

Children Creating Pedagogical Avatars: Cross-cultural Differences in Drawings and Language

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Abstract. This research identifies cultural differences among children’s drawings especially as related to their drawings of avatars for instructional software. We invited children to draw characters and textual messages within an instructional game, as a way to establish their expectations of pedagogical avatars. We were interested in both the appearance and language of the characters of different nationalities. We describe an experiment that evaluated cultural differences in children’s drawings. We analyzed drawings produced by 57 children aged 7-10 from four countries and discovered several main effects. Specifically, a significant main effect was found for a child’s nationality and gender in predicting the emotion, formality of language, and use of “polite” or nice language. Girls generally expected more details in the hair, skin and facial hair of their characters and drew more emotions (positive) into their characters. Additionally, Pakistani and Argentine boys drew more details and more head coverings than did other children. Girls from Pakistan drew fantasy figures, rather than realistic figures and did not draw headscarves on their characters. The level of detail expected in the characters varied by country.

Keywords: Developing World, Pedagogical Agents, Children’s Drawings, Localization

1 Introduction

Pedagogical agents used within adaptive learning environments have provided great benefit for learners as indicated by research over the last few decades (Lester, et al., 2004, Blair, Schwartz, Biswas, & Leelawong, 2006; Biswas, Schwartz, Leelawong, Vye, & TAG-V, 2005). Pedagogical agents are effective tools to support student learning; they provide motivation for learning and promote positive affective states (Arroyo, Woolf, Royer, & Tai, 2009). Results have shown that students are extremely sensitive to the appearance and gender of the characters reacting in different ways, and being more or less productive depending on the character’s appearance. In a series of studies, students responded more positively when the gender of the character matched the gender of the student (Arroyo et al., in press).

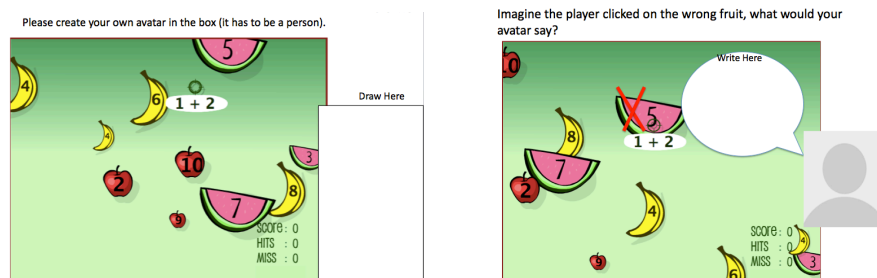
When considering the migration of educational systems and learning environments to other countries, it is unclear whether pedagogical agents would work in a similar way for students of developing countries. Should agents mimic the gestures and even dress codes of students in different countries, or is this localization effort beyond translation unnecessary? Are there differences in the style of language that pedagogical agents should use to communicate with students of different nations?

As a way to measure ecological validity, we decided to carry out an experiment that “taps into” children’s minds and their expectations for pedagogical agents. We asked students to create their own pedagogical agents or avatars that would guide them through a mathematics learning game. The following article describes an experiment across four different countries in different continents, summarizes results and draws conclusions about the way to move forward to identify children’s cross-cultural differences in expectations for a helpful avatar.

1.1 Background and Related Work

Having children draw as a way to mirror what is in their minds is a common technique used in psychology. Research into children’s drawings has focused on three main areas: (a) the internal structure and visual realism of children’s depictions (e.g., Cox, 1992); (b) the perceptual, cognitive, and motor processes involved in producing a drawing (e.g., Freeman, 1980); and (c) the reliability and validity of the interpretation of children’s drawings (e.g., Hammer, 1997). Very young children produce simple scribbles, and later demonstrate representational intentions. With maturation and increased dexterity, children draw objects as they are known rather than as they are actually perceived.

