The Impact of Voice on Perceptions of Empathy: An Experimental Study Using Conversational Agent Prototypes in the Context of Mental Healthcare.

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Table of Contents

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Abstract

Background: Empathy is a critical component of effective mental health care communication. Positive perceptions of empathy in conversational agents (CAs) operating in the healthcare domain are needed to enhance the quality of care provided by these emerging technologies.

Objective: This study investigates how demographic characteristics of individual users affect their perception of empathy in a mental health helpline service context. The impact of vocal cues engineered within nine CA prototypes is the focus of this study.

Methods: A group of psychology students (n=306) were presented with several CA prototypes, and their perceptions of empathy were evaluated via an online survey. Perceptions of empathy were rated using the Perceived Emotional Intelligence (PEI) Scale and the Rater Scale (RS10).

Results: A linear mixed model for PEI showed significantly higher ratings for high than low engineered empathy levels ($t(8)=-2.34$, $p=0.048$), and for participants of Asian and the Other category rather than Oceanic ethnicities ($t(285)=2.54$, $p=0.01$ and $t(286)=2.25$, $p=0.03$ respectively). RS10 ratings were also significantly higher for high rather than low engineered empathy levels ($t(8)=-2.45$, $p=0.04$) and for participants of the Other category rather than Oceanic ethnicities ($t(284)=2.24$, $p=0.03$). Women also showed significantly higher RS10 ratings than men ($t(283) =1.94$, $p=0.05$).

Conclusions: Recognising empathy levels in CA prototypes proved challenging, highlighting possible complexities involved with voice-based empathy detection. The perception of empathy may also be affected by different ethnic and gender-based factors.
The study findings emphasise the importance of personalised empathic communication by CAs with users based on their ethnicity and gender in the context of mental health helpline service provision

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Abstract (300 words)

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The study findings emphasise the importance of personalised empathic communication by CAs with users based on their ethnicity and gender in the context of mental health helpline service provision.

Keywords: Perceived empathy, mental healthcare, helpline service, conversational agent prototypes.

Introduction

Empathy is a psychological construct that includes emotional as well as cognitive components. Emotional empathy refers to the detection and perception of emotion in others, while cognitive empathy relates to an imagination of the others' experience, using a perspective-taking approach to interpret what a person may be feeling and the underlying reasons [1]. While empathy is critical for human interaction and the development of trust and safety [2], it is a complex and multi-dimensional construct. [2]

Several factors influence how individuals perceive empathy [3]. Women appear to perceive empathy more adeptly than men [4], with several studies demonstrating that women score higher on empathy perception than men [5, 6]. Sensitivity to empathic cues also decreases with age [4]. Cultural and ethnic backgrounds also influence how people perceive empathy [7]. Thus, social norms strongly inform how empathy is perceived and portrayed [8].

Conversational agents (CAs) with empathic capabilities offer advantages to mental healthcare [9], particularly in addressing current shortfalls in the current workforce [10]. If CAs can be shown to engage with users empathically, this technology may be leveraged to facilitate certain healthcare interactions, including patient triage, particularly via telephone and at scale.

In this experimental study, we engineer several vocal CA prototypes, displaying varying levels of empathy, that might feature in a triage context in a mental health helpline service setting. This study attempts to identify how perceptions of empathy in CA communications differ between individuals listening to staged conversations between a CA and a suicide helpline caller.

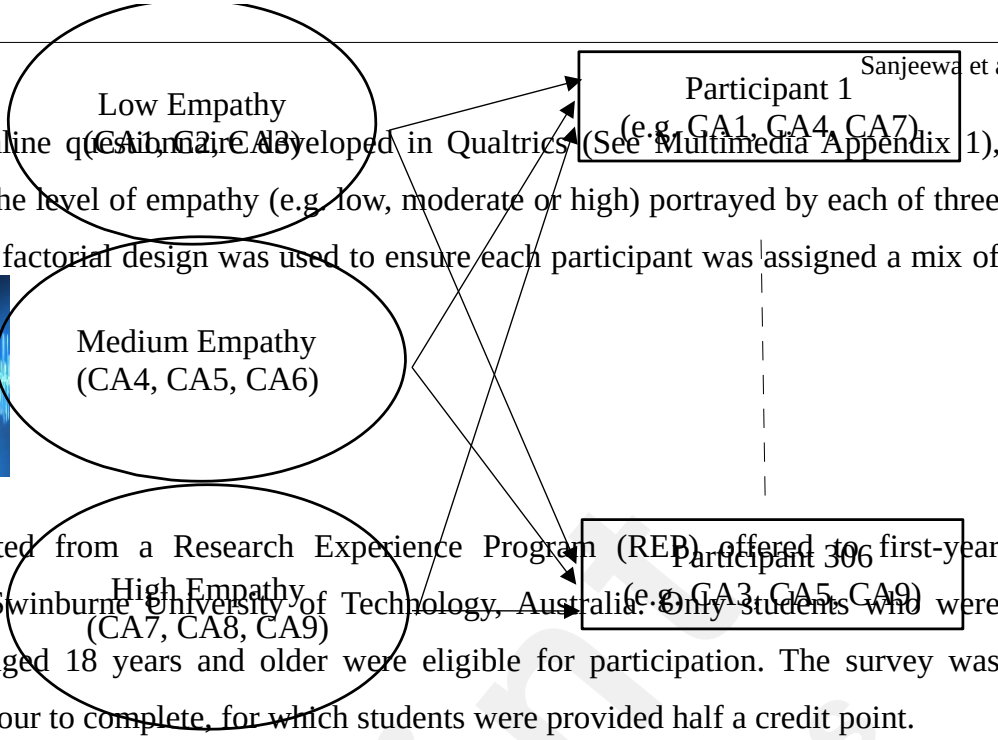
Although many studies have examined the concept of empathy [11, 12], few studies have focused on how perceptions of empathy vary between individuals. The primary objective of this study is to evaluate the extent to which ratings of empathy correspond with the levels of empathy engineered for each of the nine CAs. The secondary objective was to determine how demographics, specifically gender identity, age, ethnic background, Aboriginal and Torres Strait Islander Status, Index for Relative Socio-Economic Advantage and Disadvantage (IRSAD) and home language relate to perceptions of empathy.

