Understanding Avatar Identification through Visual Similarity for Richer Story Creation

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Abstract. This paper explores avatar identification in creative storytelling applications where users create their own story and environment. We present a study that investigated the effects of avatar facial similarity to the user on the quality of the story product they create. The children told a story using a digital puppet-based storytelling system by interacting with a physical puppet box that was augmented with a real-time video feed of the puppet enactment. We used a facial morphing technique to manipulate avatar facial similarity to the user. The resulting morphed image was applied to each participants puppet character, thus creating a custom avatar for each child to use in story creation. We hypothesized that the more familiar avatars appeared to participants, the stronger the sense of character identification would be, resulting in higher story quality. The proposed rationale is that visual familiarity may lead participants to draw richer story details from their past real-life experiences. Qualitative analysis of the stories supported our hypothesis. Our results contribute to avatar design in childrens creative storytelling applications.

Keywords: Avatar identification; Children's storytelling; Puppet play

1 Introduction

Much research has explored how to design effective user avatars for different types of virtual environments. Previous research, however, does not fully explore the effects of avatar identification with respect to at least two dimensions. First, studies investigating avatar identification has addressed more performance-based activities, such as video games and digital exercise applications. In these cases, the goal of the application is for the user to perform a generally pre-defined task, rather than produce some creative output. And second, studies of avatar identification has focused on investigating the effects of customizing one's avatar, as opposed to existing physical similarity between the user and avatar itself. This leaves room to explore the benefits of avatar physical similarity within creative applications.

Hence, the goal of our study was to investigate facial similarity between the user and their respective avatar in a creative story application and its effect on story quality and storytelling self-efficacy. Specifically, we use a puppet-based storytelling system that allowed children to produce open-ended stories given a

prompt. We posited that through increased avatar identification achieved via the facial morphing of a cartoon avatar with the participant's own face, participants would draw from personal experiences to come up with stories that are inherently richer. If our hypothesis correct, increasing avatar identification through differing levels of facial similarity should then result in better quality of written stories, if the children were asked to write down their stories.

2 Background

Prior research has established the facial appearance of an avatar has an effect on how we perceive the avatar's personality traits [W01]. Similarly, the fidelity of an avatar, for example its level of realism, can also have an effect on aspects such as psychological co-presence [K01]. When it comes to research investigating specifically avatar identification, the ability to connect with one's avatar, investigations have focused on allowing the user to customize their given avatar in some manner [B01][NL01].

2.1 Related Work

Fox and Bailenson found that providing facial similarity between user and avatar in a digital application that guided the user through exercise activities actually had a behavioral effect on participants in their study [FB01]. While the task supported by their system was not creative in nature, this shows promise that avatar facial similarity can impact the outcome of a digital application, perhaps even if the outcome were some sort of creative product. Suh et al introduced another study directly exploring the effects of avatar similarity to a user [S01]. They investigated both facial and body similarity as two dimensions of their experimental design, with low and high conditions for each. In their research, higher avatar similarity resulted in participants reporting increased positive attitudes and higher levels of avatar identification.

2.2 Theoretical Framework

Our hypothesis that avatars of greater visual similarity would lead children to produce more creative stories is grounded in Gees tripartite model of identities in virtual environments [G02][G01]. Any process of story creation is intrinsically grounded in ones previous life experiences [V01]. The brain combines and creatively reworks elements of this past experience and uses them to generate new propositions and new behavior [V01]. In a virtual storytelling environment however, this real-world identity that provides the underlying mental structures for story creation interplays with the virtual identity that the user forms from her avatar. This is represented in Figure 1.

The virtual identity may also constrain the users creative process in a storytelling task (Box B). According to Gee [G01], what the user projects from her real-world identity onto the virtual identity, and vice-versa, becomes her

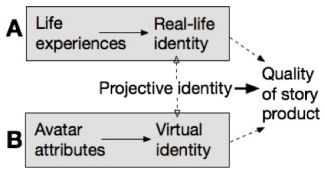

Fig. 1. Theoretical Framework

projective identity. We posit that the degree to which the projective identity emphasizes the real-world identity (that we manipulated in our study through avatar facial similarity to ones real-life self) determines ones likelihood, and perhaps even ability, to recall and draw from ones real-life experiences in story creation.

