Perceived Dimensions of Risks from Perceived Anthropomorphism in Chatbots Delivery of Healthcare Services

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BACKGROUND AND LITERATURE REVIEW

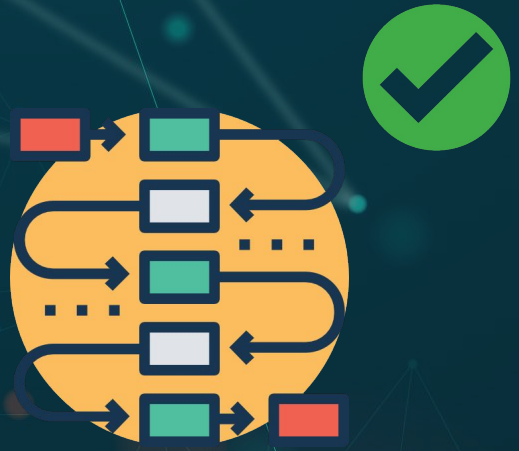
01

INTRODUCTION

- Great resignation trend due to COVID-19 and stress
- Strain on the healthcare system
- Pandemic has created a new need for contactless and remote healthcare solutions
- AI and robotics can solve this problem

AI: The Good and the Bad

- Good: ability to automate routine and time-intensive tasks → free up time



- Bad: Patient's acceptance of a service robot is questionable

Dissecting the topic

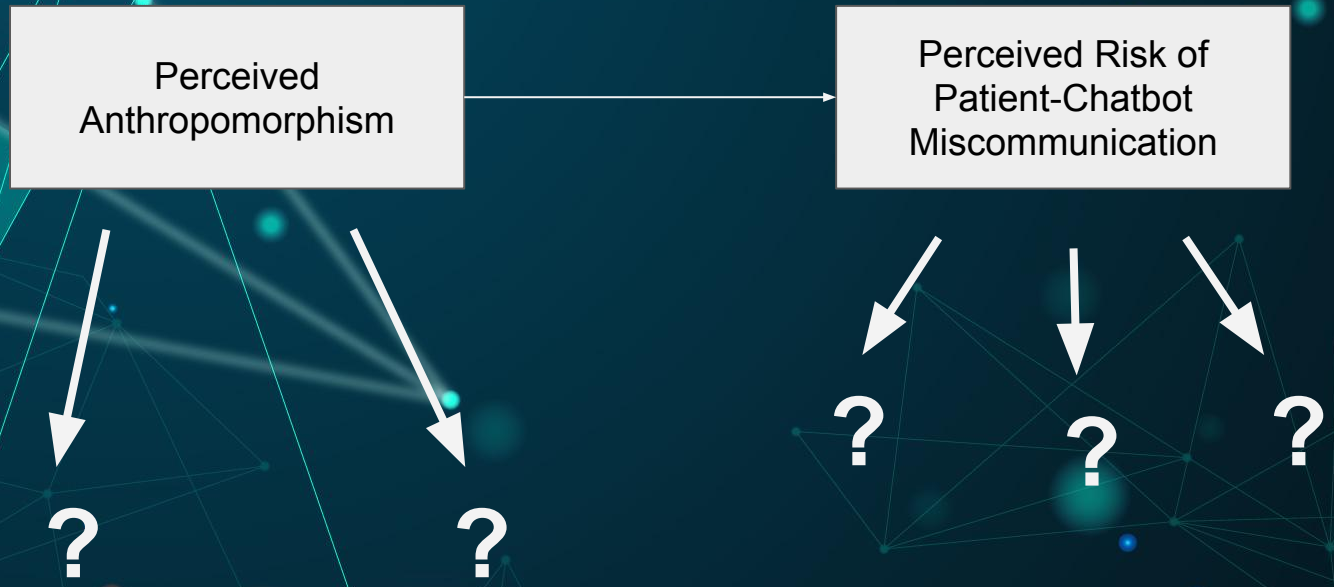
- Perceived Risks of Miscommunication from Perceived Anthropomorphism in Delivery of Healthcare Services from Chatbots
-

"attribution of human characteristics or behavior to a god, animal, or object."

Study Approach

- Give a chatbot human-like characteristics
- Test it in a health care context
- Determine perceived risk
- Examine its feasibility in the healthcare field

Crafting the Research Model



Literature Review

Relationship between perceived anthropomorphism and perceived risk
Zhang and Kaber (2008)

4th IEEE Conference on Automation Science and Engineering
Key Bridge Marriott, Washington DC, USA
August 23-26, 2008

Service Robot Anthropomorphism and Interface Design for Emotion in Human-Robot Interaction

Tao Zhang, Biwen Zhu, Lashanda Lee, and David Kaber, *Member, IEEE*

Abstract – There has been growing interest in both developing and implementing service robots for health care and home environments. In addition to a variety of functions supported by robotic technology, the interaction between a human and robot, including human emotional experiences, can affect perceived service quality and satisfaction. Based on a survey of existing service robot applications and associated interface requirements, we consider anthropomorphism as a critical characteristic of the robot interface. We propose a preliminary research framework to support identification of the exact relationship between robot interface features and user (emotional) responses in service contexts. Future experimental investigations based on the framework are to be conducted.

I. Introduction

IMPROVEMENTS in intelligent control systems and precision sensors have promoted a wide variety of robot applications in the health care field, including laboratory robots, surgical robots, rehabilitation robots, assistive robots for people with impaired mobility, and service robots (for an overview see [1]). In this paper, we constrain the terminology of service robots to robots developed to complement nurses in routine patient services (e.g., medicine delivery) in order to reduce nurse workload for more critical health care tasks. To achieve this goal, robots need to navigate independently in large-scale hospital workplaces or nursing home environments, and more importantly, they must support close and effective interaction with robot operators, pharmacists and nurses. In some operations, robots may also be expected to communicate with patients (especially elderly people) or hospital/home visitors for social interaction [2]. Emotions play an important role for these users in communication and interaction [3] and some research efforts have been focused on developing robots capable of affective expressions (e.g., [4]). However, few studies measured human emotional responses when interacting with the robots (e.g., [5]) for assessing system effectiveness, particularly in health care services. There is a need to understand potential patient emotional responses to service robots and to provide a design basis for future robots to facilitate positive patient emotional experiences and effective patient-robot interaction.