Drawings of the human figure can also reflect a child’s social world. La Voy and colleagues (2001) explored the idea that children from different cultural backgrounds may represent cultural differences in their drawings, because culture permeates a child’s representations of people. Differences across nations indicated that American children drew more smiles than Japanese children, whom in turn drew more details as well as larger figures (La Voy et al., 2001). Similarly, Case and Okamoto (1996)



Figures1-2. A simple addition math game for younger children. Children were invited to supply a drawing for an avatar (left) and then to provide the responses the avatar might provide when the student player chose the wrong mathematics answer.

showed that there are cultural differences between Chinese and Canadian children's drawings. These findings suggest that children's drawings not only reflect representational development but a child's understanding of self and culture as well.

Having students draw characters and games, as a way to tap into their minds and establish their expectations of pedagogical characters and games is an increasingly common technique, and has particularly been implemented for learning systems/games for mathematics education. For instance, Grawemeyer and colleagues (2012) managed to have participants within the autism spectrum express and externalize their individual ideas for an educational pedagogical agent for a mathematics educational game, and to combine their individual ideas with the ideas of others in a small group. Students created their own designs and also studied other students' drawings, eventually creating a common prototype.

The outcome of one of the small groups was quite different from the norm: these children with autism designed characters, such that the student would be sitting at the back seat of a car, being able to view two avatars sitting in the front seat, from the view of the person in the back seat. Instead of showing the avatar facing forward and expressing emotions through its facial expressions, as has commonly been done in the past, the avatars (shown from the back) would have a conversation about the student's learning and progress, as children might interact with their parents when traveling at the back seat of the car. Thus these students with autism expressed their own distaste for talking directly to at people or looking into their eyes. It is assumed that an avatar designed for a typical student would promote better communication if it looked directly at the student.

Other studies have invited children to design and draw full math games, which generally included characters, human or not. For instance, Kafai (1996) invited fourth grade children to design mathematics games for younger children. Her study, identified important gender differences in the design of games. In general, boys were more likely to use fantasy locations in their games (instead of real life locations, such as a sky slope), and also were more likely to have the presence of evil characters, or the idea that an avatar would fight some evil force.

2 The study

Our study involved children invited to draw characters, avatars or pedagogical learning companions to keep student players company as they used a game to learn mathematics. The goal was not to ask for complex representations, but instead, and similar to La Voy and colleagues (2001) to explore cultural differences that are important to understand for authors of creating pedagogical avatars.

Children from North America, Argentina, Pakistan, and Jamaica, aged 7-10 were asked to draw characters they thought would help younger support as they played a mathematics game for younger children. Children were given a printed package of 6

pages. On page 1, students were told “Help us design this math game! We are designing computer based math games for younger children. Can you help us?” On the second page, a screenshot of a simple addition math game, shown in Figure 1, where student players would click on the fruit with the right answer is shown and at the top reads “This is a picture of a math game. In this game, children will learn to add. Using the mouse, they have to click on the fruit with the right answer.” The children were invited to provide a voice for their avatar by providing a response that the avatar might produce in response to a student player’s incorrect answer, see Figure 2. And finally parents and teachers were instructed to complete the student demographics (age, ethnicity, nationality and gender).

We obtained drawings from 57 children from North America (14), Pakistan (11), Jamaica (18) and Argentina (14). Of these children, 30 were girls and 22 were male, mean age was 8.19 (SD = 1.42). We were interested in both the appearance and language of characters developed by these students of different nationalities.

3 Results

Although children were asked to create math avatars that looked like people, children came up with humanoid and non-humanoid images. In one study in particular, it was not clear that students had understood that we meant “characters that look like humans”. Thus, for the purpose of our analyses, we only coded humanoid images (see Figure 3).

