Human-Centred Information Systems: Designing Avatars for Users from Arab Culture

Hussain M. Al Jaroodi
BIT, MIT

A thesis submitted in fulfilment of the requirements for the degree of Doctor of Philosophy in Information Systems

School of Electrical Engineering and Computing
Faculty of Engineering and Built Environment
The University of Newcastle, Australia

April / 2020

Supervisors
Dr Raymond Chiong
Dr Marc Adam

ABSTRACT

This research explores avatar design aimed at being part of a user interface, which is human-centred and enhances user experience. Avatars here refer to images or digital representations of users or computer agents in an online environment. We first carry out a comprehensive review of the relevant literature to investigate and synthesise findings related to avatar design. Through the review, we develop a theoretical framework to capture commonly investigated constructs, interaction types, application domains, and design considerations for digital representations. We also identify the knowledge gaps and establish our research objectives.

Based on the established research objectives, we conducted two qualitative studies exploring avatar design in the context of health applications. To derive avatar design guidelines, we adopted a co-design approach, which involved stakeholders in the design process. For the first study, we focused on empathic avatar design for stroke rehabilitation in a culturally neutral manner. Here, empathic design refers to paying attention to users' needs and building an emotional relationship between users and avatars. This study was rooted in *behaviour change theory* to engage stroke survivors. For the second study, we focused on designing avatars for Arab culture by creating a health scenario that provided a context for participants' responses. Here, in designing avatars, we considered the expertise of stakeholders who have experience with Arab culture. This study was based on *social response theory*, which posits that humans behave socially to computers. To the best of our knowledge, this is the first time that Arab culture has been considered in developing design guidelines for avatars comprehensively.

Based on the design guidelines developed in the second study, a set of 12 avatars covering the dimensions of culture, gender and clothing were designed. For the Arab avatars, we additionally considered Arab *cultural markers*, which involve design elements prevalent

within Arab culture. Then, we investigated the appropriateness of avatar design, i.e., the extent to which an avatar was perceived as culturally appropriate to Arab culture. We collected data from Arab users through an online questionnaire to test our research model and hypotheses. This study broadens our understanding of the influence of cultural appropriateness. The findings reveal that Arab avatars yield higher cultural appropriateness, which, in turn, is associated with higher trust and usage intention.

This research as a whole enriches our understanding of avatar design, as it explains why involving users in the design of avatars can provide a heightened user experience. The findings reveal that including design considerations that match the context, address users' needs, and reflect users' culture can provide better human–avatar interactions. Our work emphasises the importance of *empathic elements* and *cultural markers* in achieving human-centred design. The research adds to the existing knowledge base through the development of design guidelines that assist designers create more suitable avatars. The research also offers a deeper understanding of how avatars that are culturally appropriate can improve usage intention. It provides designers of user interfaces with a better understanding of how to design avatars for health applications in Arab culture.

STATEMENT OF ORIGINALITY

I hereby certify that the work embodied in the thesis is my own work, conducted under normal supervision.

The thesis contains no material that has been accepted, or is being examined, for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text. I give consent to the final version of my thesis being made available worldwide when deposited in the University's Digital Repository, subject to the provisions of the Copyright Act 1968.

Hussain M. Al Jaroodi

ACKNOWLEDGEMENT OF AUTHORSHIP

I hereby certify that the work embodied in this thesis contains published paper/s/scholarly work of which I am a joint author. I have included as part of the thesis a written declaration endorsed in writing by my supervisor, attesting to my contribution to the joint publication/s/scholarly work.

Hussain M. Al Jaroodi

By signing below, I confirm that Hussain M. Al Jaroodi contributed to the following papers:

Aljaroodi, H. M., Adam, M. T. P., Chiong, R., Cornforth, D. J. Minichiello, M (2017). Empathic avatars in stroke rehabilitation: A co-designed mHealth artifact for stroke survivors. *Proceedings of the International Conference on Design Science Research in Information System and Technology (DSRIST)*, (pp. 73-89), Karlsruhe, Germany. Nominated for the Herbert A. Simon Award for the Best Design Research Paper. Link: https://doi.org/10.1007/978-3-319-59144-5_5

Aljaroodi, H. M., Chiong, R., Adam, M. T. P. (2017). Designing persuasive avatars in mHealth for Arabic culture: A qualitative study. *Proceedings of the Australasian Conference on Information Systems (ACIS)*, (pp. 1-10), Hobart, Australia. Selected as one of top six research-in-progress papers. Link: https://aisel.aisnet.org/acis2017/38

