AN AMBIENT AGENT MODEL FOR READING COMPANION ROBOT

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DOCTOR OF PHILOSOPHY
UNIVERSITI UTARA MALAYSIA
2019

Awang Had Salleh
Graduate School
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Abstrak

Membaca pada asasnya adalah tugas penyelesaian masalah. Berdasarkan apa yang dibaca, seperti penyelesaian masalah, ia memerlukan usaha, perancangan, pemantauan kendiri, pemilihan strategi, dan refleksi. Tambahan lagi, semakin pembaca cuba menyelesaikan masalah yang sukar, dengan bahan bacaan yang semakin rumit, maka ia memerlukan usaha yang lebih dan mencabar kognitif. Untuk menangani isu ini, robot peneman boleh digunakan untuk membantu pembaca dalam menyelesaikan tugas membaca yang sukar dengan menjadikan proses membaca lebih menyeronokkan dan bermakna. Robot sebegini memerlukan model agen ambien, yang memantau keupayaan kognitif pembaca yang mana ia melibatkan tugas yang lebih kompleks dan interaksi dinamik antara manusia dan persekitaran. Model agen ambien beban kognitif pada masa kini yang dibangunkan tidak mempunyai keupayaan analitikal dan tidak diintegrasikan ke dalam robot peneman. Oleh sebab itu, kajian ini dijalankan untuk membangunkan satu model agen ambien bagi beban kognitif dan prestasi bacaan yang diintegrasikan ke dalam robot peneman bacaan. Aktiviti penyelidikan adalah berdasarkan Proses Penyelidikan RekaBentuk Sains, Pemodelan Berasaskan Agen, dan Rangkakerja Agen Ambien. Model cadangan ini telah dinilai melalui beberapa siri penentusahan dan pengesahsahihan. Proses penentusahan melibatkan penilaian keseimbangan dan analisa jejakan automatik untuk memastikan model ini menunjukkan tingkah laku yang realistik dan selaras dengan data empirikal dan sorotan kajian. Di samping itu, proses pengesahsahihan yang melibatkan eksperimen manusia telah membuktikan bahawa robot peneman bacaan berupaya mengurangkan bebanan kognitif semasa tugas membaca. Tambahan lagi, keputusan eksperimen menunjukkan bahawa dengan mengintegrasikan model agen ambien ke dalam robot peneman bacaan dapat menjadikan robot diterima sebagai teman sampingan digital sosial yang pintar, berguna, dan mampu memberikan motivasi. Sumbangan kajian menjadikan penyelidikan ini sebagai usaha baharu yang bertujuan merekabentuk aplikasi ambien berasaskan proses fizikal dan kognitif manusia. Di samping itu, penemuan ini dapat berfungsi sebagai satu prinsip rekabentuk robot peneman yang lebih realistik di masa hadapan.

Kata kunci: Model Agen Ambien, Beban Kognitif, Prestasi Membaca, Peneman Digital.

Abstract

Reading is essentially a problem-solving task. Based on what is read, like problem solving, it requires effort, planning, self-monitoring, strategy selection, and reflection. Also, as readers are trying to solve difficult problems, reading materials become more complex, thus demands more effort and challenges cognition. To address this issue, companion robots can be deployed to assist readers in solving difficult reading tasks by making reading process more enjoyable and meaningful. These robots require an ambient agent model, monitoring of a reader's cognitive demand as it could consist of more complex tasks and dynamic interactions between human and environment. Current cognitive load models are not developed in a form to have reasoning qualities and not integrated into companion robots. Thus, this study has been conducted to develop an ambient agent model of cognitive load and reading performance to be integrated into a reading companion robot. The research activities were based on Design Science Research Process, Agent-Based Modelling, and Ambient Agent Framework. The proposed model was evaluated through a series of verification and validation approaches. The verification process includes equilibria evaluation and automated trace analysis approaches to ensure the model exhibits realistic behaviours and in accordance to related empirical data and literature. On the other hand, validation process that involved human experiment proved that a reading companion robot was able to reduce cognitive load during demanding reading tasks. Moreover, experiments results indicated that the integration of an ambient agent model into a reading companion robot enabled the robot to be perceived as a social, intelligent, useful, and motivational digital side-kick. The study contribution makes it feasible for new endeavours that aim at designing ambient applications based on human's physical and cognitive process as an ambient agent model of cognitive load and reading performance was developed. Furthermore, it also helps in designing more realistic reading companion robots in the future.

Keywords: Ambient Agent Model, Cognitive Load, Reading Performance, Digital Companion.