Two different human coders analyzed the pictures and messages to respond to correct/incorrect answers from student players. They coded the variables described in Table 1. Because many of these metrics might be somewhat subjective, we had two coders separately. After coding was done, we computed Kappa to analyze agreement between the coders. Whenever a variable had a Kappa value less than 0.5, we reconsidered the variable and came up with a new coding scheme. The variable was

Properties of avatar

1. Realism (Human / Fictional)
2. Gender (F / M / Unspecified)
3. Age (Child / Teen / Adult / Unspecified)
4. Details (+ 1 for each of these: body, eyes, nose, mouth, dimples/freckles, ears, teeth, hair, facial hair, head-covering, clothing, shoes, accessories, toys, skin-coloring)
5. Affect (Happy / Neutral / Sad / Angry)

Voice of avatar

7. Tone of incorrect answer (Polite/encouraging or Direct/Straightforward or rude/aggressive/discouraging)
8. Formality of incorrect answer (formal/neutral/informal)
9. Tone of correct answer (Polite/encouraging or Direct/Straightforward or rude/aggressive/discouraging)
10. Formality of correct answer (formal/neutral/informal)

Characteristics of Participant

11. Language spoken/written (English/Spanish/Pashto)
12. Videogame exposure (Do you play videogames?)
13. Have you ever **used** an avatar?
14. Have you ever **created** an avatar?
15. Age Student
16. Gender: Female (1) Male (2)
17. Ethnicity
18. Nationality

Table 1. Features of the study to analyze cultural characteristics of children’s drawings. Properties of the avatar, voice of the avatar, and characteristics of the student, were analyzed to explore cultural differences.

recoded and the process repeated. Variables with very low Kappas were dropped from the analysis (e.g., age of the avatar). We then carried out Analysis of Variance with the variable of interest, and nationality, gender-child as fixed factors, with age of child as a covariate. In the case of discrete variables, we ran cross-tabulations and Chi-Dquare tests. Results indicate the following.

Gender of Avatars. A significant difference was found for child's gender ($\eta^2 = 38.9, p < 0.001$) and gender of the avatar, showing that most children drew characters of their same gender. No significant differences were found for nationality. Only a minority of children drew characters of unidentifiable gender.

Realism of Avatar. A significant interaction effect between gender of the student and nationality ($F = 3.9, p < 0.015$) showed that Pakistani girls drew more fantasy characters than did children from other countries, or than boys of the same country (see Figure 4).

Level of Detail. A significant main effect was found for a child's nationality in predicting level of detail of the characters ($F = 3.6, p < 0.02$). Students from Pakistan and Argentina drew more details than did children from the United States or Jamaica, regardless of their gender, two more features from Table 1 (see 4. *Details*) on average. Further analyses showed differences in the amount of head-coverings, particularly drawn by boys in general ($F = 13.6, p < 0.001$), and for Pakistani and Argentine boys in particular ($F = 13.6, p < 0.12$), who drew more headcoverings. While we expected girls

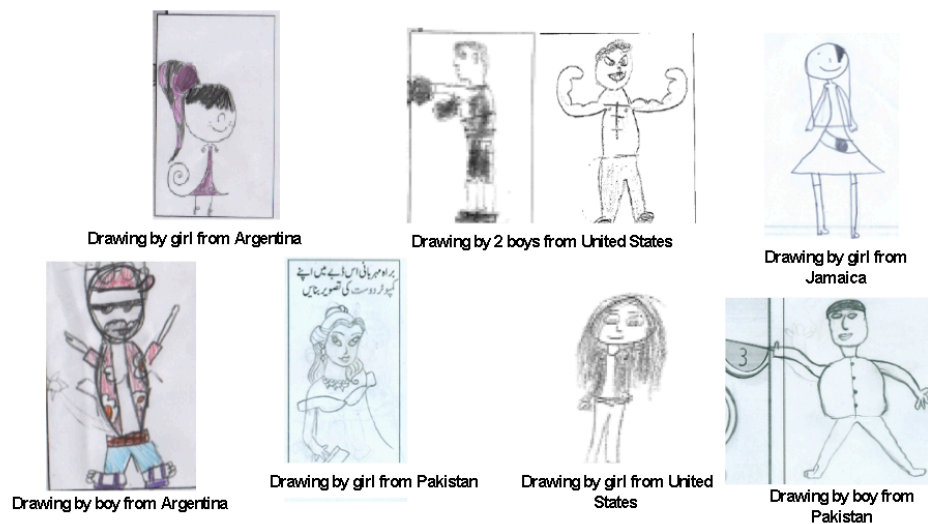
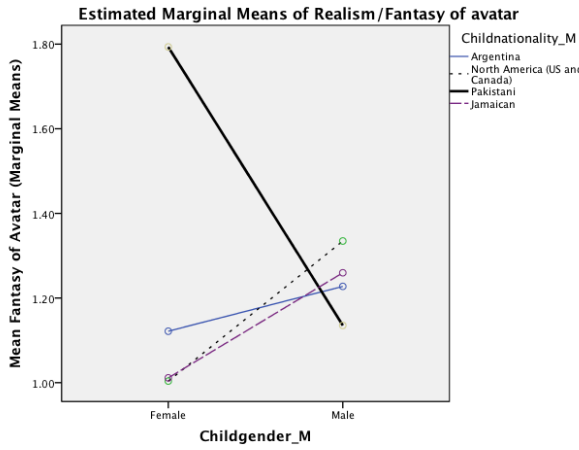