The objective of this paper is to present a preliminary framework for future research on human (patient) emotional responses in interacting with service robots. We first present a survey of service robots developed for hospital use. These robots were either research prototypes or implemented in actual health care environments to various degrees. We then identify important interface features of current robot implementations and review previous robot interface design guidelines as well as limitations. We identify anthropomorphism as a critical interface characteristic driving human emotions and perception of social capabilities. We discuss the design of anthropomorphic robots in the context of health care services. Finally, research on patient emotional experiences, as a measure of patient-robot interaction, is discussed.

II. Survey of Health Care Service Robots

A. Towards A Taxonomy

A literature review revealed a number of applications or tasks related to health care that service robots may contribute to, including: hospital delivery, cognitive prosthetics, social interaction, intelligent walkers and telemedicine. Robots for delivery tasks automatically perform point-to-point navigation within hospitals/nursing homes, carrying medicines, meals, medical records or lab specimens. Some delivery robots follow preprogrammed routes with the capability of taking elevators and opening electronic doors [6]; whereas, some others autonomously navigate in the environment using natural landmarks [7]. Robots as cognitive prosthetics serve as reminders for elderly patients, particularly those suffering from varying degrees of dementia [8]. These robots can help nurses in reminding patients to take medicine, eat meals, or use a bathroom, etc. Robots for social interaction can provide psychological, physiological and social effects for patients through intimate interaction and communication [2] [9]. Intelligent walkers are robots that provide mobility and navigation guidance to patients in need of walking assistance to reduce fall risk and confusion in a hospital [10]. Robots for telemedicine can transfer real-time multimedia medical information on patients to remote doctors for the purpose of consultation and examination [9].

Table I presents a summary of service robots that have

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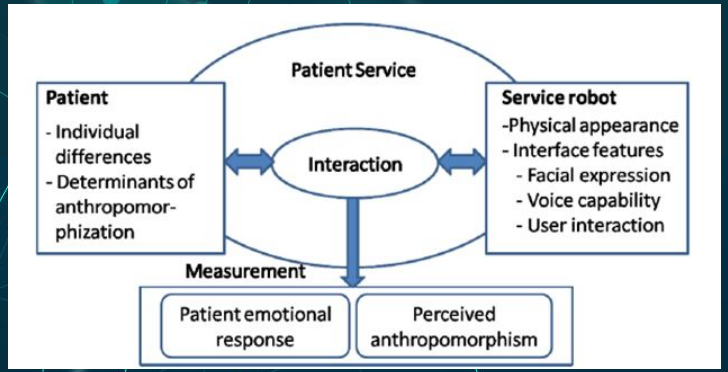
Service robots which have **human-like attributes** elicited a **positive patient emotional response**

Literature Review

Factors that constitute perceived anthropomorphism
Zhang and Kaber (2008)



Zhang and Kaber's research model

To vary:

- Facial expressions (Kinesics)
- Voice capabilities (Paralanguage)

Controlled for:

- Interactivity
- Human-like physical appearance

Crafting the Research Model

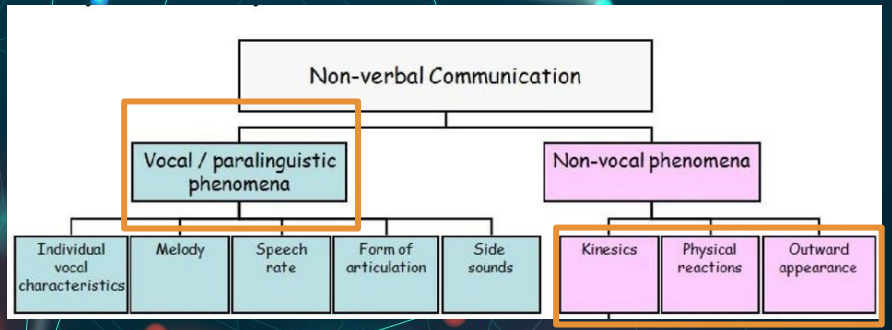
Perceived Anthropomorphism

Perceived Risk of Patient-Chatbot Miscommunication

Visual Cues (Kinesics)

Audio Cues (Paralanguage)

? ? ?



(Surkamp, 2014)

Literature Review

Factors that constitute perceived risk
Wirtz et al. (2018)

Brave new world: service robots in the frontline

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Abstract

Purpose – The service sector is at an inflection point with regard to productivity gains and service industrialization similar to the industrial revolution in manufacturing that started in the eighteenth century. Robotics in combination with rapidly improving technologies like artificial intelligence (AI), mobile, cloud, big data and biometrics will bring opportunities for a wide range of innovations that have the potential to dramatically change service industries. The purpose of this paper is to explore the potential role service robots will play in the future and to advance a research agenda for service researchers.

Design/methodology/approach – This paper uses a conceptual approach that is rooted in the service, robotics and AI literature.

Findings – The contribution of this paper is threefold. First, it provides a definition of service robots, describes their key attributes, contrasts their features and capabilities with those of frontline employees, and provides an understanding for which types of service tasks robots will dominate and where humans will dominate. Second, this paper examines consumer perceptions, beliefs and behaviors as related to service robots, and advances the service robot acceptance model. Third, it provides an overview of the ethical questions surrounding robot-delivered services at the individual, market and societal level.

Practical implications – This paper helps service organizations and their management, service robot innovators, programmers and developers, and policymakers better understand the implications of a ubiquitous deployment of service robots.

Originality/value – This is the first conceptual paper that systematically examines key dimensions of robot-delivered frontline service and explores how these will differ in the future.

Keywords Consumer behaviour, Ethics, Artificial intelligence, Privacy, Service robots, Markets

Paper type Conceptual paper

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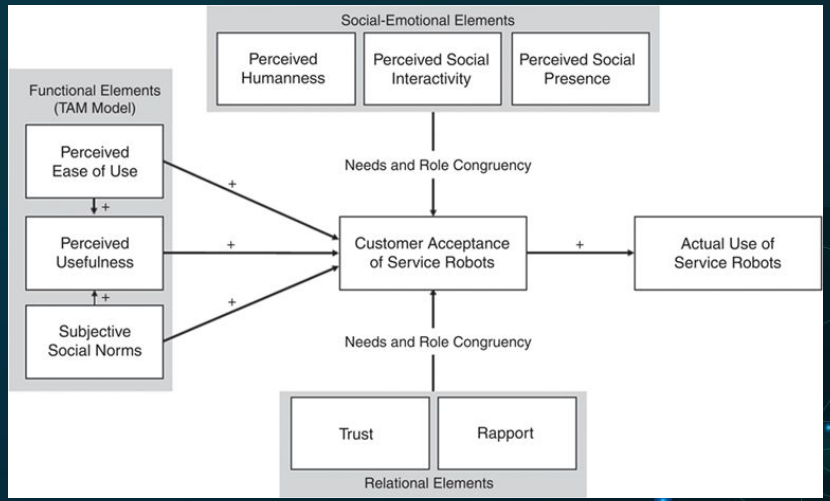
Vol. 29 No. 5, 2018
pp. 907-931
Emerald Publishing Limited
1757-5818
DOI 10.1108/JOSM-04-2018-0119



