No Joke: An Embodied Conversational Agent Greeting Older Adults with Humour or a Smile Unrelated to Initial Acceptance

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Figure 1: Three versions of the ECA, each representing a different affective state based on varying levels of valence and arousal: laughing (left), smiling (middle), neutral (right).

ABSTRACT

Embodied conversation agents (ECAs) are increasingly being developed for older adults as assistants or companions. Older adults may not be familiar with ECAs, influencing uptake and acceptability. First impressions can correlate strongly with subsequent judgments, even of computer agents, and could influence acceptance. Using the circumplex model of affect, we developed three versions of an ECA—laughing, smiling, and neutral in expression—to evaluate how positive first impressions affect acceptance. Results from 249 older adults indicated no statistically significant effects except for general attitudes towards technology and intelligent agents. This questions the potential of laughter, jokes, puns, and smiles as a method of initial engagement for older adults.

CCS CONCEPTS

• **Human-centered computing** → *User models*; *Empirical studies in HCI*; *User studies*; *Natural language interfaces*; • **Social and professional topics** → **Seniors**; • **Computing methodologies** → **Intelligent agents**.

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KEYWORDS

Embodied conversational agents, Older adults, Acceptability, First impressions, humor

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1 INTRODUCTION

Embodied conversational agents (ECAs) are interactive computer systems that mimic real agents—typically people, but also non-humans—in appearance and/or behaviour [42, 46]. The visual appearance of ECAs compared to other socially intelligent agents (IAs) allows them to communicate with users non-verbally. Non-verbal behaviors, such as nods, posture, and facial expressions, play an important role in engagement [20], trust and empathy [58], and emotional expression [1, 35], among people and with computer agents [7]. ECAs are increasingly being explored for older adults as emotional support [32], everyday support [49], and for healthcare [51]. The realism of ECAs can be attractive [58] but also uncomfortable, if "too" humanlike or uncanny [53]. Also, older adults experience more barriers to acceptance of new technologies compared to other age groups [3, 15, 17, 19]. Therefore, ECA design must be carefully geared towards older adults.

In human-human interaction, first impressions are crucial and can be lasting [4, 23, 27]—and the same appears to be true when it comes to computer agents, like ECAs [5, 42]. This may be especially

true for older adults, when first impressions are formed based on an agent's nonverbal expressions of personality and interpersonal attitudes [6]. One nonverbal characteristic that could influence first impressions and help older adults embrace ECAs more readily is humour [8, 26, 39]. Indeed, affective computing researchers have called for further study on ECA emotional expression and humour [39]. At present, very little research has been conducted on the impact of humour in ECAs generally or specifically within the context of first impressions and for older adults.

As a first step, we evaluated whether acceptance of an ECA by older adults could be influenced through first impressions featuring humour. We asked: ***Can humour improve initial acceptance of an ECA by older adults by influencing first impressions?*** To this end, we built an ECA with three distinguishable levels of affective expression that introduces itself via video. We randomly assigned older adults to each version of the ECA. We found no statistically significant differences, except in relation to general technology and IA acceptance. We report our negative results in accordance with human-computer interaction (HCI) and general science procedures against publication biases [11, 36]. We contribute these null findings and raise questions about the who, where, and how of humour for ECA design.

2 THEORETICAL BACKGROUND

2.1 Older Adults, Agent Acceptance, and Humour

Populations around the world are ageing at a rapid pace [38]. Advances in everyday technologies parallel this trend, with older adults emerging as a key user group. Anderson and Perrin [2] found that in 2016, 67% of older adults used the Internet and about 40% had a smartphone. Still, technology adoption among older adults is low compared to 90% of the general adult population being "wired in." Older adults experience barriers, e.g., complex and inaccessible user interfaces (UI) [13], and may also resist new technology, which is linked to low acceptance [18, 54].

Autonomous IA with multimodal embodiments, like ECAs, may be an inclusive and engaging option [14, 48, 56]. Still, first impressions are critical, perhaps especially for older adults [22]. By "first impressions," we mean the initial feelings and attitudes—positive, negative, and neutral—elicited in a first encounter [4]. First impressions are formed unconsciously and quickly, usually within a few seconds. Importantly, if the first use is negative, subsequent use may be disrupted or perceived as negative [16]. Facial expressions, such as smiling, can lead to positive first impressions [29, 40]. Humour may be especially effective [5, 25, 44, 52]. For instance, Tabak et al. [52] found that older adults appreciated dynamic elements such as humour over static characteristics such as agent agedness and genderedness. Binsted at el. [5] suggested that self-deprecating humour could be employed by an agent. As such, we designed our ECA to express humour, including self-deprecating humour, verbally (with voice) and nonverbally (with facial expressions).

