discussion V</i>	4.151	1.041	5
<i>Father TV V</i>	3.515	1.315	4
Difference variables anxiety			
<i>Global anxiety</i>	-1.171	0.963	-1
<i>Mother anxiety</i>	-1.02	1.128	-0.667
<i>Father anxiety</i>	-1.273	1.158	-0.833
<i>Friend anxiety</i>	-1.15	0.998	-0.833
Difference variables avoidance			
<i>Global avoidance</i>	-0.929	0.663	-0.833
<i>Mother avoidance</i>	-1.341	0.901	-1.167
<i>Father avoidance</i>	-1.477	1.166	-1.25
<i>Friend avoidance</i>	-0.843	0.743	-0.667
Difference variable emotional investment, anthropomorphic autonomy (PAX)			
<i>Difference PAX</i>	-0.395	1.301	-0.292
Demographic information			
<i>Sex</i>	1.364	0.485	1
<i>Age</i>	22.5	3.904	22
<i>Game Experience</i>	2.121	1.222	2

Appendix B

Complete output of all attachment style transfers and changes.

Table B1: Global attachment styles that transferred from real life to virtual. The numbers indicate the number of participants.

		Global attachment style (V)						
		<i>Dismissing</i>	<i>Fearful</i>	<i>Fearful/ Preoccupied</i>	<i>Preoccupied</i>	<i>Secure</i>	<i>Secure/ preoccupied</i>	<i>Total</i>
Global attachment style (R)								
<i>Dismissing</i>	0	0	0	0	0	2	1	3
<i>Fearful</i>	1	1	1	2	4	1		10
<i>Fearful/ Dismissing</i>	0	1	0	0	0	0	0	1
<i>Fearful/ Preoccupied</i>	0	1	0	0	1	0		2
<i>Preoccupied</i>	2	5	1	11	4	0		23
<i>Secure</i>	1	2	0	2	17	0		22
<i>Secure/ Preoccupied</i>	0	0	0	2	3	0		5
<i>Preoccupied</i>								
<i>Total</i>	4	10	2	17	31	2		

Table B2: Mother attachment styles that transferred from real life to virtual. The numbers indicate the number of participants.

		Mother attachment style (V)								
		<i>Dismissing</i>	<i>Fearful</i>	<i>Fearful/ Dismissing</i>	<i>Fearful/ Preoccupied</i>	<i>Preoccupied</i>	<i>Secure</i>	<i>Secure/ Dismissing</i>	<i>Secure/ Preoccupied</i>	<i>Total</i>
Mother attachment style (RL)										
<i>Dismissing</i>	5	1	0	0	0	7	1	0		14
<i>Preoccupied</i>	1	0	0	0	0	1	0	0		2
<i>secure</i>	9	1	1	1	1	36	0	1		50
<i>Total</i>	15	2	1	1	1	44	1	1		

Table B3: Father attachment styles that transferred from real life to virtual. The numbers indicate the number of participants.

		Father attachment style (V)						
		<i>Dismissing</i>	<i>Fearful</i>	<i>Fearful/Dismissing</i>	<i>Preoccupied</i>	<i>Secure</i>	<i>Secure/Dismissing</i>	<i>Total</i>
Father attachment style (RL)								
<i>Dismissing</i>	3	6	0	0	7	3	19	
<i>Fearful</i>	0	2	1	0	3	0	6	
<i>Fearful/Dismissing</i>	0	0	0	0	0	1	1	
<i>Preoccupied</i>	0	0	0	0	1	0	1	
<i>secure</i>	12	4	1	1	15	2	35	
<i>Secure/Dismissing</i>	1	0	0	0	2	0	3	
<i>Secure/Preoccupied</i>	1	0	0	0	0	0	1	
<i>Total</i>	17	12	2	1	28	6		

Table B4: Friend attachment styles that transferred from real life to virtual. The numbers indicate the number of participants.

		Friend attachment style (V)					
		<i>Dismissing</i>	<i>Fearful/Preoccupied</i>	<i>Preoccupied</i>	<i>secure</i>	<i>Secure/Preoccupied</i>	<i>Total</i>
Friend attachment style (RL)							
<i>Fearful</i>	0	0	1	2	0	3	
<i>Fearful/Preoccupied</i>	0	0	1	0	0	1	
<i>middle</i>	0	0	0	1	0	1	
<i>Preoccupied</i>	0	0	5	3	0	8	
<i>secure</i>	1	0	7	39	1	48	
<i>Secure/Dismissing</i>	0	0	0	2	0	2	
<i>Secure/Preoccupied</i>	0	1	2	0	0	3	
<i>Total</i>	1	1	16	47	1		

Appendix C

Complete output of all regression analyses performed concerning player-avatar interaction.