Methods

Data Collection

In this study, we have engineered standardised vocal responses by nine CA prototypes to short statements made by callers to a telephone counselling helpline service. Data collection was

conducted through an online questionnaire developed in Qualtrics (See Multimedia Appendix 1), where participants rated the level of empathy (e.g. low, moderate or high) portrayed by each of three randomly chosen CAs. A factorial design was used to ensure each participant was assigned a mix of empathy levels.



Participants

Nine female CAs

Participants were recruited from a Research Experience Program (REP) offered to first-year psychology students at Swinburne University of Technology, Australia. Only students who were living in Australia and aged 18 years and older were eligible for participation. The survey was expected to take half an hour to complete, for which students were provided half a credit point.

Survey procedure

Consenting students were electronically directed to the Qualtrics survey. Demographic information was collected from each student, including gender identity, age, residential postcode, Aboriginal and Torres Strait Islander status, ethnic background and home language. Then, a set of three audio recordings were assigned to each participant. These recordings were created as prototype CAs to be used within a mental health helpline service context. Each participant rated the level of empathy of each CA using two scales: the Perceived Emotional Intelligence (PEI) scale [13] and the Raters' Scale (RS10) [14], henceforth referred to as the Raters' scale.

CA Prototypes

The recordings for nine prototype CAs were developed using the Natural Reader [15], a speech synthesis software. Prototype responses were developed following an intensive analysis of counsellor responses to callers of On The Line Australia (OTLA), a national telephone helpline counselling service. A range of female voices was chosen, in part to simplify the experiment but also based upon focus group responses with OTLA staff, suggesting that female voices convey greater variation in empathy than male voices do (blinded for review).

Natural Reader software allowed each voice to be modulated to accommodate either low, moderate or high levels of conveyed empathy. The level of empathy chosen for each prototype was validated by research team members (RI & DM), drawing upon substantial experience working in mental health. Multimedia Appendix 2 includes the CA prototypes used in the study.

Measures

We collected data on a range of participant characteristics, as shown in Table 1.

Table 1: Summary of demographic features of participants and measures for perceived empathy.

Demographic features	Categories/ Range
Gender identity	• Woman • Man • Other category
Age in years	18-32 33-46 47-61
Index for Relative Socio-Economic Advantage and Disadvantage (IRSAD)	1-10 (10=Highest advantage)
Do you identify as Aboriginal and/or Torres Strait Islander?	• Yes • No
Is English your home language?	• Yes • No
Ethnic background	• Oceania (Incl. Australia and New Zealand) • North-west Europe • Southern and Eastern Europe • North African and Middle East • South-east Asia • North-east Asia • Southern and Central Asia • Peoples of Americas • Sub-Saharan Africa
Perceived empathy measured using:	
1. The Perceived Emotional Intelligence (PEI) scale [14]	A 7-item scale with each item rated from 1-10. Higher values indicate higher levels of empathy.
2. The Rater's Scale (RS10) [15]	A single-item Likert scale rating empathy from 0 to 10 with increasing levels of empathy.

Statistical Analysis

RStudio (Version 2024.04.2, Build 764)[16] was used for all analyses. Participant characteristics and empathy ratings were summarised with appropriate descriptive statistics. Spearman's rank correlation was used to assess the relationship between PEI and RS10 empathy ratings. Kruskal Wallis tests were performed to evaluate the differences between the engineered empathy levels in CA prototypes in terms of participant ratings using the PEI and RS10 measures [17].

Empathy ratings were regarded as nested within individual participants. A random intercept model was fitted with the PEI rating as the response variable and the RS10 rating as a fixed effect to more accurately model the relationship between the PEI and RS10 ratings. A linear mixed model was fitted separately for PEI and RS10 ratings, with the participant demographic information and engineered empathy levels as the fixed effects. Random intercepts for each participant and each of the nine CA

prototypes were added. These models were designed to show how participant demographic information and engineered empathy levels impacted the empathy ratings provided by participants.

Results

Data were collected from *n*=306 Swinburne University of Technology students. Participant characteristics are provided in Table 2. Ages ranged between 18 to 61 years (mean=29.65, *sd*=10.69). A mean IRSAD decile = 7.12 (*sd*=2.62) was derived using participant postcodes [18]. Figures 2 and 3 show the distributions for the RS10 and PEI empathy ratings according to engineered empathy levels.