Aljaroodi, H. M., Adam, M. T. P., Chiong, R., Teubner, T. (2019). Avatars and embodied agents in experimental information systems research: A systematic review and conceptual framework. *Australasian Journal of Information Systems*, vol. 23, pp. 1-37. Link: https://doi.org/10.3127/ajis.v23i0.1841

Aljaroodi, H. M., Chiong, R., Adam, M. T. P. (2020). Exploring the design of avatars for users from Arabian culture through a hybrid approach of deductive and inductive reasoning. *Computers in Human Behavior*, vol. 106, 106246. Link: https://doi.org/10.1016/j.chb.2020.106246

Aljaroodi, H. M., Adam, M. T. P., Teubner, T., Chiong, R. Designing avatars for Arab users: The impact of cultural appropriateness on trust and usage intention. *MIS Quarterly*, submitted on 28/11/2019 (under review)

Dr Raymond Chiong

ACKNOWLEDGEMENTS

This thesis encompasses my PhD journey at the University of Newcastle, Australia. First of all, I would like to express my sincere gratitude to my supervisors, Dr Raymond Chiong and Dr Marc Adam, for their continuous support during my PhD journey and related research, as well as their patience, motivation, and immense knowledge. Their constant guidance assisted me in the research and writing of this thesis; I could not have imagined having better supervisors and mentors for my PhD study. I could not have achieved this milestone in my life without their encouragement.

Besides my supervisors, I would like to thank Professor Timm Teubner from the Technical University of Berlin, Germany, for his insightful comments and encouragement during my PhD journey. Professor Teubner's expertise and knowledge assisted me in developing sound research skills in terms of data analysis and measurement. I could not have achieved this without his help and support.

Nobody has been more important to me in the pursuit of this PhD study than the members of my family. I would like to thank my parents whose love and guidance are always with me wherever I go or whatever I do. Most importantly, I wish to thank my loving and supportive wife, Fatimah Al Hubayl, for her encouragement and sacrifice, and I also thank my two boys, Rayan and Morad, for their smiles and hugs when I got home at the end of the day, which provided unending inspiration and kept me going.

I also recognise and thank my sponsor, the Institute of Public Administration (IPA), Saudi Arabia, for granting me this opportunity to pursue my PhD. Their financial and administration support made it easier for me and my family. I also thank the Saudi Arabian Cultural Mission (SACM) for cooperation with my sponsor to make this journey easier.

I also thank my fellow PhD candidates in the office. A special thank goes to Philipp Rouast for his advice and chats during this time. Also, I wish to thank Jacqueline Bailey, Tyler Noorbergen and Ashlea Rendell for their feedback and suggestions on my writing, structure of papers, and figures. I much appreciated the good times and memories we all shared in the office (ICT 3.43).

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ABBREVIATION	DESCRIPTION
ACE	Arab Culture Expert
AGFI	Adjusted Goodness of Fit Index
ANTH	Perceived Anthropomorphism
AVE	Average Extracted Variance
CA	Perceived Cultural Appropriateness
CASA	Computers are Social Actors
CB-SEM	Covariance-Based Structural Equation Modelling
CFI	Comparative Fit Index
CR	Composite reliability
FAM	Perceived Familiarity
H2A	Human to Avatar Interaction
H2EA	Human to Embodied Agent Interaction
H2SA	Human to Self-Avatar Interaction
HCI	Human–Computer Interaction
HCIS	Human-Centred Information System
HTMT	Heterotrait–Monotrait Ratio
IS	Information System
IT	Information Technology
ITU	Intention to Use
KSA	Kingdom of Saudi Arabia
mHealth	Mobile Health
NCD	Non-Communicable Disease
NIH	National Institutes of Health
PSP	Perceived Social Presence
PSY	Psychologist
RMSEA	Root Mean Square Error of Approximation
RT	Representation Theory
SA2A	Self-Avatar to Avatar Interaction
SA2EA	Self-Avatar to Embodied Agent Interaction
SEM	Structural Equation Modelling
SLR	Systematic Literature Review
SRMR	Standardised Root Mean Square Residual
SRT	Social Response Theory
TLI	Tucker Lewis Index
TRT	Trust
UI	User Interface
WHF	World Heart Federation
WHO	World Health Organisation
α	Cronbach or Alpha Coefficient