Figure 3. A selection of avatars drawn by children in different cultures as companion for a proposed math game.



Covariates appearing in the model are evaluated at the following values: Childage_M = 8.649

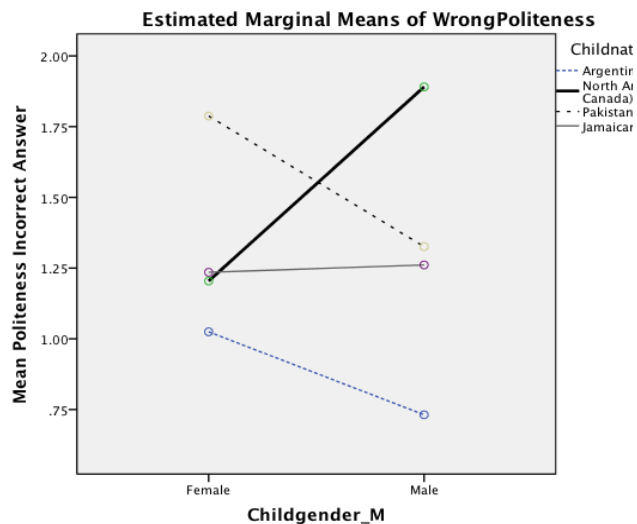
Figure 4. Girls from Pakistan drew more fantasy characters than did other children

students from Argentina drew the most facial hair on their avatars. Meanwhile, girls in general drew significantly more hair on their avatars, both on the characters head (F=11.17, p<0.02) and more facial hair details (note this included eye-brows, eye-lashes, moustache, etc.) (F=8.2, p<0.001). Girls also drew more details on the skin (e.g. freckles, dimples, tatoos, etc.) (F=4.5, p<0.04). No significant differences were found in the amount of accessories used, the kind of accessories, nor in the presence of shoes, noses, eyes, nor bodies. Most students drew all of these, mostly full-bodied avatars instead of heads, and the amount of accessories did not have a consistent differential pattern across nations or genders.

Emotions. A significant main effect was found for emotions expressed by avatars for girls and boys. Girls across nations were more likely to draw avatars with happy faces, with boys evenly split

from Pakistan to draw headscarves, they did not –in fact they tended to not draw images of real people but drew fantasy figures from other cultures such as princesses. The head accessories that boys drew were actually hats.

Another difference had to do with the drawing of clothes –children from the United States drew the least detailed clothes on their avatars (F=3.5, p<0.01). At the same time, students from Jamaica drew more hair on their characters’ heads, and



Covariates appearing in the model are evaluated at the following values: Childage_

Figure 5. Gender differences in politeness of the avatar’s response to incorrect answers from student player

between happy and neutral faces (gender effect, $F=9.8$, $p<0.003$) and a minority of children drew angry/aggressive emotion in their characters, 5% of all students, all three were boys instead of girls.

