

# ABSTRACT

We are developing a Computer Agent (CA), or “virtual provider”, to deliver medication information to support self-care among older adults. In an initial evaluation, older and younger adults responded to CAs varying in gender, age, and level of realism that delivered medication information. Findings were consistent with the idea that CAs can engender social responses. Participants preferred interacting with human-like, realistic over highly stylized (emoji) CAs. They generally preferred female over male CAs, and justified their choice by appealing to affective/relational aspects of the CAs. Justifications for choosing male CAs were more likely to focus on trust, knowledge, and ease of understanding.

## 1 INTRODUCTION

Health technology holds great promise for improving patient education, in part by augmenting provider/patient communication (Charness & Boot, 2009). CAs can emulate best practices of face-to-face communication and can be accessed as needed by patients. They can engender social responses that improve motivation and learning among students (Baylor, 2011; Moreno, 2005; Schroeder et al., 2013), and can improve health outcomes among older adults (Bickmore et al., 2009; Bickmore et al., 2010). Ryu and Baylor (2005) identify two types of CA characteristics that influence outcomes: 1) Credibility, expertise and other characteristics that support learning, (**informational role**); 2) Emotional expression and other characteristics that engage the user (**relational role**). Like human social interactions, the similarity between CA and person (e.g., matching gender or age) may influence both informational and relational roles, which may in turn influence self-care (Baylor, Shen, & Huang, 2003; Zhou et al., 2014). However, the literature has produced mixed findings, with some evidence that objectively matching CA/person characteristics (e.g., Bailenson et al., 2008, Persky et al., 2013; Yanghee, 2016) or perceived similarity (Nass et al., 1995; Rosenberg-Kima et al., 2008; Zhou et al., 2014) is more important.

Furthermore, user preferences depend on the CA role, as people may prefer male CAs especially for informational role and female CAs for relational role (Baylor & Kim, 2004; Baylor, Shen, & Huang, 2003). Level of realism is a general constraint on matching hypothesis – highly stylized CAs may be too dissimilar to evoke preferences related to matching CA/person characteristics.

We explored the impact of CA realism, gender, and age on preferences for interacting with CAs in the context of self-care, and whether participants preferred:

- More or less realistic CAs.
- Female or male CAs, and whether preferences depended on matching CA and participant genders.
- Older or younger CAs, and whether preferences reflected CA/participant match in age.

## 2 METHOD

- We developed CAs that varied in realism, gender, and age to investigate whether participants prefer more realistic CAs that match them on age and gender.

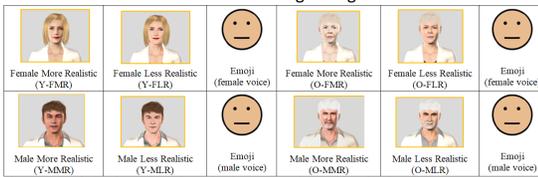


Figure 1. Study Design – CAs of varying in age, gender and levels of realism

- In an online (Mechanical Turk) study, we evaluated older (OA) and younger adults' (YA) responses to medication information delivered by the CAs. Participants either saw older or younger CAs varying in gender and level of realism.
- After all CAs were presented one-by-one, these CAs were again presented simultaneously in a 1 x 5 array of static images. Participants ranked which CA they would prefer to deliver their health messages, and answered an open-ended question about reasons for choosing their preferred CA.
- Three independent coders categorized the responses into 11 categories ( $\kappa = .943$ ; Fleiss, 1971).
- We analyzed the reasons for CA preferences, including how the reasons related to two Agent Persona Instrument (API) constructs (**affective interaction** and **informational usefulness**; Ryu & Baylor, 2005).
- We conducted discrete choice models to explore the distinctive factors underlying choice of each CA.