Table 2: Participant Characteristics (*N*=306)

Question	*n* (%)
Gender identity	
• Woman	233 (76.10)
• Man	58 (19.00)
• Other	7 (2.29)
• Missing	8 (2.61)
Do you identify as Aboriginal and/or Torres Strait Islander?	
• Yes	5 (1.63)
• No	300 (98.00)
• Missing	1 (0.33)
Is English your home language?	
• Yes	258 (84.30)
• No	47 (15.40)
• Missing	1 (0.33)
Ethnic background	
• Oceania	194 (63.40)
• Asia	47 (15.40)
• Europe	46 (15.00)
• Other	18 (5.88)
• Missing	1 (0.33)

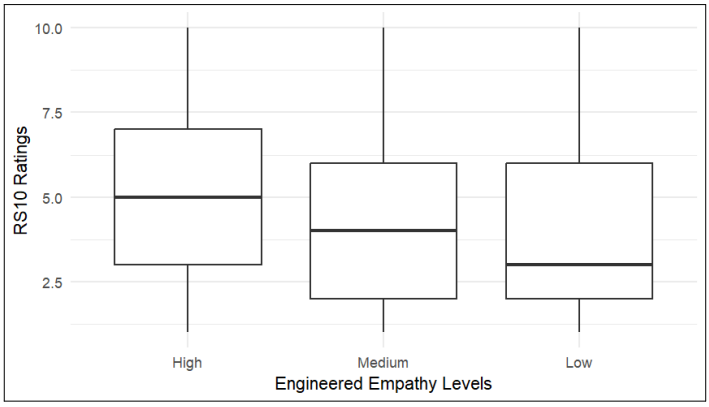


Figure 2: Distribution of RS10 empathy ratings by engineered empathy levels

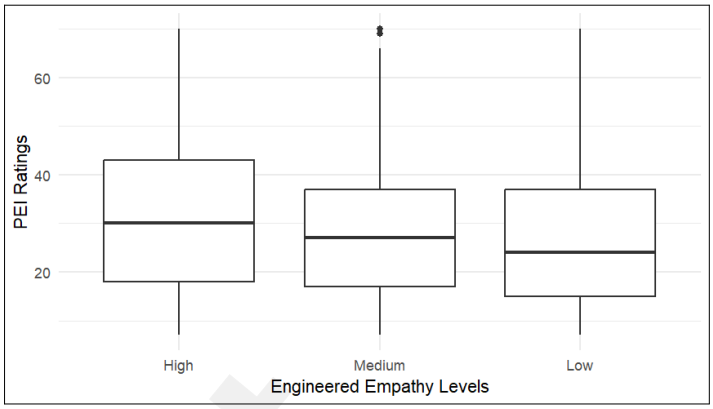


Figure 3: Distribution of PEI empathy ratings by engineered empathy levels

A strong and positive correlation between the PEI and RS10 ratings was observed (r=0.829, p<.001). This was validated by a linear mixed model predicting PEI values from RS10 ratings (β=4.69, t(863)=45.80, p<0.001).

Ratings across engineered empathy levels revealed significant differences (Table 3).

Table 3: Comparison of PEI and RS10 Ratings across Engineered Empathy Levels

Empathy Ratings	Engineered empathy Levels			Kruskal-Wallis Test	
	Low	Medium	High	Test Statistic - χ^2(df[c])	p
PEI[a] Mean (SD)	27.1 (15.1)	28.4 (14.8)	31.2 (15.9)	$\chi^2(2) = 11.865$	0.003
RS10[b] Mean (SD)	3.89 (2.34)	4.21 (2.38)	4.75 (2.47)	$\chi^2(2) = 19.737$	<.001

[a] Perceived Emotional Intelligence

[b] Rater's Scale

[c] degrees of freedom.

Linear Mixed Model Analyses

In the linear mixed model analyses, the percentage of variation attributed to participants was 63% and 46% for the PEI and RS10 ratings, respectively, while the percentage of variation attributed to the CA prototypes was only 1.5% and 2.5% for the PEI and RS10 ratings, respectively.

A linear mixed model was used to predict PEI ratings from engineered prototype empathy levels and participant characteristics (Table 4). PEI ratings were significantly higher for high rather than low prototype empathy levels (β=3.89, t(8)=-2.34, p=0.048), as were PEI measures for participants of Asian rather than Oceanic ethnicity (β=6.53, t(285)=2.54, p=0.01) and participants of Other ethnicities rather than Oceanic (β=8.23, t(286)=2.25, p=0.03).

Table 4: Fixed effects for the Linear Mixed Model for PEI ratings

Fixed effects	β	SE[a]	df[b]	t	p
(Intercept)	26.68	4.67	276.03	5.72	<.001
Engineered empathy levels (Low versus High)	-3.89	1.66	7.79	-2.34	0.048
Engineered empathy levels (Medium versus High)	-2.65	1.66	7.79	-1.59	0.15
Age	-0.06	0.07	286.71	-0.80	0.43
Gender Identity (Woman versus Man)	2.64	1.9	285.34	1.36	0.17
Ethnicity (Asia versus Oceania)	6.53	2.57	285.23	2.54	0.01
Ethnicity (Europe versus Oceania)	2.99	2.24	285.72	1.33	0.18
Ethnicity (Other = Sub-Saharan African, North African, the Middle East and Peoples of Americas) versus Oceania)	8.23	3.66	285.88	2.25	0.03
Is English your home language? Yes versus No	0.58	2.63	285.51	0.22	0.83
IRSAD[c] Decile	0.23	0.30	287.01	0.76	0.45

[a] Standard error

[b] degrees of freedom

[c] Index for Relative Socio-Economic Advantage and Disadvantage

A linear mixed model was also used to predict RS10 ratings from engineered prototype empathy levels and participant characteristics (Table 5). RS10 measures were significantly higher for high than low engineered empathy prototype levels (β=0.82, t(8)=-2.45, p=0.04), as were the RS10 measures for other ethnicities versus Oceania origin (β=1.18, t(284)=2.25, p=0.03). In addition, women provided significantly higher RS10 values than men.