Wirtz's research model, based on the Technology Acceptance Model (TAM)

Crafting the Research Model

Perceived Anthropomorphism

Perceived Risk of Patient-Chatbot Miscommunication

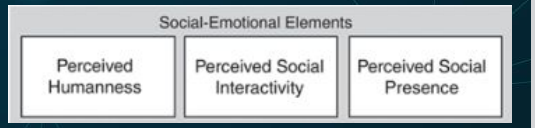
Visual Cues (kinesics)

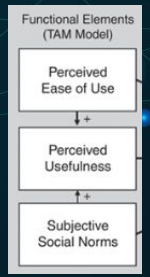
Audio Cues (paralanguage)

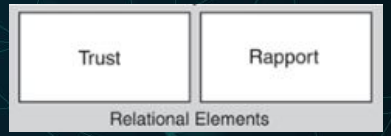
Socio-Emotional Elements

Functional Elements

Relational Elements



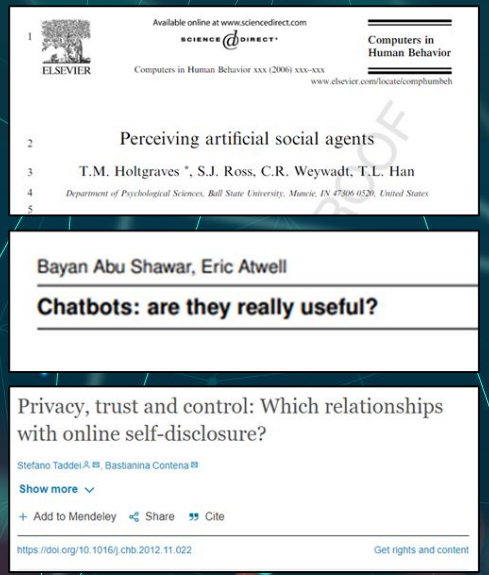




Literature Review

Effect of perceived anthropomorphism of chatbot interface on **Socio-Emotional** elements of perceived risk

Holtgraves et al. (2007), Shawar and Atwell (2007),Taddei and Contena (2013), Mou and Xu (2017)



People rely on **social cues** like language, interactivity, and capability of expressing emotions **when interacting with computers**

These cues positively influence the **computers'** perceived socialness

Crafting the Research Model

Perceived Anthropomorphism

Perceived Risk of Patient-Chatbot Miscommunication

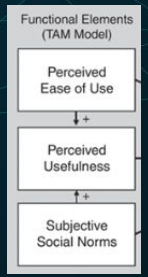
Visual Cues (kinesics)

Audio Cues (paralanguage)

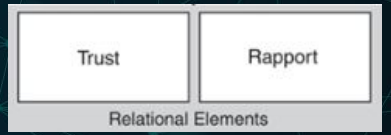
Socio-Emotional Elements ?