Acknowledgement

"Education is the most powerful weapon which you can use to change the world."
Nelson Mandela

The end of my childhood dream is become visible by the time I start writing this acknowledgment. I have always dreamt of obtaining a good education to dive in adding little spices to the mind-blowing jar of scientific knowledge. I will not deny people inspirations foster my aspiration and drove me thousands of miles away from home country (Mesopotamia) to Malaysia just to make my old dream comes true. And after four years of hate-love relationship with my thesis, all I can say is, I am happy, thankful, and proud of being able to make a little contribution in the fields of Artificial Intelligence and Robotic Technology.

First and foremost, I would like to express utmost appreciation to my main supervisor Dr. Azizi Ab Aziz for always being available, and for all the helpful brainstorm sessions. Also, I would like to express my profound thanks to my co-supervisor Assoc. Prof. Dr. Faudziah Ahmad, who is like a mum to me, for supporting and guiding me to complete this thesis. She is such an intelligent, humble and spiritual woman who has been always there to support during the whole period of the study and especially for her guidance during the inevitable ups and downs of my academic issues. I doubt that I will ever be able to convey my appreciation fully, but I owe them endless gratitude.

Next, I would like to thank my family, my brothers (Jasim, Ali, and Basim), and sisters (Basima, Najala, Hala, and Noor) for their constant support. They are always ready to help me. I am the youngest among them and this gives me an amazing privilege as I always feel like that all of them are competing in terms of offering their help.

To my parents, Mohammed Ali and Fatima, I hope you are proud of seeing your little son accomplishing this thesis. I am undoubtedly assured that your constant prayers, encouragement, love, and support over years have eased my journey. I love you much and I wish I can draw consistent smile on their faces.

Additionally, special thank goes to my wonderful friends in both Iraq and Malaysia (Wael, Ahmed, Mohammed, Hussain, Tholfikar, Athirah, Hidayah, Roqia, Naser, Goke, Mustafa, Ammar, Laura, and Him Zerkiny). Thanks to all of you for your encouraging words and support during the difficult times. Also, I appreciatively acknowledge the support of all people who have knowingly and unknowingly helped me in the successful completion of this thesis.

Last but not least, I gratefully acknowledge the funding received towards my PhD from Universiti Utara Malaysia (UUM).

Finally, all Praise to Allah (S.W.T) the Almighty, for giving me the blessing, the strength, the chance and endurance to complete this thesis.

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CHAPTER ONE
INTRODUCTION

1.1 Introduction

Intelligent artefacts have always received important attention among many scientists, engineers, and innovators to improve quality of life and facilitate daily activities through understanding human physical and cognitive processes (Costa, Novais, & Julian, 2018). These new endeavours of creating intelligent and knowledgeable artefacts to the great extent are becoming a dispensable part towards broaden the landscape of state of the arts in intelligent applications. For instance, in ambient intelligence paradigm (AmI), which is a discipline that brings intelligence to our living environments and makes those environments responsive to our needs, intelligent applications were developed extensively to aid humans by making their surrounding environments more sensible to response in a timely fashion. Such AmI applications can be seen in a wide range of application domains, such as in education (Zhu, Yu, & Riezebos, 2016; Corno, De Russis, & Sáenz, 2017; Durães, Castro, Bajo, & Novais, 2017), healthcare interventions (Al-Shaqi, Mourshed, & Rezgui, 2016; Dey & Ashour, 2017; Durães et al., 2017), public transportations (Nakashima, Hirata, & Ochiai, 2017), emergency services (Kleinberger, Jedlitschka, Storf, Steinbach-Nordmann, & Prueckner, 2009), and robotics (Bellotto, Fernandez-Carmona, & Cosar, 2017).

However, with the new endeavours to enhance the state of the arts of these smart applications (Treur, 2016b), these AmI applications need to acquire additional information related to human functioning to provide relevant assistance in a knowledgeable manner. In other words, AmI applications were initially developed merely based on the sensor-based and data fusion information acquisition, therefore

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REFERENCES

Aarts, E., & De Ruyter, B. (2009). New research perspectives on Ambient Intelligence. *Journal of Ambient Intelligence and Smart Environments*, *1*(1), 5–14.

Aziz, A. A., Ahmad, F., ChePa, N., & Yusof, S. A. M. (2013). Verification of an Agent Model for Chronic Fatigue Syndrome. *International Journal of Digital Content Technology and Its Applications*, *7*(14), 25.

Aziz, A. A., Ahmad, F., & Hintaya, H. M. (2012). An agent model for temporal dynamics analysis of a person with chronic fatigue syndrome. In *Brain Informatics* (pp. 107–118). Springer.