Table 5: Fixed effects for the Linear Mixed Model for RS10 ratings

Fixed effects	β	SE[a]	df[b]	t	p
(Intercept)	4.05	0.69	218.18	5.85	<.001
Engineered empathy levels (Low	-0.82	0.33	8.17	-2.45	0.04

versus High)					
Engineered empathy levels (Medium versus High)	-0.49	0.33	8.17	-1.46	0.18
Age	0.01	0.01	284.94	-0.98	0.33
Gender Identity (Woman versus Man)	0.54	0.28	283.00	1.94	0.05
Ethnicity (Asia versus Oceania)	0.65	0.37	282.84	1.75	0.08
Ethnicity (Europe versus Oceania)	0.20	0.32	283.60	0.63	0.53
Ethnicity (Other = Sub-Saharan African, North African, the Middle East and Peoples of Americas) versus Oceania)	1.18	0.53	283.87	2.24	0.03
Is English your home language? Yes versus No	0.16	0.38	283.34	0.43	0.67
IRSAD[c] Decile	0.03	0.04	285.21	0.76	0.45

[a] Standard error

[b] degrees of freedom

[c] Index for Relative Socio-Economic Advantage and Disadvantage

Discussion

Key findings

This study aimed to investigate the complex issue of empathy perception and the factors that influence these perceptions. This novel study employed experimental prototypes of voice-based CAs, engineered to reflect low, moderate or high levels of empathy in their vocals. The perception of empathy provided by study participants was compared against pre-established empathy levels. In addition, several demographic characteristics of the participants were evaluated to identify how these affected their perceptions of vocal empathy.

While empathy has been the focus of numerous research studies [19], the perception of empathy by individuals against pre-established empathy levels, defined using vocal prototypes, has not been the focus of many studies [20]The integration of the participant characteristics adds value to this study, showing to what extent empathy perceptions vary within the student population considered.

The results indicate that perceptions of empathy do not always match with pre-established (“engineered”) empathy levels, and it appears that it is difficult for people to identify small differences in empathy levels (e.g. between low and medium empathy and between medium and high empathy) using only vocal cues. In addition, it has been shown that demographic characteristics do

impact on the way that people perceive empathy. In particular, ethnic background and to some extent gender have been shown to affect how people perceive empathy in this study.

The evaluation of empathy was conducted using two scales: the PEI scale, which is comprised of multiple factors catering to the broader concept of emotional intelligence, and the RS10 scale, a single-factor scale providing a more direct evaluation of empathy levels (0-10). Similar results were obtained using these two scales which provides more confidence in the conclusions. However, the participant gender effect was only marginally significant in the case of the RS10 rating and not significant in the case of the PEI rating, suggesting, perhaps, that the simpler RS10 scale is more sensitive to gender differences in perceptions of empathy.

Other studies have found that women have higher empathic ability compared to men [21], perhaps making them more attuned to the emotional status of others, and therefore more likely to perceive empathy in others. Their higher empathic ability perhaps makes women more sensitive to empathic cues in others, leading them to provide more precise perception ratings. By far, the majority of participants in this study were women, making it unfeasible for separate models to be fitted for men and women. Future studies should try to obtain a more balanced representation of male and female participants so that an in-depth exploration of gender differences in empathy perception can be studied. Additionally, a useful extension of the current study would be to consider how non-binary and other gender identities also perceive empathy, given that these minorities often suffer a greater mental health burden.

The PEI rating was perhaps more sensitive for the detection of ethnic differences than the RS10, because it detected significantly higher perceptions of empathy for participants with an Asian rather than Oceanic background, while the RS10 did not. As a measure of perceived emotional intelligence, the PEI measures a broader concept of empathy than the RS10. While empathy is the ability to put oneself in the place of another to understand their feelings [22], emotional intelligence is a set of skills that help us to effectively understand and express ourselves, understand and relate to others and cope with difficult situations [23]. The PEI scale's multifactorial nature, therefore, evaluates a wider range of attributes than the RS10, perhaps explaining its greater sensitivity for detecting ethnic differences.

The ethnic background of the study participants had a significant impact on the perceived empathy ratings for both the PEI scale and the RS10 rating scale. Most participants were of Oceanic background (including Australia and New Zealand), which was also the reference group for the linear mixed model. When the PEI ratings were considered, participants from Asia and the other categories (Sub-Saharan Africa, North Africa, Middle East and Peoples of Americas) provided

significantly higher ratings than those from Oceanic ethnicity. However, only the other category showed significantly higher ratings when using the RS10 scale. The construct of empathy, how people identify, understand and show empathy, has been shown to depend on whether their ethnic background is individualist or collectivist [24]. Western backgrounds are reported to be more individualist, respecting and prioritising individual rights and wellbeing more than non-Western backgrounds and less likely to see empathy in others. However, social desirability is also less valued in Western countries, perhaps resulting in more critical ratings (lower ratings) when it comes to perceptions of empathy compared to collectivistic countries [25], suggesting that differences in perceived empathy may be due to differences in social desirability.