Perceived Social Interactivity

Functional Elements

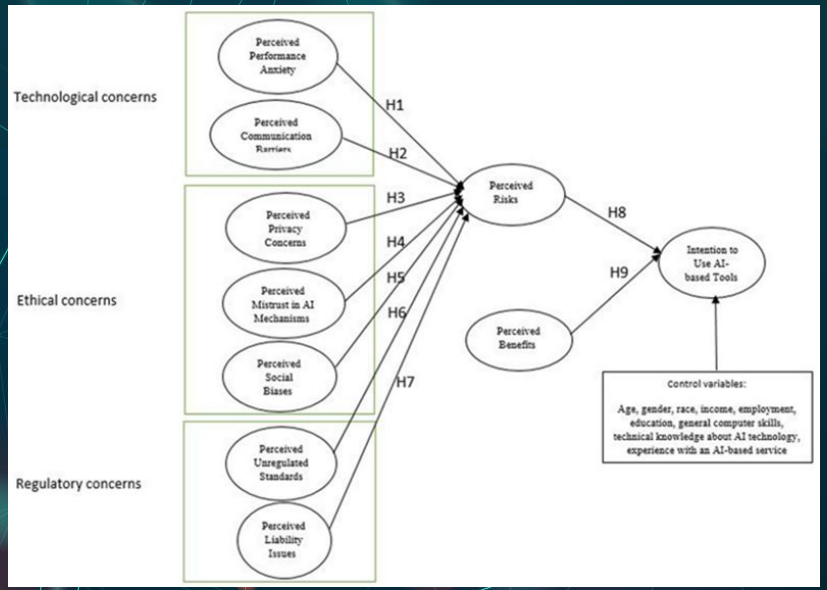


Relational Elements



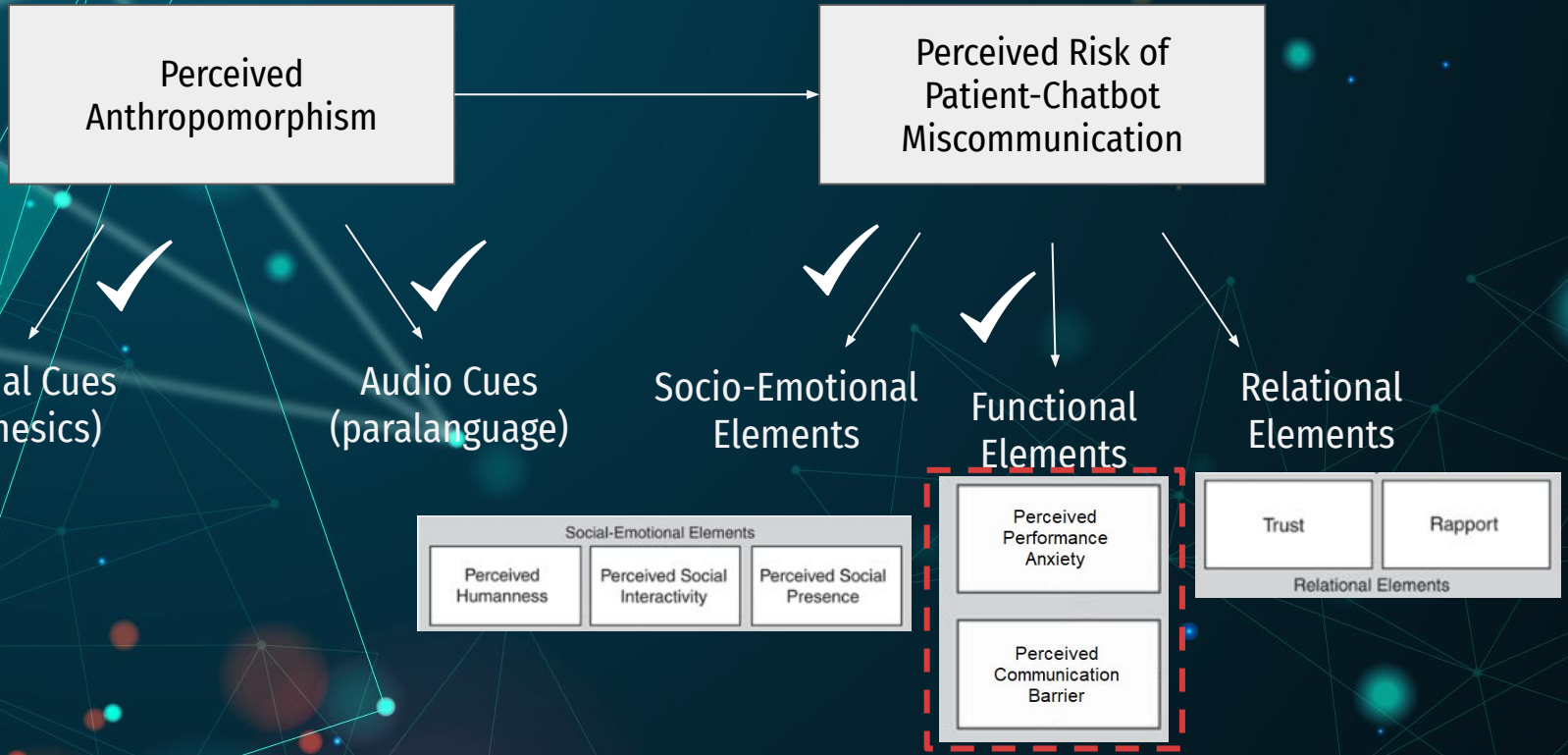
Literature Review

Effect of perceived anthropomorphism of chatbot interface on **Functional** elements of perceived risk
Esmaeilzadeh (2020)



Only **technological concerns** were valid predictors of risk beliefs among AI based tools

Crafting the Research Model



Literature Review

Effect of perceived anthropomorphism of chatbot interface on Relational elements of perceived risk
Holzwarth et al. (2006), Bente et al. (2008), Visser et al. (2016)

The Influence of Avatars on Online Consumer Shopping Behavior

Martin Holzwarth, Chris Janiszewski, Marcus M. Neumann

First Published October 1, 2006 | Research Article
https://doi.org/10.1509/jmkg.70.4.019

Article information

Avatars elicited a feeling of **social presence** among online shoppers → better brand satisfaction

Avatar-Mediated Networking: Increasing Social Presence and Interpersonal Trust in Net-Based Collaborations

Gary Bente, Sabine Rüggenberg, Nicole C. Krämer, Felix Eschenburg

First published: 26 March 2008 | https://doi.org/10.1111/j.1468-2958.2008.00322.x | Citations: 14

Images and human-like language made one more immersed within a virtual environment, creating **positive social responses**

Almost human: Anthropomorphism increases trust resilience in cognitive agents

Ewart J de Visser [1], Samuel S Monfort [1], Ryan McKendrick [1], Melissa A B Smith [1], Patrick E McKnight [1], Frank Krueger [1], Raja Parasuraman [1]

Affiliations + expand

PMID: 27505048 DOI: 10.1037/xap0000092

Trusting beliefs towards virtual assistants can be created through the use of anthropomorphic agents who **exhibit social behavior**

Crafting the Research Model

Perceived Anthropomorphism

Perceived Risk of Patient-Chatbot Miscommunication

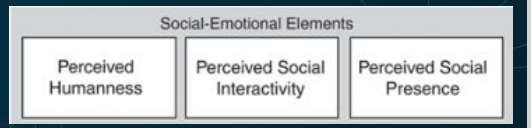
Visual Cues (kinesics)

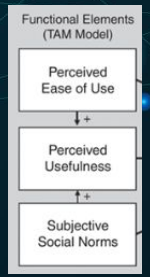
Audio Cues (paralanguage)

