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Agent Gender and Frequency Dimension Used in Voicing, and Use of Pedagogical Interface Agents

Betül TONBULOĞLU*, Nesrin ÖZDENER*

Abstract: The purpose of this study is to investigate effects of use of voice in interface agents included in educational software on students' agent preferences and learning levels. In this context, it was investigated to see whether there are any relations between student gender and the preferred agent gender; students' preference among agents with voices in different frequencies; and effects of the voicing technique on students' achievements. The post-test experimental model was used in the study and the study group consisted of 112 primary education students. Data collection tools of the study included pre-knowledge test; four educational software packages, in which agents having different voices and genders were used, and an achievement test. Multi-factor ANOVA and ANCOVA tests were used in analysis of data. At the end of the study, it was seen that the frequency used in voicing the pedagogical interface agents of the software did not have any significant effects on students' learning levels, and it was observed that students tend to choose the agents of their own gender, and that they prefer high-pitched voice for male agents and high-pitched voice for female agents.

Keywords: Pedagogical interface agents, Agent gender, Agent voicing.

Interface agents are software programs that assist a user to perform specific tasks on a computer, and interact with the user by observing his/her actions (Lashkari et al, 1994). Interface agents intended for educational software are called pedagogical interface agents, and they are used for developing more effective educational software (Morozov et al, 2003). According to Baylor and Kim (2003), interface agents facilitate learning by providing social interaction between computer and individual.

Baylor (2005) lists the studies conducted in this field as agent's interface characteristics, roles and functions of agents, their influencing supports, effects of audio and animations. It is observed that there are studies that show different findings related to the gender of agents in the literature. Baylor and Kim (2003) conducted a study analogous to the one conducted by Baylor, Shen, Huang (2003) previously for the purpose to investigate how the ethnic origin and gender of pedagogical interface agents influence perceptions and attitudes of students. The study conducted using four different interface agents with different gender and ethnic origin showed that male and female students studying with a male interface agent achieve more satisfaction, and that male interface agent provided more assistance with their self-regulation. Similarly, according to Kim (2004), students studying with a male agent learned more than those who studied with a female agent, paid more attention to their tasks, and tended to perceive agent's personality more positively. However, according to the findings of the study conducted by Kim and Flann (2007) among high school students, a large portion of female students preferred a female agent. Furthermore, it was also observed that mathematics self-efficacy of students studying with a female agent increased, but of those studying with a male agent decreased. Furthermore, mathematics self-efficacy of female students, who chose their agent themselves, was higher than of those, whose agents were chosen randomly.

Within the literature available there are many sources that investigate what voicing techniques used in pedagogical interface agents positively affect learning. It is known that a pedagogical interface

* İhsan Kurşunoğlu Primary School, Ataşehir , İstanbul 34704,Turkey, email: betultonbuloglu@gmail.com
* Marmara University , GöztepeCampus, Kadıköy İstanbul34722, Turkey

agent communicating with students using voice renders courses more attractive, facilitates recollection and enhances perception of learning better compared to one communicating using texts (Moreno, 2001; Moreno, Mayer, Lester, 2000; Craig, Gholson, Driscoll, 2002). Morozov et al (2003) stated that interface agents using both text and voice communications influence students' achievement more positively compared to those using either voice or text only communication.

In their study, in which they investigated social impacts of speaking animated agents, Louwerse et al (2005) observed that participants preferred natural agents with natural voice, as the social bookmarking hypothesis proposes. However, the study conducted with regard to human-like agents showed that a female agent speaking with a low-pitched voice provided more successful results compared to one with high-pitched voice. It is considered worthwhile to study whether the results of the study conducted by Louwerse et al (2005) among university students also apply to primary school students.

Purpose of the study and research questions

The purpose of this study is to investigate use of pedagogical interface agents, gender of agent, and frequency dimension used in voicing. In this context, it was investigated to see whether there are any relations between student gender and the preferred agent gender; students' preference among agents with voices in different frequencies; and effects of the voicing technique on students' achievements. Answers to the following questions were sought within the scope of this study:

1. Arethereanydifferences in terms of student achievement between study groups that studied using software, in which agents with voices in different frequencies (male agent with high-pitched voice, and female agent with low-pitched voice)?
2. Whatarestudents' preferences with respect to software, in which agent with voices in different frequencies (male agent with high-pitched voice, and female agent with low-pitched voice)?
3. Is student'sgender an effective factor on agent preference?

Method

The post-test experimental model was used in the study and the study group consisted of 112 primary education students. Data collection tools of the study included pre-knowledge test; four educational software packages, in which agents having different voices and genders were used, and achievement test. The pre-knowledge test was used to determine the pre-knowledge of students in the study group about the subjects covered by the educational software. Four educational software packages were developed by the researchers, and during the voicing process, the voice frequencies and agent genders were changed (male agent with low-pitched voice, female agent with high-pitched voice, and female agent with low-pitched voice and male agent with high-pitched voice) to determine students' agent preferences, and the effects of the software on students' achievements. The achievement test was used to make comparisons between the groups at the end of the application.