These findings raise challenges for researchers trying to understand the complex phenomenon of empathy perception when designing an empathic CA. How does one design a CA that exhibits empathy for all when perceptions of empathy are so subjective, depending on gender and ethnic background? Also, what does this say about “true” or “engineered” empathy ratings? Maybe this helps to explain the lack of accuracy in the perceived empathy ratings for moderate empathy levels that was discovered in this study and the absence of research addressing this crucial question.

Limitations of the study

The main limitation of the study was the unrepresentative nature of the sample of 306 participants who contributed to the online survey. The students from the REP were predominantly women (233/306, 76%). Most students in the sample were of Caucasian ethnicity from Australia/ New Zealand (194/30,63%) and European background (46/306, 15%). In addition, only five of the 306 (1.6%) were of Aboriginal or Torres Strait Islander origin. Further, the students recruited for this study through the REP sample were mostly young adults, with 64% (197/306) within the 18-32 age range, also having a relatively higher socio-economic status with the average IRSAD decile. Therefore, future researchers are encouraged to extend the sample to individuals with a wider age range and level of socioeconomic status. Also, it is important that participants with more varied backgrounds are considered (not just psychology students), also allowing for more variation in ethnicity. It is also recommended that a suitable measure of social desirability is included in future surveys, which will allow for adjustment of social desirability bias in the perceived ratings of empathy.

Another limitation of this study was the use of only voice recordings as the basis of the empathy perceptions. There are many other ways in which empathy can be detected, such as facial expressions, body language and other non-verbal cues. It may be that various ethnic groups use these different ways of detecting empathy differently.

Future Opportunities

This study was focused on the design of a CA for deployment in a mental health environment, but these results hold more general appeal because empathic communications are a key component of mental healthcare [26]. However, future research needs to acknowledge that the perception of empathy is a complex issue.

The significance of ethnicity as a predictor of perceived empathy is clearly a sign that future mental healthcare could benefit from ethnically tailored training of healthcare professionals in the expression of empathy, which could be based on RS10 ratings. Training guides for healthcare practitioners, teaching them how to adapt, demonstrate empathy, and personalise their communication styles based on gender and ethnic backgrounds are also possibilities raised by this study. It is recommended that the development of these training materials be undertaken using a co-creation process involving relevant stakeholders to ensure that real-world complexities are considered.

Also, the identification of CA empathy levels remains problematic. While our PEI and RS10 scales showed good agreement with each other and exhibited an ability to differentiate between low and high engineered empathy levels, they were unable to identify moderate levels of empathy correctly. This might suggest a role for empathy education: promoting a greater understanding of how empathy is defined and reflected in speech. Conversely, this study demonstrates that the display of empathy by CAs needs to be tailored to end-user characteristics. This will ensure that CAs used in various telephone mental healthcare applications can provide a more human-like user experience.

Acknowledgements

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Author’s Contributions

RS wrote the first draft of the manuscript, developed the CA prototypes, online survey and conducted the statistical analysis, which was guided by DM. DM and RI collaborated in the development of the CA prototypes and survey structure. All authors reviewed and provided revisions leading to the final manuscript.

Conflicts of Interest

None declared

Abbreviations

CA: Conversational Agent

IRSAD: Index for Relative Socio-Economic Advantage and Disadvantage
OTLA: On the Line Australia
PEI: Perceived Emotional Intelligence
REP: Research Experience Program
RS10: Raters' Scale