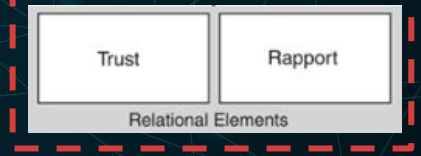
Socio-Emotional Elements

Functional Elements

Relational Elements







RESEARCH QN HYPOTHESES

02

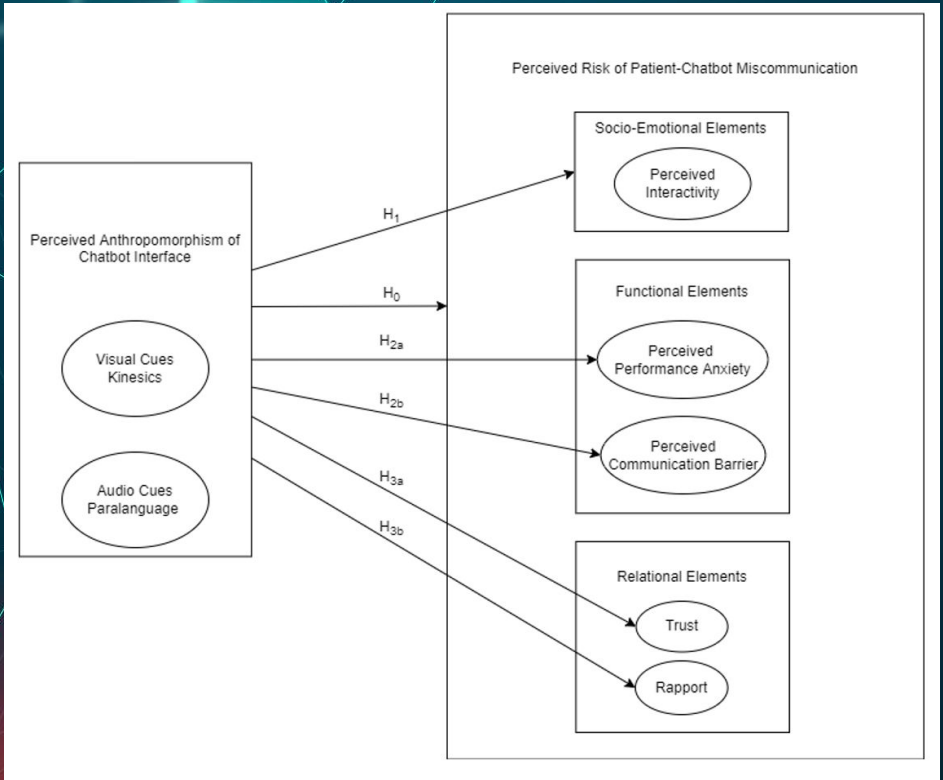
RESEARCH QUESTION

How does the perceived anthropomorphism of a chatbot affect patients' perceived dimensions of risk in patient-chatbot interaction?

NULL HYPOTHESIS, H0

H0: Perceived anthropomorphism of a chatbot interface is negatively associated with perceived risk in patient-chatbot interaction (up to a certain point).

RESEARCH HYPOTHESES



H-1: Perceived anthropomorphism of a chatbot interface is positively associated with the patients' **perceived interaction risk** under **Socio-Emotional Risks**.

H-2a: Perceived anthropomorphism of a chatbot interface is negatively associated with patients' **perceived performance anxiety** about the chatbot under **Functional Risks**

H-2b: Perceived anthropomorphism of a chatbot interface is negatively associated with the patients' **perceived communication barriers** under **Functional Risks**

H-3a: Perceived anthropomorphism of a chatbot interface is positively associated with patients' **Relational Risk** due to **lack of trust** towards a chatbot.

H-3b: Perceived anthropomorphism of a chatbot interface is positively associated with patients' **Relational Risk** due to **lack of rapport** with a chatbot.

RESEARCH DESIGN

03

Defining Measurement Variables

Independent variable:

Perceived anthropomorphism describes people's tendency to attribute human characteristics to non-lifelike artifacts (Fink, 2012)

2 Dimensions:

- Facial expression kinesics (visual cues)
- Voice paralanguage (audio cues)

Dependent variable:

Perceived risk of communication arises when an individual perceives possible threats to successful communication, such as whether the message communicated was received and whether the information within the message was understood (Lee et al., 2007)

5 Dimensions:

- Socio-emotional: Perceived interactivity
- Functional: Perceived performance anxiety, Perceived communication barriers
- Relational: Trust, Rapport

Research Method

RQ: How does the perceived anthropomorphism of a chatbot affect patients' perceived dimensions of risk in patient-chatbot interaction?

Quantitative, Non-experimental

- Describe perceived risk dimensions of miscommunication affected by perceived humanness in the delivery of healthcare services
- Examine relationships between preexisting social phenomena within a random sample and identify associations between the constructs.

Participants and Sampling Methods

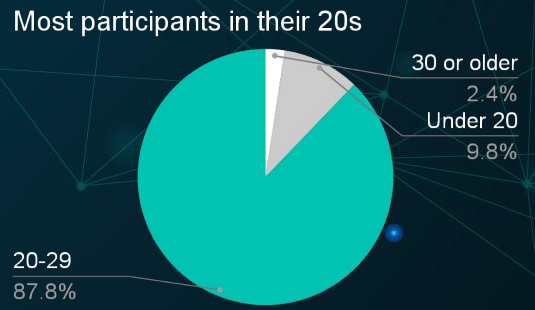
Online survey (20 minutes)
Data collection: 13 March to 20 March

82 respondents located in Singapore
Employed **non-probability sampling**

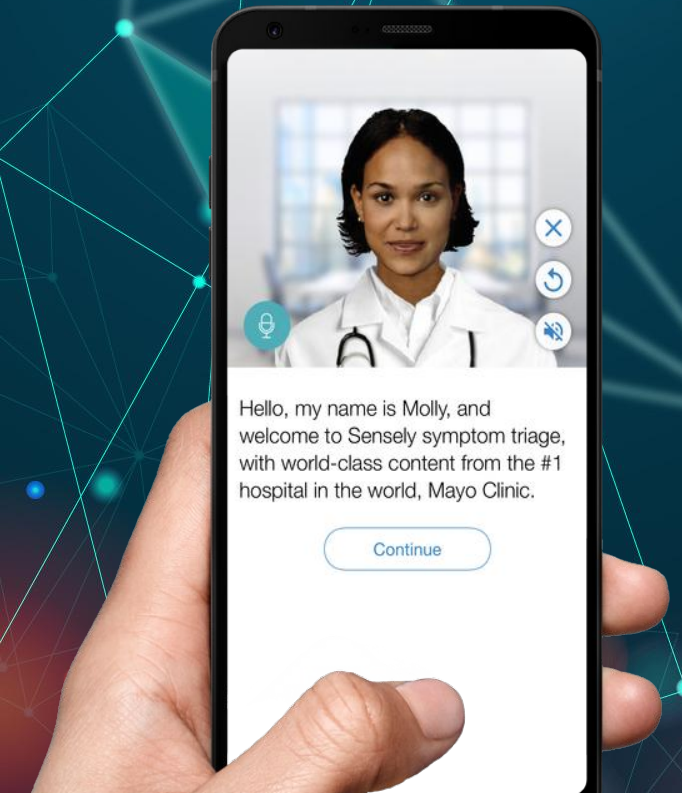
- Convenience sampling
- Snowball sampling

Sample consisted of 44 female and 38 male participants

- Aged between 18 and 40
- Majority (87.8%) in their 20s
- Most (92.7%) had English as their primary language



Procedure - Survey Task



After giving their informed consent to participate:

1. Participants answer questions on **demographic information**
    a. Gender, age, primary language, education level, employment status, tech-savviness, and familiarity with using virtual assistants
2. **Interact with medical chatbot** on the Sensely app by performing a task to ask for health advice.
3. Following the task, fill in questionnaire on **dimensions of perceived anthropomorphism** and **dimensions of perceived risk of miscommunication**

Measures of Dimensions of Variables

5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree)