Aziz, A. A., Shabli, A. H. M., & Ghanimi, H. M. A. (2017). Formal Specifications and Analysis of an Agent-Based Model for Cognitive Aspects of Fear of Crime BT - Multi-disciplinary Trends in Artificial Intelligence: 11th International Workshop, MIWAI 2017, Gadong, Brunei, November 20-22, 2017, Proceedings. In S. Phon-Amnuaisuk, S.-P. Ang, & S.-Y. Lee (Eds.) (pp. 331–345). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-69456-6_28.

Abar, S., Theodoropoulos, G. K., Lemarinier, P., & O'Hare, G. M. P. (2017). Agent Based Modelling and Simulation tools: A review of the state-of-art software. *Computer Science Review*, *24*, 13–33.

Abro, A. H., Klein, M. A. C. A., Manzoor, A. R., Tabatabaei, S. A., & Treur, J. (2014). A Computational Model of the Relation between Regulation of Negative Emotions and Mood. In C. Loo, K. Yap, K. Wong, A. Teoh, & K. Huang (Eds.), *Neural Information Processing SE - 8* (Vol. 8834, pp. 59–68). Springer International Publishing. https://doi.org/10.1007/978-3-319-12637-1_8

Adam, C., & Gaudou, B. (2016). BDI agents in social simulations: a survey. *The Knowledge Engineering Review*, *31*(3), 207–238.

Adegoke, O., Aziz, A. A., Yusof, Y. (2015). Designing a BDI Agent Reactant Model Of Behavioural Change Intervention. *Jurnal Teknologi*, *78*(2–2), 83–93.

Aigner, P., & McCarragher, B. (1999). Shared control framework applied to a robotic aid for the blind. *Control Systems, IEEE*, *19*(2), 40–46.

Al-Shaqi, R., Mourshed, M., & Rezgui, Y. (2016). Progress in ambient assisted systems for independent living by the elderly. *SpringerPlus*, *5*(1), 624. https://doi.org/10.1186/s40064-016-2272-8

Al Hazzouri, A. Z., Haan, M. N., Deng, Y., Neuhaus, J., & Yaffe, K. (2014). Reduced heart rate variability is associated with worse cognitive performance in elderly Mexican Americans. *Hypertension*, *63*(1), 181–187.

Al Husaini, Z. A. E. (2013). Knowledge, attitude and practice of reading habit among female medical students, Taibah University. *Journal of Taibah University Medical Sciences*, *8*(3), 192–198. https://doi.org/http://dx.doi.org/10.1016/j.jtumed.2013.09.004.

Alexander, P. A., & Laboratory, T. D. R. and L. R. (2012). Reading Into the Future: Competence for the 21st Century. *Educational Psychologist*, *47*(4), 259–280. https://doi.org/10.1080/00461520.2012.722511

Alidoust, M., & Rouhani, M. (2015). A Computational Behavior Model for Life-Like Intelligent Agents. In J. Romportl, E. Zackova, & J. Kelemen (Eds.), *Beyond Artificial Intelligence SE - 12* (Vol. 9, pp. 159–175). Springer International Publishing. https://doi.org/10.1007/978-3-319-09668-1_12

Alsheikh, N. O., & Mokhtari, K. (2011). An examination of the metacognitive reading strategies used by native speakers of Arabic when reading in English and Arabic. *English Language Teaching*, *4*(2), 151.

An, G., Mi, Q., Dutta-Moscato, J., & Vodovotz, Y. (2009). Agent-based models in translational systems biology. *Wiley Interdisciplinary Reviews: Systems Biology and Medicine*, *1*(2), 159–171.

Applegate, A. J., Applegate, M. D., Mercantini, M. A., McGeehan, C. M., Cobb, J. B., DeBoy, J. R., … Lewinski, K. E. (2014). The Peter effect revisited: Reading habits and attitudes of college students. *Literacy Research and Instruction*, *53*(3), 188–204.

Aryania, A., Daniel, B., Thomessen, T., & Sziebig, G. (2012). New trends in industrial robot controller user interfaces. *3rd IEEE International Conference on Cognitive Infocommunications*, 365–369. https://doi.org/10.1109/CogInfoCom.2012.6422007

Augello, A., Cipolla, E., Infantino, I., Manfré, A., Pilato, G., & Vella, F. (2018). Social signs processing in a cognitive architecture for an humanoid robot. *Procedia Computer Science*, *123*, 63–68. https://doi.org/https://doi.org/10.1016/j.procs.2018.01.011.

Augusto, J. C., & McCullagh, P. (2007). Ambient intelligence: Concepts and applications. *Computer Science and Information Systems*, *4*(1), 1–27.