Students in the study group were first subjected to a pre-knowledge test relating to the subject covered by the educational software for the purpose to assess their level of knowledge about target subject, and whether they had the pre-knowledge required for learning it. During the application stage, each student used one computer, and was asked to choose the agent he/she liked the most from among those whose pictures and voices were introduced, and to use the software in their studies, in which the chosen agent was used. During the application that lasted 3 weeks, after listening to the contents of the educational software covering different subjects each week, students were subjected to a multiple-choice achievement test consisting of knowledge (remembering) and comprehension (understanding) questions relating to the subject studied during respective week. Only one voice

recording was used to prevent differences in use of language, accent, stress, etc. in a number of recordings, and different voices were generated using frequency ranges different from that of original recording, using the Goldwave sound editor. Because it was desired to investigate the impacts of voicing, a text summary of the voice recordings was displayed, instead of the full text of the same. And because it was desired to investigate students' levels of achievement in line with their choices, they were not allowed to replace the agent they had already chosen, and the same agent was used. The subjects used in the educational software programs were ""What is software?, "Types of Software", "Spyware", "Firewall", and "Worms".

Findings

Because the pre-knowledge levels of students were not equal, average scores of the achievement test, which were corrected based on scores obtained from the pre-knowledge test, were determined using the ANCOVA test, and they are provided in Table I.

Table I
Descriptive statistics of Post-test achievement scores by groups.

Groups	N	Mean	RecoveredMean
Gender: Male, Voice: Low-Pitched	19	47,11	46,81
Gender: Male, Voice: High-Pitched	21	52,89	49,55
Gender: Female, Voice: High-Pitched	60	50,66	51,37
Gender: Female, Voice: Low-Pitched	12	38,25	65,39

Results of the ANCOVA test conducted for the purpose to determine whether the differences that were observed among the corrected average achievement test scores of groups are significant are provided in Table II.

Table II
ANCOVA results of the achievement test corrected based on the pre-test scores by groups.

Source of Variance	Sum of Squares	Sd	Average of Squares	f	Sig. (p)
Pre-test	820,03	1	820,03	1,96	,16
Group	1355,34	3	451,78	1,08	,36
Failure	43533,73	104	418,59		
Total	321497,56	112			

According to the test results, no significant differences were found among average achievement test scores of students in different groups, corrected based on the pre-knowledge test [$p > .05$]. In other words, achievement levels of students were not related to the group they belonged to.

Results of two different choice processes conducted for determination of students' agent preferences are provided in Table 3. According to the results of the first choice run, the high-pitched female agent became the most preferred agent among students with a percentage of 53,5%. Furthermore, it was also seen that high-pitched voice was preferred more than the low-pitched voice in general. Taking into consideration the likelihood that generation of the low-pitched voice using a software program would affect the results, the study group was asked to make a second choice.

Different agents were used in the second choice run, and the agents were voiced using actual low- and high-pitched voice frequencies, without using a sound editor. The results of the second choice run, provided in Table III, show that high-pitched voice was again preferred more than the low-pitched voice. In this case, it is possible to say that students tend to prefer female agents with high-pitched voice and male agents with high-pitched voice.

According to the data provided in Table III, 92% of female students preferred a female agent, while 72% of male students preferred a male agent. Therefore, it can be said that students tend to choose the agents of their own gender.

Table III
Results of students agent preferences.

Agent Choice	Student's Gender	Female Agent				Male Agent			
		Voice: High-Pitched		Voice: Low-Pitched		Voice: High-Pitched		Voice: Low-Pitched	
		Frequency	Percent	Frequency	Percent	Frequency	Percent	Frequency	Percent
First Choice	Female	48		11		4		1	
	Male	12	%53,5	1	%10,7	17	%18,7	18	%16,9
	Total	60		12		21		19	
Second Choice	Female	42		5		12		5	
	Male	12	%48,2	2	%6,2	17	%25,8	17	%19,6
	Total	54		7		29		22	

Conclusion, Discussion and Recommendations

The agent gender, frequency dimension used in voicing, and use of pedagogical interface agents were investigated in this study. The results of this study show that voicing the agents in different voice frequencies (male agent with high-pitched voice, and female agent with low-pitched voice) does not affect the learning levels of students. However, results of the study conducted by Louwerse et al (2005) on university students showed that a female agent with low-pitched voice produced more successful results in terms of learning levels than the agent with high-pitched voice. In this case, it may not be possible to say that the results obtained by Louwerse at al would apply to all student groups.

According to the results of another study, students tend to prefer a female agent with high-pitched voice and a male agent with high-pitched voice, and the results of a second choice made by students showed that high-pitched voice was preferred more than the low-pitched voice. Furthermore, female agents were preferred more than the male agents. When students constituting the study group were asked the reason of their choice, they said they found the high-pitched voice more polite, and that they thought they would learn better with the high-pitched voice. It is quite interesting that one group of students said male teacher image sounded frightening to them and that therefore they did not tend to prefer low-pitched voice. It considered worthwhile to investigate this point.

According to another finding obtained from this study, primary education students tend to choose the agents of their own gender. This finding matches Freud's psychosexual stages of development theory. According to this theory, in the latent stage (5-11 ages), both male and female children

approach to their fellows. Furthermore, results of the study conducted by Sel (2009) on primary education students match this result.

In conclusion, it would be worthwhile to take into consideration the fact that, for the agents used in educational software designed for primary education students, both the voice frequency and the gender factors are important elements in terms of increasing students' interest.

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