Sample Demographics	
Age:	
YA (n=240)	m=36.4 years (19-59)
OA (n=120)	m=65.5 years (60-77)
Gender:	
63.3% female	
Education:	
YA	m= 15.4 years
OA	m= 15.2 years
(t-test: p > .10, ns)	
Help to read health materials (measure of health literacy; Chew et al., 2004):	
YA	OA
Always = 2.5%	Always = 0%
Often = 5.8%	Often = 3%
Sometimes = 22.9%	Sometimes = 8%
Occasionally = 18.8%	Occasionally = 13%
Never = 50%	Never = 77%
(χ <sup>2</sup> : p > .05, ns)	
Self-reported health: (7 pt scale - very unhealthy/very healthy)	
YA	m= 5.00
OA	m= 4.99 (t-test: p > .10, ns)

# The Influence of Computer Agent Characteristics on User Preferences in Health Contexts

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## 3 RESULTS

Younger CAs	n (%) first choice	Mean rank	n (%) last choice	Older CAs	n (%) first choice	Mean rank	n (%) last choice	All CAs	n (%) first choice	Mean rank	n (%) last choice
	54 (20.0%)	2.42	10 (5.6%)		56 (31.1%)	2.41	11 (6.5%)	Female More Realistic (FLR)	110 (50.6%)	2.42	21 (9.8%)
	45 (20.0%)	2.57	16 (8.9%)		37 (20.6%)	2.76	21 (11.7%)	Female Less Realistic (FLR)	82 (37.2%)	2.66	37 (10.3%)
	21 (11.7%)	3.06	11 (6.1%)		19 (10.9%)	3.19	23 (12.8%)	Male More Realistic (MMR)	40 (18.2%)	3.12	14 (9.4%)
	41 (22.8%)	2.72	14 (7.8%)		56 (30.0%)	2.78	15 (8.3%)	Male Less Realistic (MLR)	77 (34.4%)	2.75	30 (8.1%)
	19 (10.8%)	4.24	120 (71.7%)		32 (17.8%)	3.80	110 (61.1%)	Emoji Smil Control	51 (23.2%)	4.05	239 (66.4%)
Total	100 (100%)		100 (100%)	Total	100 (100%)		100 (100%)	Total	360 (100%)		360 (100%)

### Participant-CA concordance: Gender and Age:

We found no evidence that participants chose CAs matching their gender ( $\chi^2 = 3.3$ ,  $df=1$ ,  $p$ -value < .10, ns.). Since the variable CA age was manipulated between subjects, we could not directly test whether participants preferred CAs with (roughly) matching age. However, as reported in Azevedo et al. (2018), analysis of trial-by-trial CA evaluation found some evidence that older participants evaluated older versus younger CAs more positively.

### Reasons for choice preferences:

CAs	(GEN)	(FF/A)	(S/V)	(C/P)	(E/P)	(FR)	(R/HL)	(REL)	(KN)	(T/C)	(UND)
Factor	CA	CA	CA	Affect Int.	Info Usef.	Info Usef.	Info Usef.				
FLR	19.2%	17.4%	13.7%	40.9%	31.9%	15.4%	31.8%	17.3%	1.8%	9.1%	0.9%
FMR	21.7%	10.7%	17.4%	26.8%	11.8%	25.5%	36.8%	10.7%	1.1%	4.4%	3.6%
MLR	7.6%	22.9%	12.4%	15.0%	20.1%	12.7%	32.0%	10.0%	14.8%	15.0%	9.5%
MMR	8.0%	14.3%	10.3%	11.8%	12.9%	9.4%	63.0%	11.8%	3.7%	9.0%	0.0%

### Discrete Choice Model:

**Younger CAs** : two distinctive factors predicted choice: **perceived realism** ( $\beta = .30(0.10)$ ,  $p < .001$ ) and **expressiveness** ( $\beta = -.30(0.13)$ ,  $p < .01$ ). **Older CAs**: only **participant age** predicted choice. We described each of the choices by participants' age. While the choices among the older CAs are more evenly distributed for younger participants (MMR=30.9%, FLR=27.8%, FMR=25.8%, except less favoring MLR CAs=15.5%), older adults have a strong preference for FLR CAs (56.9%) compared to others (FMR=23.5%, MMR=11.8%, and MLR=7.8). Overall, participants preferred the FLR CA because it was more comforting (40.9%) and expressive (31.9%)