3 Research Questions

The questions we sought to answer in this study were as follows:

RQ1a: Does increasing the level of an avatar's facial similarity to its user affect the user's sense of character identification?

RQ1b: Does increasing an avatar's facial similarity to its user increase the user's sense of immersion in the story creation experience?

RQ2: Does the level of an avatar's facial similarity to its user affect the quality of the stories created by the user?

RQ3: Does the level of an avatar's facial similarity to its user affect the user's sense of creative self-efficacy?

Our specific hypotheses for the study were as follows:

1) The greater the avatar facial similarity, the greater the user's sense of character identification.

2) The greater the avatar facial similarity, the greater the user's immersion in the story creation experience.

3) There is a significant difference in the quality of stories resulting from the use of avatars of varying levels of facial similarity.

4) There is a significant difference in the user's sense of creative self-efficacy from the use of avatars of varying levels of facial similarity.

We did not provide any hypothesis for RQ2b since that research question was more exploratory.

4 Study

4.1 Study Materials

Avatars: To produce avatars with varying levels of facial similarity to the user, we used a facial morphing software and graphic processing software to create three similarity conditions: 0% similarity; 60% similarity; and 100% similarity.

In 0% similarity, the child was presented with a cartoon puppet avatar whose face was a stranger's face photo with a cartoon filter applied.

In 60% similarity, the participant's face photo was morphed at 60% with a stranger's face photo. The cartoon filter was then applied to the resultant morphed face photo and integrated into the cartoon puppet avatar. In this case, the avatar would produce somewhat of a sense of familiarity - i.e., the participant might not recognize the puppet avatar as themselves, but might feel that the avatar looks familiar.

In 100% similarity, the child was presented with a cartoon puppet avatar whose face was exactly his or her face photo with a cartoon filter applied. In the study, participants were always given avatars of the same gender as them.

Story Starters: Four story starters with different contexts were created to allow for a childs participation in all of the study conditions. The story starters differed in terms of environment (grandparents house, beach, national park or ranch) and in terms of focus objects (a strange necklace, a spatial seashell, a mysterious mushroom, or a magic rock). All the story starters, however, were made as comparable as possible with the same structure: a boy/girl went to the [context] with family. He/she found [focus object]. Create a short story about what happens next.

Puppet-based Storytelling System: A puppet theater was made with white foam board (14 X 8.5 X 11 inches) with backgrounds depicting different scenes printed on large sheets of paper. The puppet theater was placed on the table in front of a camera connected to a large TV screen (Figure 2). In the study, the child participant was asked to create a story by enacting using avatar puppets. When the child enacted a story with the avatar puppets, the camera recorded the childs puppet story enactment and projected the play on the TV screen in real-time so the child could see his/her play. The system produced a video file of the enacted puppet story at the end of the child's enactment.

Fig. 2. From left to right: 60% Morphed Puppet Above 100% Morphed Puppet; Puppet Box Photo; Diagram of Study Set Up

4.2 Study Design

The study used a within-subjects design. The independent variable was 'level of facial similarity' with three levels: 0%, 60% and 100%. A participant also engaged in a baseline condition whereby he/she was asked to write a story without any intervention. One story starter was given for each level of facial similarity and the baseline, such that a child only did a story starter once. The order in which the story starters were assigned was counterbalanced across the participant sample. The order of the study conditions in general was also counterbalanced across the sample.

4.3 Study Description

We conducted the study with 14 children aged 7 to 14 years old (3 boys and 11 girls) recruited through university e-mail listservs. All children participated individually, and the study consisted of two sessions spread over two days. The duration for each session was approximately 1.5 hours.