2.2 Modeling Technology Acceptance

Davis [12] used the Theory of Rational Action (TRA) to infer that beliefs about technology can affect intention to adopt technology: the Technology Acceptance Model (TAM) [12]. Core concepts include perceived ease of use and perceived usefulness. TAM predicts that people are more likely to adopt a technology when it is perceived to be easy to use and useful, and perceived ease of use can influence perceived usefulness [12]. For example, Lee at el. [28] explored whether and to what degree older adults would accept a soft service robot in the home, finding that perceived ease of use, usefulness, and subjective norms were statistically significant predictors of acceptance. Chen at el. [9] later developed the Senior Technology Acceptance Model (STAM) using the TAM and other models, including the Unified Theory of Acceptance and Use of Technology (UTAUT) [55]. The elder-centred STAM includes eight predictors: geriatric technology self-efficacy, geriatric technology anxiety, facilitation conditions, self-reported health status, cognitive ability, social relationships, life attitudes and satisfaction, and physical functioning. Acceptance of geriatric technology is operationalized as positive attitudes towards technology. As such, an ECA that introduces itself in a positive way may influence older adults' first impressions in a similarly positive way, and thus their acceptance of the ECA.

Combining the potential of a humorous ECA and the STAM, we hypothesized that: ***H1. Use of humour expressed by an ECA through nonverbal facial expressions and verbal content, i.e., laughing, puns, and jokes, will improve its acceptance by older adults.*** We compared this version to a smiling one (a low arousal complement) and one with a neutral expression. We used measures from STAM research. Since socio-demographic factors, including level of familiarity with technology, could have an effect [9], we also compared novice and non-novice groups.

3 METHODS

We conducted a between-subjects online[1] experiment, where each group viewed a greeting video by the ECA with one of three expressions: laughing with a pun and joke, smiling with a pun, and neutral with a pun (refer to subsection 3.4 and Figure 1 for details). Our protocol was registered before data collection[2] and approved by the IRB (#2023064).

3.1 Participants

Japanese older adults (N=249; women n=60 or 24% and men n=189 or 76%, of which n=2 were X-gender[3] and n=2 declined to report details) aged 65–80 [38] (M = 69.6, SD = 3.6) were recruited through Yahoo! Crowdsourcing[4] between June 12th and June 13th, 2023. We excluded records less than 6 minutes, the bare minimum time according to video length and pilot tests. Older adults were pseudo-randomly assigned to ECA group by birthday; this and data quality eliminations led to different totals per group: n=78 in laughing, n=69 in smiling, and n=102 in neutral. 76% (n=190) had never seen or heard about ECAs before, and 96% (n=240) had never used ECAs before. Participants were paid in accordance with the participant pool at roughly 1200 yen/hour, equating to 400 yen for 25 minutes.

[1] We used SurveyMonkey: https://www.surveymonkey.com/
[2] Registered on April 2nd, 2023, at OSF: https://osf.io/yhtd6
[3] X-gender is similar to non-binary in Japanese culture.
[4] Yahoo! JAPAN ensures unique respondents and quality through identity verification: https://crowdsourcing.yahoo.co.jp/

3.2 Procedure

Participants answered the general attitudes questionnaire (refer to subsection 3.3). Then they watched the ECA self-introduction video (refer to subsection 3.4) and answered an attention check question (input the random number at the end of the video). They also answered questions about their attitudes towards the ECA (refer to subsection 3.3). Finally, they provided demographics and received a Yahoo! Crowdsourcing code for compensation.

3.3 Measures and Instruments

All responses were rated on a 5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree), unless noted.

3.3.1 Technology Acceptance (GAT, GAIA). We used the nine TAM items from the STAM model-based [10], validated 14-item instrument by Chen at el. [9] to capture general attitudes towards technology (GAT) and IA specifically (GAIA). Content included: attitude towards use, perceived usefulness, perceived ease of use, technology anxiety, technology self-efficiency, facilitating conditions, self-reported conditions, social relationships, attitudes towards ageing, and life satisfaction. We excluded the health and capability items, since the ECA context of use was not medical.