Formality of Language. A significant main effect was found for a child's nationality predicting the formality of language for the avatars response to incorrect or correct answers from student players in the game ($F=9.7$, $p<0.001$). Students from the United States used more informal language than did students from Jamaica and Argentina (e.g. nope for "no", awesome), and children from Argentina used the most formal language (i.e. least informal language) in their answers than Jamaica, United States and Pakistan.

Tone of Language. Significant effects were found across countries for the avatars' answer after an *incorrect* answer from a student player, where as no significant differences existed for having the character express a response after a player's *correct* answer. A significant main effect for nationality ($F=3.3$, $p<0.03$) showed that students from Argentina used the least "polite" language as compared with students from other countries (e.g., least use of words such as *sorry*, *please*, *thank you* etc.), with children from the United States and Pakistan using the most polite language. Interestingly, there was an interaction effect between gender of the child and nationality ($F=2.9$, $p<0.05$), which indicated gender differences in the tone of the avatar's response to incorrect answer for children of different genders. Actually, boys' avatars from the United States used more polite language than girls' avatars from the same country, despite the fact that the appearances of U.S. boys' tended to be more aggressive than girls' (see examples in Figure 3 drawings); the reverse happened for Pakistan, where girls' avatars used more polite language than boys' (see Figure 5).

4 Discussion

Some research articles have claimed that children's drawings are a mirror to children's minds (Cherney et al, 2006). In light of this, what do these results imply in terms of the creation of pedagogical agents, and the translation of adaptive learning systems to fit new countries, after some important differences in the look and conversation of children's pedagogical agents? If we consider that what children draw is what they expect, value, and desire, the findings suggest that children, regardless of country, expect characters to be of their same gender. This is consistent with our prior findings (Arroyo et al, 2013), which indicated that matching the gender of the student with the character's gender led to improved affective, behavioral and learning outcomes, such as engagement and reduced frustration. Girls also expect more details in their character's hair, skin and facial hair. Boys might want to have more head coverings, particularly hats. Also, girls from Pakistan might prefer fantasy figures instead of figures that depict themselves. Lastly, the fact that girls in general drew more emotions (positive) on their characters could suggest an expectation of girl's avatars to emote and act affectively –however, this needs to be examined further.

It does seem important that the level of detail expected in the characters will vary by country. Children from Argentina and Pakistan might expect more level of detail in their characters than do students of the United States or Jamaica, e.g. clothes and hair. Meanwhile, differences across countries are especially marked in the *kind* of language to be used when the characters talk, specifically when student players produce incorrect answers, with Argentine children apparently expecting the least politeness. Expectations of politeness and niceness of the language can be explained by cultural differences. People in Argentina are very straightforward in their dialog (similar to European countries such as France, Italy or Spain) and do not excuse themselves so much in their daily interactions. This is something that needs to be examined when designing characters that communicate with students, even if the communication is in the form of text and not voice. This would potentially argue against a mere translation from English to Spanish, where such polite words might show up. Differences in formality of the language between Argentina and the United States could be explained by the fact that the language might not lend itself to informal distortion of words such as “nope”.

5 Conclusions and future work

Large differences were observed in children’s design of pedagogical agents across a variety of dimensions, but probably in different areas than we had originally expected. . Differences were present across countries, across gender, and across country and gender. Main differences were in language of incorrect answer across countries, and in the look of characters, both across countries and genders. These differences span across the visual appearance of pedagogical agents as well as in the language used to communicate to student players. From a methodological point of view, having children design pedagogical agents by having the freedom to draw and create, can act as a mirror to their minds and help researchers to externalize their expectations.

The main limitation of this study has to do with the total amount of subjects available, which is not representative of different socio-economic levels of each country, as well as a lack of representation in terms of ethnicities in each country, Future work will consist on a larger study, with a much larger number of students.

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