Day 1 (Session 1): At the beginning of session 1, the child completed a questionnaire capturing baseline data. The child then engaged in the baseline condition. He/she was provided with the first story starter, and asked to write the story on paper. No time limit was given. Afterwards, the child engaged in the 0% similarity condition. The child was given the 'stranger' avatar puppet and given a different story starter. To make sure that the child paid attention to the avatars face, the researcher casually asked the child participant before he/she was allowed to start story creation: "Please look closely at the avatars face. What can you explain about your character?". Each child was given enough time to brainstorm the story ideas and allowed to create paper-based story props if so desired. When the child was ready to enact a story, he/she moved to the story enactment station. After story enactment, the child was asked to write the story that he/she just enacted on paper. No time limit was imposed. The child was allowed to review at will the video of his/her story enactment during story writing. At the end of the session, the child was asked to complete a post-questionnaire, and the investigator conducted a short interview with him/her. The child's parent was also asked permission for the investigator to take a photo of the child. No information or indication was given to the child and parents that the photo would be used for avatar creation.

Day 2 (Session 2): In-between day 1 and day 2, we created the child's avatar puppets for the 60% and 100% similarity conditions by using the child's photo taken at the end of session 1. The procedures for session 2 were essentially the same as session 1, except that the child engaged in the 60% and 100% similarity conditions (order differed depending on counterbalancing). At the end of session 2, the child was given the opportunity to ask any questions, debriefed, and given a toy gift before he/she was released from the study. We provided a copy of the children's stories to them if they so requested.

4.4 Measures

The dependent variables for this study included the following:

- *manipulation check*. We included two single items to measure how effective our morphing was in providing varying levels of avatar similarity, as perceived by the participant: "The looks of my paper puppet is similar to me", and "My looks resemble my paper puppet".
- *sense of character identification*. This was measured after each condition using the appropriate sub-scales from a scale created for for measuring identification in MMOGs [VL01];
- *sense of immersion in the storytelling experience*. This was measured using the General Engagement Questionnaire [BF01] after each condition;
- *quality of written stories*. This was assessed by coding the stories in terms of number of adjectives, adverbs, nouns, and descriptive verbs (e.g., whisper, chat, mutter are descriptive verbs, but talk is not);
- *sense of creative self-efficacy*. This was measured at baseline and after each condition using the creative self-efficacy scale proposed by Tierney and Farmer [TF01]. The scale consists of 3 items: "I am good at coming up with new ideas; "I have a lot of good ideas, and "I have a good imagination.

5 Data Analysis and Results

We present the results of the study below by research question:

5.1 Manipulation Check

Our manipulation involved varying the extent to which the avatar puppet's face resembled the child participant using a facial morphing technique together with cartoon filter applied. Average scores were calculated for the two items that were included in the post-questionnaire for the manipulation check. A repeated measures ANOVA was ran on the scores. There was a statistically significant effect of facial similarity on the perceived resemblance scores, $F(2, 26) = 12.25$, $p = .000$. Pairwise comparisons showed that the 100% similarity condition ($M = 3.64$) was significantly different from both the 0% ($M = 2.99$) and 60% ($M = 2.55$) conditions.

5.2 RQ1a: Facial similarity and character identification

A repeated measures ANOVA was ran on character identification scores. Since the assumption of sphericity was violated for this test, greenhouse-geisser adjustments were applied. There was a statistically significant effect of facial similarity on character identification, $F(2, 26) = 12.00$, $p = .001$. Pairwise comparisons showed that the 100% similarity condition ($M = 4.00$) was significantly different from both the 0% ($M = 2.61$) and 60% ($M = 2.86$) conditions.

5.3 RQ1b: Facial similarity and experience immersion

A repeated measures ANOVA was ran on immersion scores. No significant differences were found, although the means were higher the greater the facial similarity (0% M = 2.71; 60% M = 2.84; 100% M = 2.98) .