## 4 CONCLUSIONS

- Human-like agents were preferred to the highly stylized emoji, suggesting these agents engaged social responses but were not so realistic that they might fall into the uncanny valley, where people may have trouble distinguishing agents from people (Mori, 1970).
- Participants tended to prefer both younger and older female over male CAs. They tended to justify their preference in terms of affective/motivational characteristics of the CA (e.g., expressiveness).
- When participants chose male CAs, they tended to mention reasons related to the CAs informational usefulness (e.g., credibility). Similarly, Baylor found that students tend to prefer male CAs because they are perceived as more knowledgeable. These findings suggest gender stereotypes are projected to interactions with CAs. Baylor (2011) suggests female figures (e.g., mothers, teachers) may be more motivational, relational and persuasive.
- Preferences for female CAs did not depend on participant gender, contrary to the matching hypothesis. This may reflect limited interaction with the CAs in this study.
- Results for the discrete choice models also suggested that older versus younger adults tended to prefer the female less realistic CA. Perhaps less realistic female CAs enhanced emotion detection compared to more realistic ones (see Kendall et al., 2016).

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### Exemplars of reasons for choice preferences

Categories	General Agent Factors	Quotes : Examples
Gender (GEN)	CA Physical Characteristics	"I'd prefer info come from a male doctor looking person" "Well I'm a female, so I guess I just relate to the female more (...)"
Facial Features / Animation (FF/A)	CA Physical Characteristics	"I liked the ease of animation on my number one choice the most." "Better to see the cartoon cause of the mouth movement."
Speech / Voice (S/V)	CA Physical Characteristics	"I feel like I liked how they talked better" "I feel like the man illustration was clear in speech"
Comfort / Positive Feelings (C/P)	Affective Interaction	"They were all good, but I felt more comfortable with the one I chose." "The human faces that look more realistic are more comforting and show positive feelings to me personally."
Expressive / Personality (E/P)	Affective Interaction	"Because I felt this avatar was more personable and showed emotion better than the others" "I ranked them in order by the amount of personality I felt they had, and how much they expressed themselves"
Friendly (FR)	Affective Interaction	"Female CA seems healthier and friendly (She looks like a doctor)" "They appeared more friendly/lit up"
Realism / Human-Like (R/HL)	Affective Interaction	"I prefer one that looks like a human being (...)" "I would prefer a more realistic female face over a realistic male one, or at least a human face over a smiley face."
Relatable (REL)	Affective Interaction	"I identify closer with the older white woman. I have no identification with the smiley face." "Computer agents who have more expressive features are seen as more relatable"
Knowledgeable (KN)	Informational Usefulness	"I chose this way because they appeared to be more trustworthy, relevant to me, and more knowledgeable." "The smiling faces don't seem as knowledgeable. The Woman looks dumber than the man."
Trust / Confidence (T/C)	Informational Usefulness	"I thought she had a more professional voice and was more direct and trustworthy."
Understanding (UND)	Informational Usefulness	"I went by what I would trust the most and what looked the most expressive." "Because the man explained the best" "How easy it was for me to understand it clearly"

### Reasons for choice preferences mapped into API constructs: (Ryu & Baylor, 2005)

Younger CAs	Affective Interaction	Info Usefulness	Older CAs	Affective Interaction	Info Usefulness	All CAs	Affective Interaction	Info Usefulness
Y-FLR	28.70%	4.30%	O-FLR	24.10%	3.60%	FLR	26.40%	3.90%
Y-FMR	20.60%	5.20%	O-FMR	16.90%	0.90%	FMR	18.70%	3.00%
Y-MLR	13.10%	17.50%	O-MLR	15.80%	8.80%	MLR	14.40%	13.10%
Y-MMR	9.80%	5.70%	O-MMR	13.20%	2.80%	MMR	11.50%	4.20%