Multimedia Appendix 1: Online Survey for evaluating CA prototypes

Multimedia Appendix 2: The set of CA prototypes used in the study

References

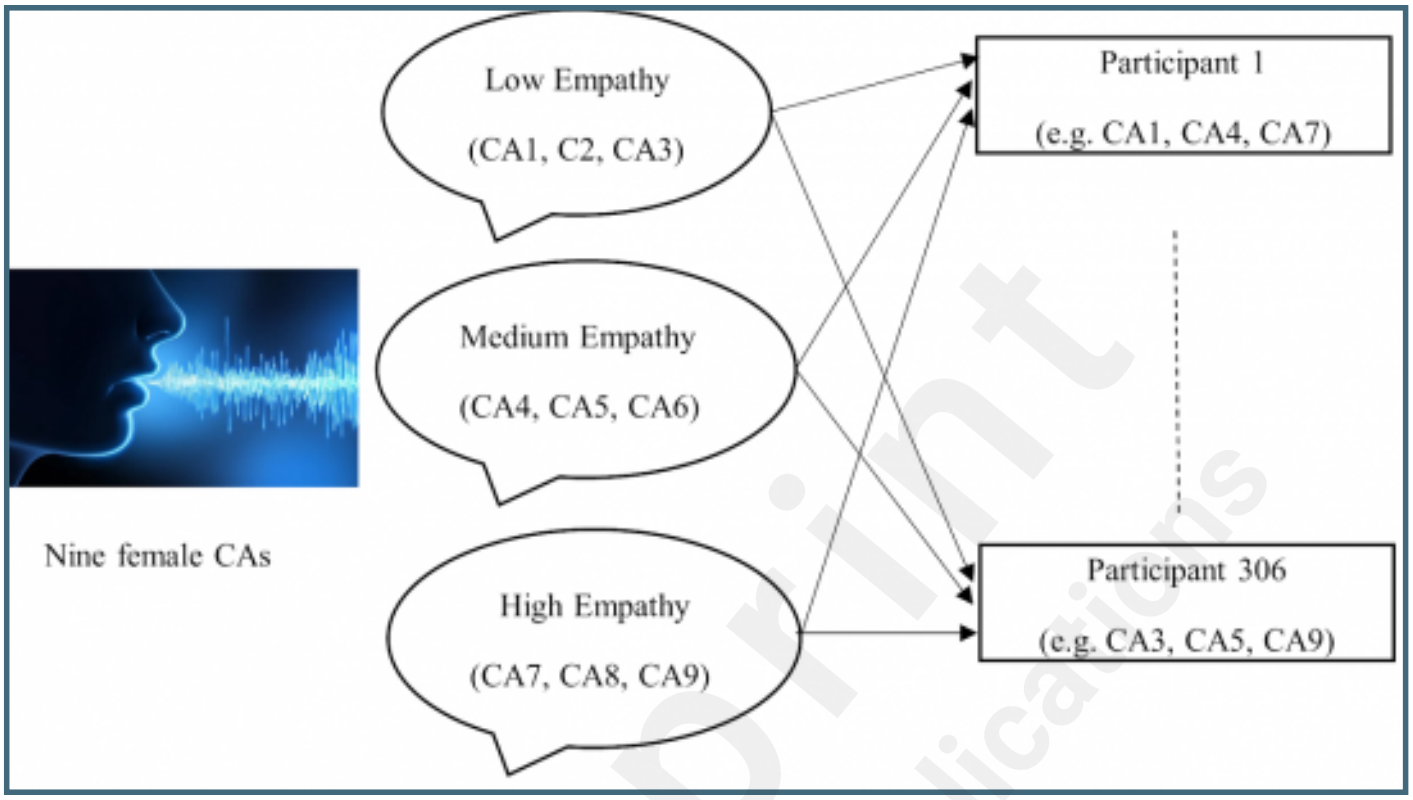
1. Khanjani Z, Mosanezhad Jeddi E, Hekmati I, Khalilzade S, Etemadi Nia M, Andalib M, et al. Comparison of cognitive empathy, emotional empathy, and social functioning in different age groups. Australian Psychologist. 2015;50(1):80-5. doi: 10.1111/ap.12099
2. Moreno-Poyato AR, Rodríguez-Nogueira Ó, Group MCW. The association between empathy and the nurse–patient therapeutic relationship in mental health units: a cross-sectional study. Journal of Psychiatric and Mental Health Nursing. 2021;28(3):335-43. doi: 10.1111/jpm.12675
3. Artinger F, Exadaktylos F, Koppel H, Sääksvuori L. In others' shoes: do individual differences in empathy and theory of mind shape social preferences? PloS one. 2014;9(4):e92844. doi: 10.1371/journal.pone.0092844
4. Rosen JB, Brand M, Kalbe E. Empathy mediates the effects of age and sex on altruistic moral decision making. Frontiers in Behavioral Neuroscience. 2016;10:67. doi: 10.3389/fnbeh.2016.00067
5. Cundiff NL, Nadler JT, Swan A. The influence of cultural empathy and gender on perceptions of diversity programs. Journal of Leadership & Organizational Studies. 2009;16(1):97-110. doi:10.1177/1548051809334193
6. Löffler CS, Greitemeyer T. Are women the more empathetic gender? The effects of gender role expectations. Current Psychology. 2023;42(1):220-31. doi: 10.1007/s12144-020-01260-8
7. Kapıkıran NA. Sources of Ethnocultural empathy: personality, intergroup relations, affects. Current Psychology. 2023;42(14):11510-28. doi:10.1007/s12144-021-02286-2
8. Clarke E, DeNora T, Vuoskoski J. Music, empathy and cultural understanding. Physics of life reviews. 2015;15:61-88. doi: 10.1016/j.plrev.2015.09.001
9. Inkster B, Sarda S, Subramanian V. An empathy-driven, conversational artificial intelligence agent (Wysa) for digital mental well-being: real-world data evaluation mixed-methods study. JMIR mHealth and uHealth. 2018;6(11):e12106. doi: 10.2196/12106
10. Kearns WR, Bertram J, Divina M, Kemp L, Wang Y, Marin A, et al., editors. Bridging the Skills Gap: Evaluating an AI-Assisted Provider Platform to Support Care Providers with Empathetic Delivery of Protocolized Therapy. AMIA Annual Symposium Proceedings; 2023: American Medical Informatics Association. PMID: 38222441
11. Jami PY, Walker DI, Mansouri B. Interaction of empathy and culture: a review. Current Psychology. 2024 2024/01/01;43(4):2965-80. doi: 10.1007/s12144-023-04422-6.
12. Olderbak S, Wilhelm O. Emotion perception and empathy: An individual differences test of relations. Emotion. 2017;17(7):1092. doi: 10.1037/emo0000308
13. Mayer JD, Salovey P, Caruso DR, Sitarenios G. Measuring emotional intelligence with the MSCEIT V2. 0. Emotion. 2003;3(1):97. doi: 10.1037/1528-3542.3.1.97 PMID: 12899321
14. Davey HM, Barratt AL, Butow PN, Deeks JJ. A one-item question with a Likert or Visual Analog Scale adequately measured current anxiety. Journal of clinical epidemiology. 2007;60(4):356-60. doi:

10.1016/j.jclinepi.2006.07.015
15. Naturalsoft. NaturalReader. Naturalsoft Ltd; 2023; 5/25/2023:[Available from: https://www.naturalreaders.com/webapp.html.]
16. Builds R. 2024; Available from: [https://chatgpt.com/c/95dcde54-c1c1-4206-b9be-9ea4f625e6f0.]
17. McKight PE, Najab J. Kruskal-wallis test. The corsini encyclopedia of psychology. 2010:1-. doi: 10.1002/9780470479216.corpsy0491
18. Statistics ABo. Socio-Economic Indexes for Areas (SEIFA), Australia. Australian Bureau of Statistics; 2023 [updated 27/04/2023; cited 2023]; Available from: https://www.abs.gov.au/statistics/people/people-and-communities/socio-economic-indexes-areas-seifa-australia/latest-release.
19. Lee HK, Park JE. Designing a new empathy-oriented prototyping toolkit for the design thinking process: creativity and design sensibility. International Journal of Art & Design Education. 2021;40(2):324-41. doi: 10.1111/jade.12345
20. Xiao B, Huang C, Imel ZE, Atkins DC, Georgiou P, Narayanan SS. A technology prototype system for rating therapist empathy from audio recordings in addiction counseling. PeerJ Computer Science. 2016;2:e59. doi: 10.7717/peerj-cs.59
21. Pang C, Li W, Zhou Y, Gao T, Han S. Are women more empathetic than men? Questionnaire and EEG estimations of sex/gender differences in empathic ability. Social Cognitive and Affective Neuroscience. 2023;18(1). doi: 10.1093/scan/nsad008.
22. Seïler NR, Craig P. Empathetic technology. Emotions, technology, and design: Elsevier; 2016. p. 55-81. doi: 10.1016/B978-0-12-801872-9.00004-1
23. Bar-On R. The Bar-On model of emotional-social intelligence (ESI) 1. Psicothema. 2006:13-25. PMID: 17295953
24. Chopik WJ, O'Brien E, Konrath SH. Differences in Empathic Concern and Perspective Taking Across 63 Countries. Journal of Cross-Cultural Psychology. 2016 2017/01/01;48(1):23-38. doi: 10.1177/0022022116673910.
25. Fang J, Prybutok V, Wen C. Shirking behavior and socially desirable responding in online surveys: A cross-cultural study comparing Chinese and American samples. Computers in human behavior. 2016;54:310-7. doi: 10.1016/j.chb.2015.08.019
26. Benster LL, Swerdlow NR. Pathways to empathy in mental health care providers. Advances in Health and Behavior. 2020;3:125-35. doi: 10.25082/AHB.2020.01.004