5.4 RQ2: Facial similarity and story quality

The first seven participants were selected from our dataset, and their stories were analyzed for this paper. To analyze the quality of the stories, each story was first broken down into an 'idea digest' [RH01]. The idea digest deconstructs a story into individual units of thought or essence of meaning. This deconstruction could even occur within sentences. For example, a story sentence reading "She ate it and felt really special and found out she could fly!" would be broken down into two ideas: "She ate it and felt really special", "and found out she could fly!". After an idea digest had been extracted for each story (including the baseline stories), it was coded for *details*, that we operationalized as the 5Ws+1H (Who/What/When/Where/Why/How's), *conjunctions* (e.g., because, then, so), and *richness descriptors*, operationalized as adjectives, nouns used as adjectives, adverbs, and descriptive verbs. Repeated measures ANOVAs with were ran on the number of details, conjunctions and richness descriptors with baseline story quality values as covariate. We standardized the value of the story quality scores in two ways, by word count, and by number of ideas. This way, even if a story was significantly shorter than another, and naturally possessed fewer descriptors, we could still gauge a sense of its richness.

There was a statistically significant effect of facial similarity on richness descriptors scores standardized by story word count, $F(2, 10) = 4.81$, $p = .034$. The mean values were .08, .09 and .05 for the 0%, 60% and 100% similarity conditions respectively. The effect on richness descriptors scores standardized by number of story ideas was marginally significant ($p = .06$) and showed the same trend. Details digest: There was also a marginal effect of facial similarity on details scores standardized by number of story ideas ($p = .06$). Mean values for this were .62, .64 and .47 for the 0%, 60% and 100% similarity conditions respectively. No significant effects were found for conjunctions scores.

5.5 RQ3: Facial similarity and creative self-efficacy

A repeated measures ANOVA was ran on creative self-efficacy scores. No statistically significant differences were found.

6 Discussion

Our manipulation check showed that the 60% morph condition did not result in the children being able perceive any distinct resemblance to themselves, but they were able to do so for the 100% condition. This means that while morphing did

provide facial similarity for the avatar, it did not manage to create a familiarity effect that we expected in the 60% morph condition. We posit that the effect may have been washed out by the filter we applied to the avatars.

As for character identification, it was only significantly different between the 0% and 100% similarity conditions, and the 60% 100% conditions. This seems to imply that character identification occurs primarily when participants can fully recognize themselves.

The difference in terms of sense of immersion was not statistically significant, but it appears to have an upwards trend increasing with facial similarity. This could perhaps be due to the participants paying more attention to the kind of story they create, or engaging more with the storytelling experience when the avatar puppet resembles them.

For story quality, facial similarity impacted the number of richness descriptors used as well as the level of details in the stories. The story quality was better for the 60% similarity condition. We encountered an interesting recurring phenomenon in the participants' stories where after using the puppet storytelling system, their written stories became more like scripts than actual short story essays. This made comparison to the baseline difficult, as this effect was not found among the baseline stories.

Sense of self efficacy was flat across all conditions, which makes sense when considering this was a brief intervention and self efficacy typically takes longer to impact.

7 Conclusion

We investigated primarily two things: the effects of avatar similarity through facial morphing on avatar identification, and the effects of avatar identification on the output of a task that is both digital and creative. Through the use of a puppet storytelling system intended for children, we invited children participants to create stories with puppets of varying facial similarity, measuring character identificationn, immersion, and creative self-efficacy after each use of our system.

There are a few key limitations with this study thus far. Our sample size was small (N=14), leaving ample room to conduct our study with more participants in the future. A more thorough analysis involving the rest of the participants' stories could also provide more clarity as to the final impact of character identification on the creative output. There is also the possibility of looking at the enacted story recordings as the creative output instead of written re-tellings from the participants use of the system. Lastly, it could be the case that a fully digital storytelling system would have differing results. While the puppet storytelling set-up we implemented made use of digital feedback, it largely existed in a physical context.

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