3.3.2 Acceptance of the ECA (AECA). We followed the measurement selection protocol of Kramer at el. [24], using the same measures with 26 items for acceptance based on use of the ECA: relationship with ECA, usability, enjoyment, aesthetics, privacy concerns, control, and perceived usefulness. Items on direct interaction were excluded because we used videos for first impressions.

3.3.3 Helpfulness Potential (HP) and Helpfulness Ratio (HR). Behavioural responses are difficult to measure in online experiments, but procedures may be adapted from previous research. Porath and Erez [43] considered how rudeness affects task performance and desire to help, which they operationalized as the average number of pencils that each group helped the researchers pick up. Kühnlenz at el. [25], at the end of the experiment, gave participants the option to go directly to the final stage or to help the robot with an object labeling task. Agreeing to this additional, arduous task was used to measure a basic willingness to help the robot, and the number of labeled pictures produced was used as an indicator of the degree of help. In Wood et al. [57], word count was used to measure children's willingness to talk to a robot by comparing the total number of words children used in their interactions with the robot versus in the interactions with a human interviewer, helping the researcher to understand the differences in their performance in these two contexts. This method provided a quantitative way to compare children's interactions in different interviewer contexts by translating verbalizations into numerical data.

Based on the above, we created the Helpfulness Potential (HP) and Helpfulness Ratio (HR) measures to test willingness to help the ECA. Given the "conversational" context, we asked participants to imagine a conversation with the ECA. We captured (i) the percentage of those willing to help train the ECA, or HP (similar to picking up a pen [43] or an object labeling task [25]) and (ii) how many words participants were willing to contribute, or HR (like dialog word counts between children and a robot [57] and how many labels were produced to help a robot [25]).

The task proceeded as follows. First, participants were given the option to help or not help train the ECA (HR):

> *Thank you for taking the time to let us know what you think of our agents. We appreciate your help in training our agents to speak better.* (エージェントの感想をお聞かせいただき、ありがとうございます。エージェントをもっとうまく話せるように訓練するために、ご協力をお願いいたします。)
> *A. Yes, I'll help* (はい、お手伝いします)
> *B. I'll just finish the last questions* (結構です、最後の質問を終わらせます)

Then they were asked to write a conversational script between themselves and the ECA (HP) using this template:

> *Please use the following template:* (テンプレートに関しては、以下のものをご使用ください)
> *Me* (私)：
> *Mikan* (みかん)：
> *Me* (私)：
> *Mikan* (みかん)：
> *(...)*

3.3.4 Demographics. Demographics included age, gender, health condition, familiarity with ECAs (seen or heard before, or not), and, if applicable, use frequency of ECAs and which kinds used.

3.4 Materials

3.4.1 Design of the ECA. We created three versions of the ECA using Unreal Engine 5, Live Link Face 1.2.1, and Metahuman Creator[5] by Epic Games. Based on Kulms at el. [26] and our Japanese population, we chose a feminine Asian avatar in formal dress. Animating the agent in line with the voice and script involved capturing a Japanese lab member's facial expressions and lip movements on a mobile device (iPhone 11) using Live Link Face and transferring these to Unreal Engine to sync with Metahuman Creator. We used the mappings of Lim and Aylett [31], based on the circumplex model of affect [45], to identify three distinct facial expressions and how to animate these using the ECA's facial features: laughing for the humour condition (high arousal, positive valence), smiling as a non-humorous complement (low arousal, positive valence), and neutral as a control (low arousal, neutral valence). The lab member first studied Figure 9 from Lim and Aylett [31], focusing on the eyebrows, eyes, and mouth of the faces. Then, they imitated each expressions while reading the associated script aloud.

The script was a self-introduction. For all conditions, we set a baseline positive tone using a pun related to the ECA's name ("Although I'm not an edible 'Mikan,' I absolutely love oranges!"). For the "laughing" condition, we used a joke related to technology[6] that a Japanese lab member translated and back-translated ("Do you know why the computer is feeling cold? Ha-ha! It is because Windows is left open!"). The ECA introduced its name, functions, and interests (refer to Appendix A in Supplementary Materials). All videos are on OSF [7], with links to each video listed in Appendix B (Supplementary Materials).