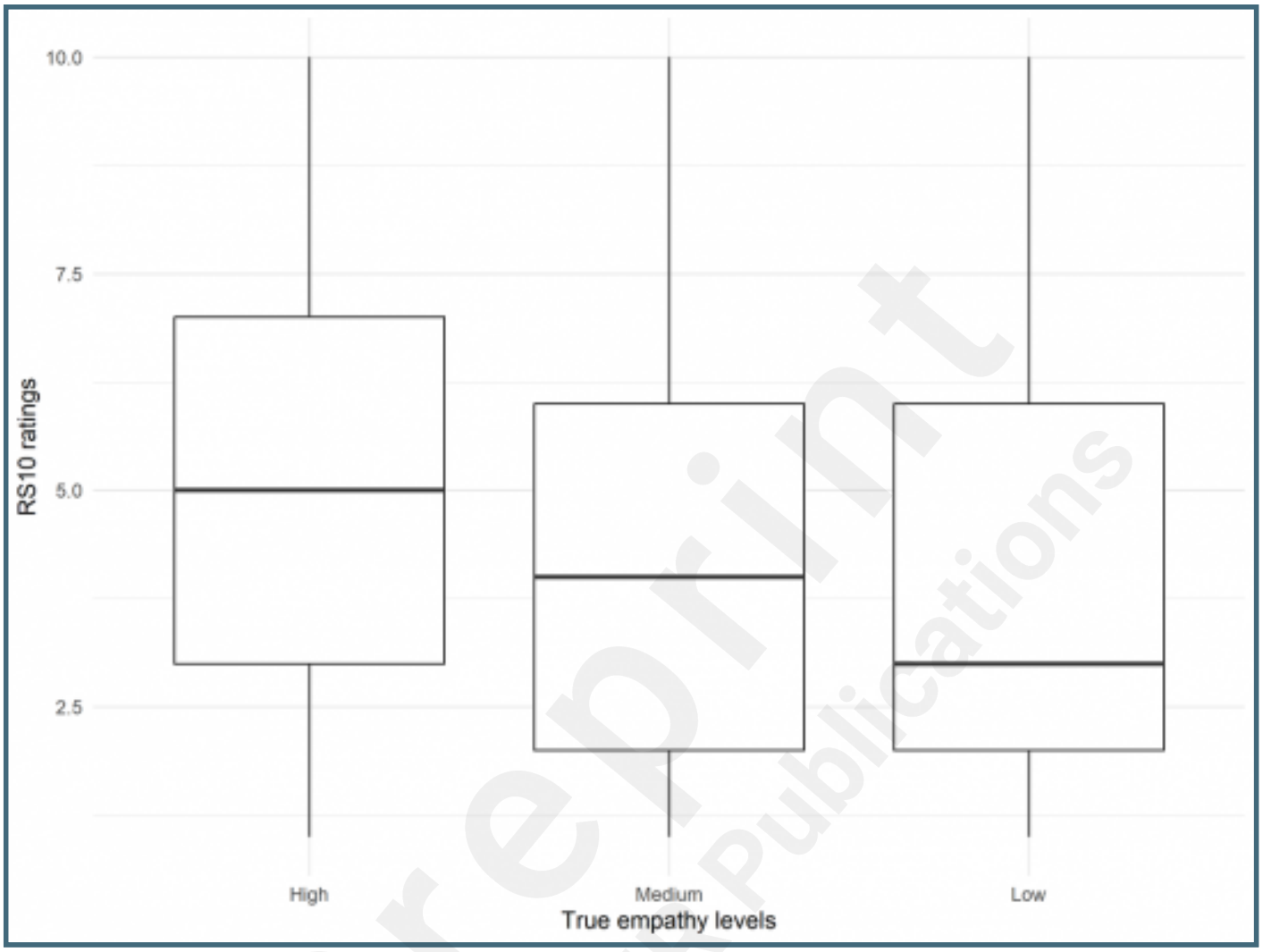
Supplementary Files

Figures

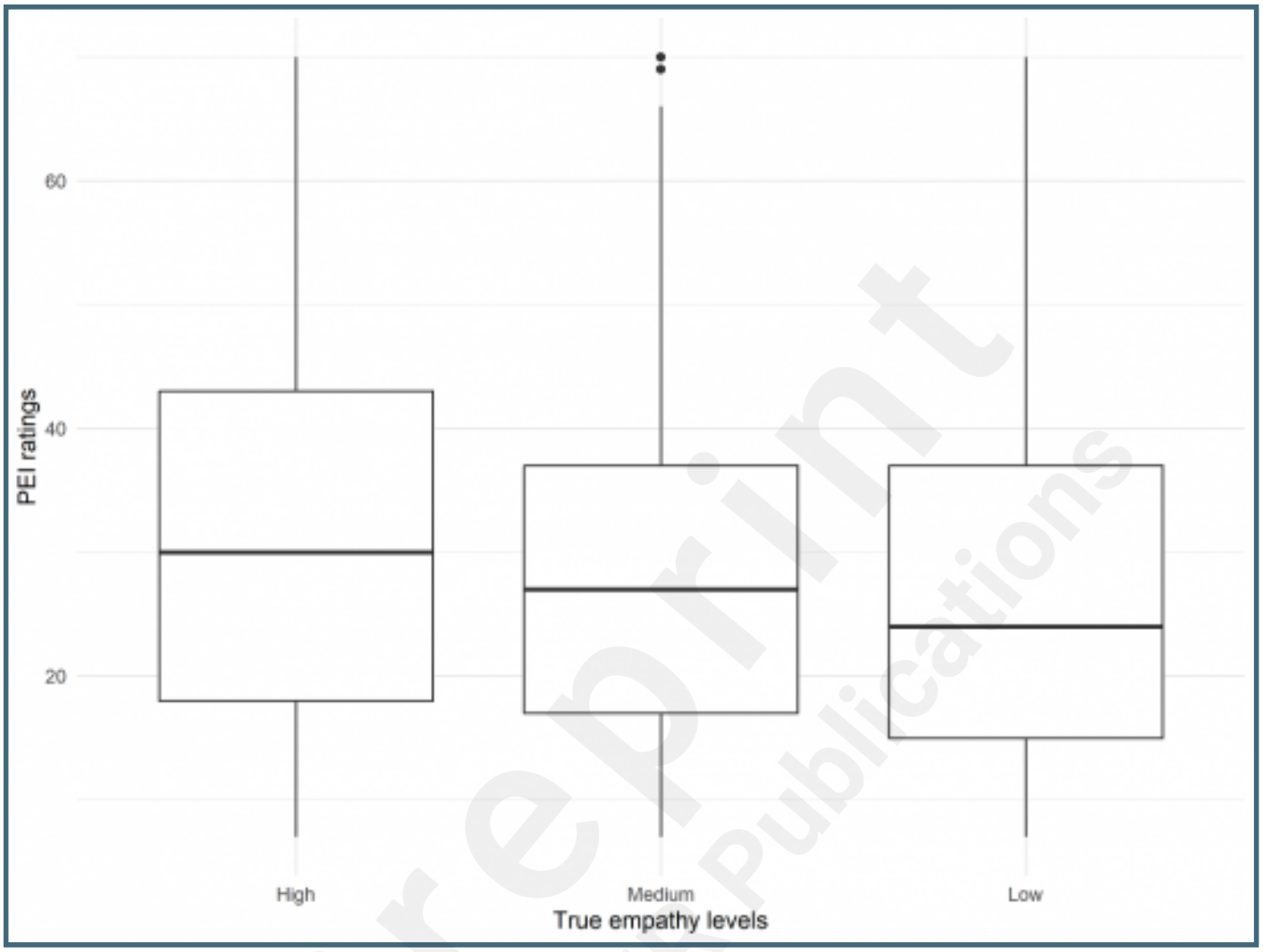
Outline of the prototype assignment to participants (The CA image was sourced from Media Medic (https://www.mediamedic.studio) All Rights Reserved).



Distribution of RS10 empathy ratings by engineered empathy levels.



Distribution of PEI empathy ratings by engineered empathy levels.



Multimedia Appendixes

Online Survey for evaluating CA prototypes.
URL: http://asset.jmir.pub/assets/26de37867f4b36bdecb93f2c6a06230d.docx

The set of CA prototypes used in the study.
URL: http://asset.jmir.pub/assets/c3b98ef1f22791a569c65720da2e9d47.zip