Table C1: Multiple regression analyses of the measure of player-avatar interaction with the outcome measures of the attachment style anxiety dimensions.

	Attachment style dimension global anxiety			Attachment style dimension mother anxiety			Attachment style dimension father anxiety			Attachment style dimension friend anxiety								
	β	R^2	ΔR^2	β	R^2	ΔR^2	β	R^2	ΔR^2	β	R^2	ΔR^2	F	p				
	Player-avatar interaction (PAX)																	
<i>Emotional investment</i>	-0.135	0.053	-0.009	0.857	0.1889	0.014	1.231	0.209	0.103	0.091	0.032	1.534	0.3947	-0.13	0.037	-0.026	0.586	0.225
<i>Anthropomorphic autonomy</i>	0.222	0.053	-0.009	0.857	0.0933	0.014	1.231	0.864	-0.081	0.091	0.032	1.534	0.6008	0.053	0.037	-0.026	0.586	0.7
<i>Suspension of disbelief</i>	0.025	0.053	-0.009	0.857	0.8024	0.014	1.231	0.406	-0.228	0.091	0.032	1.534	0.0545	0.058	0.037	-0.026	0.586	0.577
<i>Sense of control</i>	0.004	0.053	-0.009	0.857	0.9661	0.014	1.231	0.184	0.112	0.091	0.032	1.534	0.3249	-0.047	0.037	-0.026	0.586	0.64

Table C2: Multiple regression analyses of the measure of player-avatar interaction with the outcome measures of the attachment style avoidance dimensions.

	Attachment style dimension global avoidance			Attachment style dimension mother avoidance			Attachment style dimension father avoidance			Attachment style dimension friend avoidance										
	β	R^2	ΔR^2	F	p	β	R^2	ΔR^2	F	p	β	R^2	ΔR^2	F	p					
Player-avatar interaction (PAX)																				
<i>Emotional investment</i>	0.006	0.064	0.002	1.035	0.932	-0.073	0.075	0.014	1.231	0.438	-0.06	0.071	0.01	1.163	0.6241	0.116	0.66	0.004	1.071	0.142
<i>Anthropomorphic autonomy</i>	0.053	0.064	0.002	1.035	0.552	0.186	0.075	0.014	1.231	0.128	0.08	0.071	0.01	1.163	0.6115	0.042	0.66	0.004	1.071	0.675
<i>Suspension of disbelief</i>	-0.095	0.064	0.002	1.035	0.165	-0.077	0.075	0.014	1.231	0.405	-0.203	0.071	0.01	1.163	0.0924	0.017	0.66	0.004	1.071	0.827
<i>Sense of control</i>	0.047	0.064	0.002	1.035	0.482	-0.084	0.075	0.014	1.231	0.347	0.076	0.071	0.01	1.163	0.5128	-0.09	0.66	0.004	1.071	0.227

Appendix D

Table D1: F-Tests and T-tests of the measure of difference variable player-avatar interaction with the outcome measures of the group variables attachment style transfer.

		F-test for quality of Variances		Welch two sample t-test for quality of Means			Mean Difference	95% Confidence Interval of the Difference	
		<i>F</i>	<i>Sig.</i>	<i>t</i>	<i>df</i>	<i>Sig.</i>		<i>Lower</i>	<i>Upper</i>
<i>Global transfer</i>	<i>Equal variances assumed</i>	0.763	0.4642	-0.715	63	0.477	0.818	-0.523	-0.295
<i>Mother transfer</i>	<i>Equal variances assumed</i>	0.868	0.6757	-0.935	48	0.3547	0.714	-0.99	0.362
<i>Father transfer</i>	<i>Equal variances assumed</i>	0.955	0.9475	0.255	37	0.8	0.089	-0.616	0.793
<i>Friend transfer</i>	<i>Equal variances assumed</i>	1.501	0.318	-1.803	50	0.07741	0.564	-1.193	0.064

Appendix E

Complete output of all regression analyses performed concerning presence.

Table E1: Regression analyses of the measure of presence and presence subcategories with the outcome measures of the attachment style anxiety dimensions.