	Dimension	Measure	E.g. of item
Perceived anthropomorphism	**Facial expression kinesics**	Godspeed questionnaire by Bartneck et al. (2009) • Test different human-robot interactions (HRI)	"The chatbot's appearance made it feel humanlike"
	Voice paralanguage		"The chatbot's responses made the interaction feel natural"
Perceived risk of miscommunication	**Perceived interactivity**	Measures of Perceived Interactivity (MPI) by McMillian and Hwang (2002) • Reflects direction of communication, user control and time	"I can hold a conversation with chatbots in real-time"

Measures of Dimensions of Variables

5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree)

	Dimension	Measure	E.g. of Item
Perceived risk of miscommunication	**Perceived performance anxiety**	Subscale of Anxiety toward Discourse with Robots in the Robot Anxiety Scale (RAS) by Nomura et. al (2006) • Measures anxiety that prevents interaction with communicative robots in daily life	"I feel anxious about how I should talk to chatbots"
	Perceived communication barriers	Subscale of Anxiety toward Communication Capability of Robots in the Robot Anxiety Scale (RAS) by Nomura et. al (2006) • Robot-human communication applicable to chatbots	"Chatbots may be inflexible to converse with"

Measures of Dimensions of Variables

5-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree)

	Dimension	Measure	E.g. of item
Perceived risk of miscommunication	**Trust**	Measurement instruments of trust in technology by Mcknight et al. (2011) • Test trust in specific technology • Adequacy and responsiveness of functions; chatbot's consistency and predictability	"Chatbots are reliable"
	Rapport	Rapport–Expectation with a Robot Scale (RERS) (Nomura & Kanda, 2016) • Test expected rapport based on value of relationship and value as a conversation partner	"It would be enjoyable to interact with chatbots"

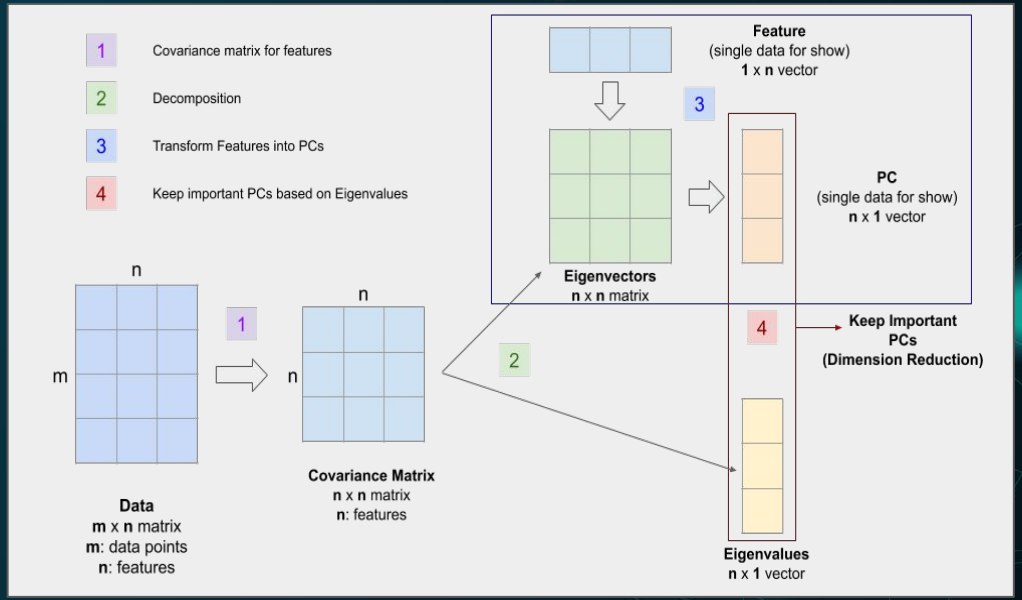
ANALYSIS RESULTS

04

Statistical Mechanism for Operationalizing Constructs

To prove Construct Validity for our Variables:

- Used Factor Analysis
- Applied Principal Component Analysis and Varimax Rotation
  - Determine eigenvectors and proportion of variance of each component of each variable.
  - Compare eigenvectors with eigen-decomposition of the total variance of all the factors loaded
- Accept components if:
  - Eigenvalue >1
  - Combined eigenvalues of components contribute to large proportion of variance



Measures for Perceived Anthropomorphism

Validity Proven:
- 2 main components identified with % variance explained > 76%
- Factor loadings >0.7 for each item

Reliability Proven:
- Cronbach a >0.7

Visual Cues

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.769	.781	2

Audio Cues

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.912	.912	4

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.848
Bartlett's Test of Sphericity	Approx. Chi-Square	549.916
	df	28
	Sig.	<.001

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.766	68.087	68.087	4.766	68.087	68.087	2.891	41.297	41.297
2	.620	8.855	76.943	.620	8.855	76.943	2.495	35.645	76.943
3	.567	8.105	85.048						
4	.554	7.907	92.955						
5	.216	3.089	96.044						
6	.153	2.183	98.228						
7	.124	1.772	100.000						

Extraction Method: Principal Component Analysis.

Rotated Component Matrix[a]

	Component 1	Component 2
The chatbot responses made me feel that it is conscious	.939	
The chatbot's responses made the interaction feel lifelike	.829	
The chatbot's responses made the interaction feel natural	.721	
The chatbot appearance made me feel that it is conscious	.716	
The chatbot's appearance made the interaction feel lifelike		
The chatbot's responses made it feel humanlike		
The chatbot's appearance made it feel humanlike		.882
The chatbot's appearance made the interaction feel natural		.811

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization.

a. Rotation converged in 3 iterations.