[5] https://metahuman.unrealengine.com/
[6] https://911cybersecurity.com/tech-jokes-a-collection-of-computer-network-infrastructure-and-cybersecurity-humor
[7] https://osf.io/9a7wf/files/osfstorage

3.4.2 Pilot Tests and Manipulation Checks. We conducted three pilot tests to ensure (i) the design of the ECA, i.e., manipulation checks, (ii) no deficiencies in the survey, e.g., bugs, typos, Japanese language checks, and (iii) no instances of bias. Eight Japanese lab members (1 woman, 7 men) participated in all tests. The first focused on the three emotional expressions: whether these matched the expected arousal and valence levels and were distinguishable. Each person voted on the level of valence and arousal for each ECA. The sums matched expectations; however, all thought that the laughing ECA was a bit unnatural. As such, a hand was added, in line with social norms for women laughing in Japanese culture. The second pilot test focused on the content and logic of the three questionnaires (one for each version of the ECA). We modified the base questionnaire by adding explanations about the ECA at the start and editorial fixes. The third pilot test focused on the new ECA design for the laughing condition. The original version and two new versions with a hand over mouth or under chin were evaluated based on arousal and valence. Results indicated that the "hand under chin" version was highest in valence, so we used this video for the laughing condition in the study.

3.5 Data Analysis

Descriptive statistics were generated for all measures (GAT, GAIA and AECA) by ECA version and self-reported familiarity with ECAs: novice (no knowledge) and non-novice (some knowledge or more). Shapiro-Wilk tests were used to determine normality. Most were atypical, so non-parametric tests, e.g., Kruskal-Wallis, were used for analyzing the differences between groups. GoTranscript[8] was used for calculating the number of Japanese words for HP.

4 RESULTS

We present our results below, with key results provided in Figure 2.

4.1 General Acceptance of Technology (GAT) and Intelligent Agents (GAIA)

Descriptive statistics for the GAT were: laughing group (M = 3.3, SD = 0.6), smiling group (M = 3.4, SD = 0.5), and neutral group (M = 3.4, SD = 0.6). For the GAIA: laughing group (M = 3.3, SD = 0.6), smiling group (M = 3.3, SD = 0.6), and neutral group (M = 3.3, SD = 0.5). Kruskal–Wallis tests found no statistically significant difference by ECA group for GAT (p = .842) and GAIA (p = .890). A Mann-Whitney U test found a statistically significant difference in GAT between novices (M = 3.3, SD = 0.6) and non-novices (M = 3.6, M = 0.4), U = 2400.5, Z = -2.61, p < .001, but not for GAIA, p = .096. This indicates similar levels of technology and IA acceptance for all older adults, but flags a potential difference between novices and those more familiar with general technology.

4.2 Acceptance of the ECA (AECA)

A Kruskal-Wallis test found no statistically significant difference between the laughing (M = 2.9, SD = 0.6), smiling (M = 2.8, SD = 0.6), and neutral (M = 2.8, SD = 0.6) groups, p = .420 (Figure Subfigure 2(d)). This suggests that first impressions, regardless of emotional expression, did not have an impact on acceptance of the ECA. A Mann-Whitney U test also did not find a statistically significant difference for AECA between novices (M=2.8, SD=0.6) and non-novices (M=3, SD=0.5), p = .196, meaning older adults accepted the ECA regardless of general familiarity with ECAs. However, a Spearman's rank correlation test for GAT and AECA was statistically significant, $r(247)$ = .422, p < .001, as was one for GAIA and AECA, $r(247)$ = .454, p < .001. Older adults who were more open to accepting technology or IA in general were also more accepting of our ECA. In sum, general acceptance over first impressions.

4.3 Helpfulness Potential (HP) and Helpfulness Ratio (HR)

The portion of participants who chose to help train the ECA (HP) were 71% (n=55) in the laughing group, 72% (n=50) in the smiling group, and 72% (n=73) in the neutral group (Figure Subfigure 2(a)). A Chi-square test indicated no statistically significant differences, p = .966, meaning that willingness to help did not appear to be affected by ECA version. A Chi-square test indicated that the same was true for novices (helped n=152, declined n=6) compared to non-novices (helped n=66, declined n=5), p = .102 (Figure Subfigure 2(b)). However, Mann-Whitney U tests found statistically significant relationships between GTA and HP, U = 7816.5, Z = 3.42, p < .001, and GAIA and HP, U = 8034.5, Z = 3.85, p < .001.

For those who chose to help (n = 178, 71%), a Kruskall-Wallis test found no statistically difference for HR between the laughing group (M = 49.5, SD = 30.7), smiling group (M = 51.0, SD = 28.0), or neutral group (M = 46.1, SD = 34.3), p = .396 (Figure Subfigure 2(c)). Nor did a Mann-Whitney U test find a statistically significant difference between novices (M = 48.1, SD = 31.7) and non-novices (M = 50.7, SD = 30.4), p = .685. However, a Spearman's rank correlation test for GAT and HR was statistically significant, $r(180)$ = .314, p < .001, as was one for GAIA and HR, $r(180)$ = .376, p < .001).