	Attachment style dimension global anxiety			Attachment style dimension mother anxiety			Attachment style dimension father anxiety			Attachment style dimension friend anxiety										
	R^2	ΔR^2	F	β	R^2	ΔR^2	F	β	R^2	ΔR^2	F	β	R^2	ΔR^2	F	p				
Player Experience of Needs Satisfaction (PENS)																				
<i>Presence</i>	0.094	0.012	-0.004	0.758	0.387	-0.274	0.073	0.058	5.022	0.0285	0.166	0.025	0.01	1.658	0.202	-0.006	<0.001	-0.016	0.005	0.945
<i>Physical presence</i>	0.058	0.014	-0.033	0.303	0.598	-0.246	0.106	0.063	2.461	0.0489	0.197	0.064	0.018	1.401	0.131	0.098	0.085	0.043	1.981	0.2367
<i>Emotional presence</i>	0.055	0.014	-0.033	0.303	0.611	0.033	0.106	0.063	2.461	0.7866	0.138	0.064	0.018	1.401	0.28	-0.18	0.085	0.043	1.981	0.0287
<i>Narrative presence</i>	0.023	0.014	-0.033	0.303	0.866	-0.07	0.106	0.063	2.461	0.6448	-0.183	0.064	0.018	1.401	0.256	0.094	0.085	0.043	1.981	0.3569

Table E2: Regression analyses of the measure of presence and presence subcategories with the outcome measures of the attachment style avoidance dimensions.

	Attachment style dimension global avoidance			Attachment style dimension mother avoidance			Attachment style dimension father avoidance			Attachment style dimension friend avoidance										
	R^2	F	p	β	R^2	F	p	β	R^2	F	p	β	R^2	F	p					
	Player Experience of Needs Satisfaction (PENS)																			
<i>Presence</i>	0.03	0.003	-0.013	0.166	0.685	-0.127	0.025	0.009	1.611	0.209	0.026	0.001	-0.015	0.038	0.846	-0.006	<0.001	-0.016	0.005	0.945
<i>Physical presence</i>	0.052	0.012	-0.035	0.259	0.495	0.014	0.042	-0.004	0.909	0.89	0.027	0.013	-0.035	0.275	0.842	0.098	0.087	0.043	1.981	0.2367
<i>Emotional presence</i>	-0.037	0.012	-0.035	0.259	0.623	0.021	0.042	-0.004	0.909	0.832	-0.1	0.013	-0.035	0.275	0.449	-0.18	0.087	0.043	1.981	0.0287
<i>Narrative presence</i>	0.019	0.012	-0.035	0.259	0.837	-0.171	0.042	-0.004	0.909	0.177	0.111	0.013	-0.035	0.275	0.505	0.094	0.087	0.043	1.981	0.3569

Appendix F

Complete output of all regression analyses performed concerning appreciation and enjoyment.

Table F1: Regression analyses of the measures of enjoyment and appreciation with the outcome measures of the attachment style anxiety dimensions.

	Attachment style dimension global anxiety			Attachment style dimension mother anxiety			Attachment style dimension father anxiety			Attachment style dimension friend anxiety												
	R^2	ΔR^2	F	β	R^2	ΔR^2	F	β	R^2	ΔR^2	F	β	R^2	ΔR^2	F	β	R^2	ΔR^2	F	β	p	
Audience response																						
<i>Enjoyment</i>	-0.075	0.015	<0.001	0.947	0.334	-0.094	0.017	0.001	1.076	0.304	-0.067	0.008	-0.007	0.519	0.474	0.074	0.013	-0.002	0.848	0.361		
<i>Appreciation</i>	-0.099	0.014	<0.001	0.937	0.337	-0.213	0.049	0.034	3.295	0.074	0.173	0.031	0.015	2.017	0.16	-0.084	0.01	-0.006	0.634	0.429		

Table F2: Regression analyses of the measures of enjoyment and appreciation with the outcome measures of the attachment style avoidance dimensions.

	Attachment style dimension global avoidance			Attachment style dimension mother avoidance			Attachment style dimension father avoidance			Attachment style dimension friend avoidance										
	R^2	ΔR^2	p	β	R^2	ΔR^2	p	β	R^2	ΔR^2	p	β	R^2	ΔR^2	p					
Audience response																				
<i>Enjoyment</i>	0.02	-0.013	0.141	0.708	-0.077	0.018	0.002	1.14	0.29	-0.073	0.009	-0.006	0.602	0.441	0.082	0.029	0.014	1.919	0.171	
<i>Appreciation</i>	-0.038	0.005	-0.011	0.291	0.592	-0.139	0.032	0.017	2.142	0.148	-0.06	0.004	-0.012	0.23	0.633	-0.054	0.007	-0.008	0.47	0.496