Measures for Dimensions of Risk

Perceived Performance Anxiety

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.852	.852	4

Perceived Comm Barrier

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.875	.877	2

Perceived Interaction Risk

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.636	.630	3

Trust

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.534	.532	3

Rapport

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.796	.795	3

Total Variance Explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	5.420	22.581	22.581	5.420	22.581	22.581	4.008	16.701	16.701
2	4.171	17.378	39.960	4.171	17.378	39.960	3.341	13.921	30.622
3	2.282	9.509	49.469	2.282	9.509	49.469	2.664	11.099	41.720
4	1.833	7.639	57.107	1.833	7.639	57.107	2.568	10.700	52.421
5	1.407	5.863	62.970	1.407	5.863	62.970	2.532	10.550	62.970
6	1.283	5.345	68.316						
7	1.236	5.151	73.467						
8	.956	3.983	77.449						
9	.829	3.454	80.904						
10	.818	3.410	84.314						
11	.641	2.672	86.986						
12	.552	2.301	89.287						

Validity Proven:

- 5 main components identified with % variance explained > 61%
- Eigenvalues >1 for each component

Reliability Proven:

- Cronbach a >0.7

KMO and Bartlett's Test

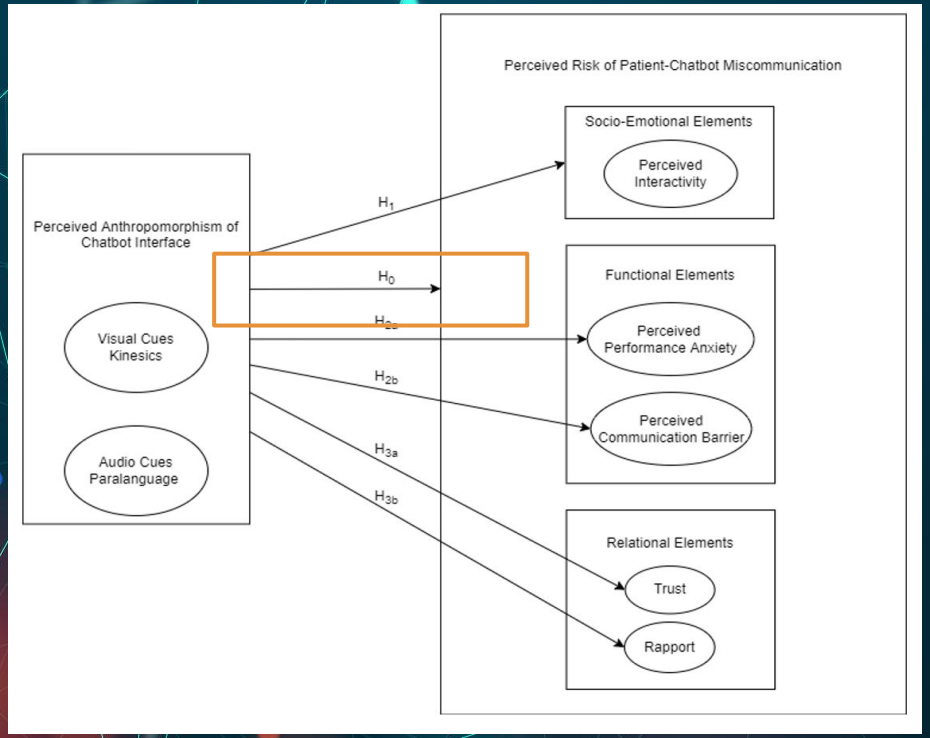
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.509
Bartlett's Test of Sphericity	Approx. Chi-Square	570.367
	df	276
	Sig.	<.001

**See corresponding factor loadings for each item for each Dimension of Risk in Report

Summary Statistics in Operationalizing Constructs

Variables	Validity	Reliability
Independent variable: Perceived Anthropomorphism	Proven Construct Validity with Factor Analysis: • KMO and Bartlett's Test, value >0.5 and p <0.001 • 2 main components identified with % variance explained > 76% • Factor loadings >0.7 for each item	Cronbach alpha for: • Visual Cues > 0.7 • Audio Cues > 0.7
Dependent variable: Perceived Dimensions of Risks	Proven Construct Validity with Factor Analysis: • 5 main components identified with % variance explained > 61% • Eigenvalues >1 for each component • See Factor Loadings >0.699 per factor in Appendix	Cronbach alpha for: • P. Performance Anxiety > 0.7 • P. Comm. Barrier > 0.7 • P. Interactive Risk <0.7 • Trust < 0.7 • Rapport > 0.7

Overview of Results (Framework view)



Correlations

		Perceived Risk Dimensions	Perceived Anthropomorphism
Pearson Correlation	Perceived Risk Dimensions	1.000	.419
	Perceived Anthropomorphism	.419	1.000
Sig. (1-tailed)	Perceived Risk Dimensions	.	<.001
	Perceived Anthropomorphism	.000	.
N	Perceived Risk Dimensions	82	82
	Perceived Anthropomorphism	82	82

Reject H0:
$p < 0.001$ (Alternative Hypothesis is significant)
r-value = 0.419

Premise for Research Question proven true:

- Before, predict a negative relationship between perceived humanness and perceived risk because of positive correlation to robot acceptance.
- Our survey shows: The higher the perceived humanness of a chatbot, the higher the perceived risk of patient-chatbot miscommunication (reject H0)

Summary of Results of Hypotheses

Correlations

		Perceived Anthropomorphism	Perceived Performance Anxiety	Trust Factor	Perceived Interactive Risk	Perceived Communication Barriers	Rapport Factor
Pearson Correlation	Perceived Anthropomorphism	1.000	.199	.526	.215	-.157	.154
	Perceived Performance Anxiety	.199	1.000	.000	.000	.000	.000
	Trust Factor	.526	.000	1.000	.000	.000	.000
	Perceived Interactive Risk	.215	.000	.000	1.000	.000	.000
	Perceived Communication Barriers	-.157	.000	.000	.000	1.000	.000
	Rapport Factor	.154	.000	.000	.000	.000	1.000
Sig. (1-tailed)	Perceived Anthropomorphism	.	.037	<.001	.026	.079	.084
	Perceived Performance Anxiety	.037	.	.500	.500	.500	.500
	Trust Factor	.000	.500	.	.500	.500	.500
	Perceived Interactive Risk	.026	.500	.500	.	.500	.500
	Perceived Communication Barriers	.079	.500	.500	.500	.	.500
	Rapport Factor	.084	.500	.500	.500	.500	.

H	Construct	Sig	Cor.
H1	P. Interaction Risk	✓	+
H2a	P. Perf Anxiety	✓	+
H2b	P. Comm Barrier	✗	
H3a	(Lack of) Trust	✓	+
H3b	(Lack of Rapport)	✗	

Eliciting the Relationships with Dimensions of Risks

Correlations

		Perceived Anthropomorphism_X	Relational Elements_Y3	Functional Elements_Y2	Perceived Interactive Risk_Y1
Pearson Correlation	Perceived Anthropomorphism_X	1.000	.481	.030	.215
	Relational Elements_Y3	.481	1.000	.000	.000
	Functional Elements_Y2	.030	.000	1.000	.000
	Perceived Interactive Risk_Y1	.215	.000	.000	1.000
Sig. (1-tailed)	Perceived Anthropomorphism_X	.	<.001	.396	.026
	Relational Elements_Y3	.000	.	.500	.500
	Functional Elements_Y2	.396	.500	.	.500
	Perceived Interactive Risk_Y1	.026	.500	.500	.