In short, the differing emotional expressions of the ECA had no real impact on willingness to help or degree of aid, and neither did familiarity. Instead, general technology and IA acceptance seems to have had a greater impact.

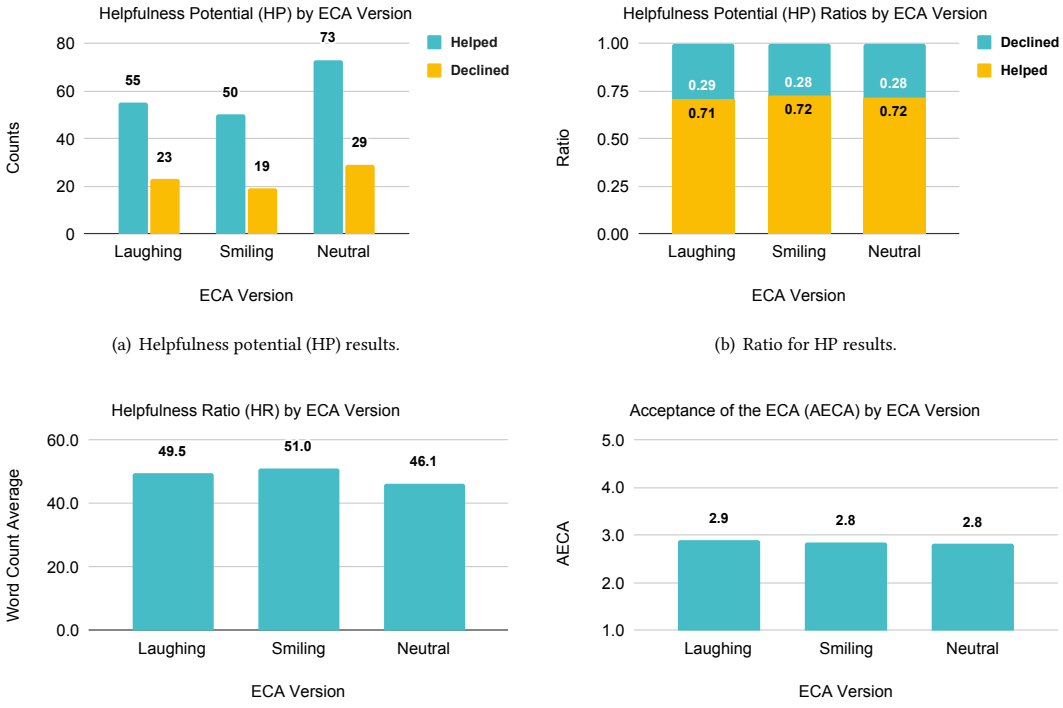
4.4 Results Summary and H1

Altogether, the results fail to support H1. The use of laughter and humour as well as smiling had no effect on initial acceptance of the ECA. Instead, general technology acceptance seemed to explain patterns in acceptance of the ECA.

5 DISCUSSION

The aim of this research was to investigate the influence of humour, laughter, and positive expressions in an ECA as a facet of first impressions that may influence older adult's initial acceptance of the ECA. We employed a rigorous theoretical and design process, including multiple pilot tests and manipulation checks. Yet, the expected result was not found: humour and laughter, as well as general positivity expressed through verbal puns and nonverbal smiles, had no apparent effect. This included attitudes as well as behavioural measures. We could, however, explain this result through general attitudes towards technology and IA. A notable exception was the hint of a difference between novices and non-novices, but

[8]https://gotranscript.com/



(a) Helpfulness potential (HP) results.

(b) Ratio for HP results.

(c) Helpfulness ratio (HR) results.

(d) Acceptance of the ECA (AECA) results.

Figure 2: Key results for behavioural and attitudinal measures by ECA version.

this did not bear out. In short, humour could not improve acceptance in the context of first impressions with the ECA, nor could ECA positivity, at least in the case of our "Mikan."