H	Construct	Sig	Cor.
H1	Socio-Emotional Elements of Risk	✓	+
H2	Functional Elements of Risk	✗	
H3	Relational Elements of Risk	✓	+

Accounting for Interaction Effects

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				
					R Square Change	F Change	df1	df2	Sig. F Change
1	.528[a]	.278	.251	1.21658	.278	10.034	3	78	<.001

a. Predictors: (Constant), Perceived Interactive Risk_Y1, Functional Elements_Y2, Relational Elements_Y3

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95.0% Confidence Interval for B		Correlations		
		B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part
1	(Constant)	1.933E-17	.134		.000	1.000	-.267	.267			
	Relational Elements_Y3	.481	.096	.481	4.999	<.001	.289	.672	.481	.493	.481
	Functional Elements_Y2	.030	.096	.030	.308	.759	-.162	.221	.030	.035	.030
	Perceived Interactive Risk_Y1	.305	.136	.215	2.240	.028	.034	.575	.215	.246	.215

a. Dependent Variable: Perceived Anthropomorphism_X

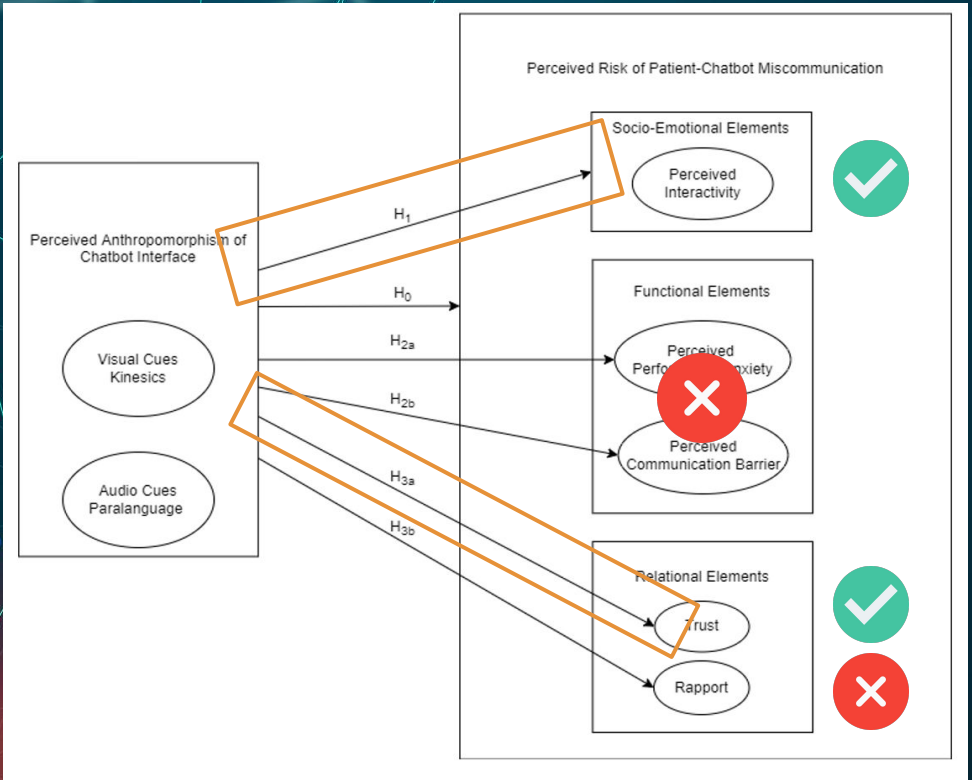
Functional Elements Risk, p > 0.05

Multiple Linear Regression

- Accounting for interaction effects show that there is **no other potential dimension** of risk that might provide a significant pathway correlating **Perceived Anthropomorphism (IV)** to **Functional Dimension of Risk**.

- **No significant indirect relationship**, between Perceived Anthropomorphism (IV) and Functional dimension of risk

Overview of Results (Framework view)



- Reject H0
  - Proof of perceived risks in patient-chatbot communication as result of humanlike physical features
- H1 is supported:
  - Socio-emotional Risks positively correlated with Perceived Anthropomorphism
- H2 is not supported
- H3 is partially supported.
  - (Risks from) Rapport is not supported
  - (Risks from) Trust is positively correlated with Perceived Anthropomorphism

DISCUSSION 05

Discussion

- Significance of **Perceived Anthropomorphism** on **Socio-Emotional Element**
  - **Significant (+)**

Socio-Emotional Element and Items	Statistical Significance	Possible Explanation
Perceived Interactivity • **Active participation** by the chatbot • **Real-time** content delivery • **Synchronous** communication • Retaining user's **attention**	Significant (+)	Chatbot's mimicking of natural human conversation (Adamopoulou & Moussiades, 2020)

Discussion

- Significance of **Perceived Anthropomorphism** on **Functional Elements**
  - **Insignificant**

Functional Element and Items	Statistical Significance	Possible Explanation
Perceived Performance Anxiety • **Talking** with and **replying** to the chatbot • **Mutual understanding** in communication	Significant (+)	Uncanny Valley Effect (Mori, 1982)
Perceived Communication Barriers • **Inconsistent** communication • **Inflexible** communication • **Incomprehensible** communication	Insignificant	Clear communication in English

Discussion

- Significance of **Perceived Anthropomorphism** on **Relational Elements**
  - **Significant (+)**

Relational Element and Items	Statistical Significance	Possible Explanation
Trust • Reliability, Functionality • Competency, Effectiveness • Comfort level	Significant (+)	Emulating a medical professional
Rapport • Value as a **good conversational partner** • Value in the human chatbot relationship	Insignificant	No chatbot small talk

CONCLUSION 06

Implications of the Study

Importance of:

- **Socio-emotional** and **relational** elements e.g. **perceived interactivity** and **trust**, in the chatbot design of smartphone healthcare applications
- **Human-like experience** vs **mechanistic interactions**
- Application of risk dimensions when incorporating **anthropomorphic AI chatbots** into **assistive robots at hospitals (Patient-Centered Care)**

Limitations and Future Research

- **Convenience** sample
- Respondents in **Singapore** & **age group** of respondents
- **Not** conducted in a **controlled laboratory setting**
- **Chatbots** of **varying characteristics**
- **Customized interaction experience** with chatbot

THANK YOU!