Prior research has emphasized the significance of positive emotions and dynamic features in ECAs for older adults [39, 44]. For instance, Ring at el. [44] suggested that humour might have a more substantial impact on user acceptance than what we found. Our results may be attributed to differences in ECA design [47], the cultural backgrounds of participants [2], variations in research methods across studies [47], and how older adults approach humour, i.e., individual and personality factors [30, 34]. Even age may play a role: the type of humour that older adults find most enjoyable may differ from other forms [33]. Differences could also relate to the specific type of humour selected or the specific way it was incorporated in the ECA, e.g., the choice of joke and particular facial expressions. Humour preferences may vary among individuals: what may be humorous to one person may not be to another.

Future work can explore these possibilities. For example, ECAs can be designed to adapt their humour styles based on users' personality traits to create more personalized and engaging interactions. Additionally, ECAs can be programmed to recognize and respond to the emotional state of a user, allowing for the strategic use of humour to elevate the mood of a user and enhance their overall experience with the technology. Personality traits and mental health can also be used as variables in ECA acceptance studies and can provide valuable insights for developing targeted interventions. For example, if humour was found to have a more significant impact on individuals with specific personality traits or mental health, then interventions could be designed to use humour to increase ECA acceptance among these groups.

How the ECA was framed as a general personal assistant with a wide array of ever-customizable interests could also have influenced responses in general and especially towards its expressions of humour and positivity. Mikan introduced "herself" and "her" functionalities in a certain way: able to read, converse, buy things, and even play baseball—plus whatever else the user was interested in. This is a rather broad framing of mostly transactional abilities that may not lend itself to humour. Future work should explore what ECA "types" may be best and least suited to humour.

Humour can also be influenced by cultural factors, as Easterners and Westerners often have different attitudes towards humour [21]. As such, perceptions of humour and its impact on the acceptance of ECA may be influenced by cultural background. We should therefore design humour in accordance with different cultures. Therefore, the incorporation of humour in ECAs designed for Japanese users should be culturally sensitive and consistent with current cultural norms and preferences. humour that resonates positively with Japanese participants can increase their engagement with the ECA and promote more enjoyable and natural interactions.

While little work exists, some suggests that older adults may face challenges when it comes to accepting humour expressed in technology [37]. O'Connell et al. [41] indicated that lack of exposure to

technology creates an additional psychological barrier to adoption of new technology. In our case, most participants had little or no prior experience with ECAs, making it their first encounter with this advanced technology. Consequently, older adults unacquainted with the intricacies of ECAs may display hesitation, even when more "humanlike" factors, such as humour, are integrated into the design. An approach tailored to the specific desires and barriers faced by older adults may be crucial for enhancing their receptiveness to ECAs. Perhaps first impressions are not enough. Future work may explore longer-term engagements or run follow-up studies wherein older adults directly interact with the ECA to further investigate the relationship between humour and acceptance.

5.1 Limitations

We acknowledge several limitations in this work, particularly with the online setup. Online experiments cannot guarantee high quality due to various uncontrollable factors (e.g., environment setup and sudden distractions). While we used an attention check, we cannot confirm that participants were fully attentive (e.g., savvy respondents could have skip-searched the video for the code, although we tried to account for this shortcut by removing respondent data less than 6 minutes). There were also uneven distributions in terms of gender (over-representation of men) and ECA group (due to the randomization procedure and elimination of data after quality checks). This may have introduced bias into the results, as participant gender may relate to ECA acceptance [9], and we used a feminine ECA. While we avoided stereotype threats [50] by asking about demographics at the end of the study, future work should aim for accurate gender representation.

Participants did not directly interact with the ECA. Since we were focused on first impressions, we believe that our setup reflected a typical introductory experience. Still, the "engagement" was short- and without a follow-up interactive experience. Future work should consider first impressions in longer-term engagements.

We used a novel measure of helpfulness towards the ECA. While we based it on previous, similar research, other features of the research design could have affected results. For instance, participants may have been more open to helping the ECA after an interactive experience, especially a conversational one, expressions of keen interest in the user, and/or if given a lighter task. Participants could have also been given the task indirectly, i.e., asked to converse through text input with the ECA. This would require some automation in the online study environment. Future work may explore these theoretical and technical possibilities. The development and validation of standard objective, behavioural measures would be a boon for continued online experiments and meta-analysis work.

6 CONCLUSION

Positive first impressions and humour did not impact older adults' initial acceptance of an ECA. We should deeply explore the nuances of humour in ECAs for older adults to identify the most effective and culturally sensitive approaches. Even if humour itself does not directly affect acceptance, it may play a role in longer-term engagements. Designers may take a holistic and longitudinal approach using a range of other factors, such as usability, functionality, familiarity with the technology, and personal preferences, perhaps by asking older adults for their favourite jokes.

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