Ayasun, S., Fischl, R., Vallieu, S., Braun, J., & Cadırlı, D. (2007). Modeling and stability analysis of a simulation–stimulation interface for hardware-in-the-loop applications.

Simulation Modelling Practice and Theory, *15*(6), 734–746.

Aziz, A. A. (2012). Exploring Computational Models for Intelligent Support of Persons with Depression (doctoral's thesis). *VU University Amsterdam, Netherland.*

Aziz, A. A. (2016). Knowing When to Support: A Human-Aware Agent Model in a Psychological Domain. *Human Factors and Ergonomics Malaysia*, *Vol 1*(No 1), 45–54.

Aziz, A. A., & Klein, M. C. A. (2011). Computational Modeling of Therapies related to Cognitive Vulnerability and Coping. In *BICA* (pp. 16–25).

Aziz, A. A., Klein, M. C. A., & Treur, J. (2010). An integrative ambient agent model for unipolar depression relapse prevention. *Journal of Ambient Intelligence and Smart Environments*, *2*(1), 5–20.

Baars, M., Wijnia, L., & Paas, F. (2017). The association between motivation, affect, and self-regulated learning when solving problems. *Frontiers in Psychology*, *8*, 1346.

Baddeley, A. (1992). Working memory. *Science*, *255*(5044), 556–559.

Bainbridge, W. W. a., Hart, J., Kim, E. S. E. S., & Scassellati, B. (2008). The effect of presence on human-robot interaction. In *RO-MAN 2008 - The 17th IEEE International Symposium on Robot and Human Interactive Communication* (pp. 701–706). IEEE. https://doi.org/10.1109/ROMAN.2008.4600749.

Bakar, J. A. A., Mat, R. C., Aziz, A. A., Jasri, N. A. N., & Yusoff, M. F. (2016). Designing agent-based modeling in dynamic crowd simulation for stressful environment. *Journal of Telecommunication, Electronic and Computer Engineering (JTEC)*, *8*(10), 151–156.

Bangor, A., Kortum, P. T., & Miller, J. T. (2008). An empirical evaluation of the system usability scale. *Intl. Journal of Human–Computer Interaction*, *24*(6), 574–594.

Bartneck, C. (2003). Interacting with an embodied emotional character. In *Proceedings of the 2003 international conference on Designing pleasurable products and interfaces* (pp. 55–60). New York,USA: ACM.

Bartneck, C., Kulić, D., Croft, E., & Zoghbi, S. (2009). Measurement instruments for the anthropomorphism, animacy, likeability, perceived intelligence, and perceived safety of robots. *International Journal of Social Robotics*, *1*(1), 71–81.

Batula, A. M., Kim, Y. E., & Ayaz, H. (2017). Virtual and Actual Humanoid Robot

Control with Four-Class Motor-Imagery-Based Optical Brain-Computer Interface. *BioMed Research International*, *2017*.

Bazghandi, A. (2012). Techniques, advantages and problems of agent based modeling for traffic simulation. *Int J Comput Sci*, *9*(1), 115–119.

Bear, G. G., Slaughter, J. C., Mantz, L. S., & Farley-Ripple, E. (2017). Rewards, praise, and punitive consequences: Relations with intrinsic and extrinsic motivation. *Teaching and Teacher Education*, *65*(Supplement C), 10–20. https://doi.org/https://doi.org/10.1016/j.tate.2017.03.001.

Behroozi, M., Lui, A., Moore, I., Ford, D., & Parnin, C. (2018). Dazed: measuring the cognitive load of solving technical interview problems at the whiteboard. In *Proceedings of the 40th International Conference on Software Engineering: New Ideas and Emerging Results* (pp. 93–96). ACM.

Bellotto, N., Fernandez-Carmona, M., & Cosar, S. (2017). Enrichme integration of ambient intelligence and robotics for AAL. AAAI.

Berland, M., & Wilensky, U. (2015). Comparing Virtual and Physical Robotics Environments for Supporting Complex Systems and Computational Thinking. *Journal of Science Education and Technology*, 1–20. https://doi.org/10.1007/s10956-015-9552-x.

Berns, K., & Hirth, J. (2006). Control of facial expressions of the humanoid robot head ROMAN. In *International Conference on Intelligent Robots and Systems* (pp. 3119–3124). IEEE.

Bicho, E., Louro, L., & Erlhagen, W. (2010). Integrating verbal and nonverbal communication in a dynamic neural field architecture for human–robot interaction. *Frontiers in Neurorobotics*, *4*.

Bickmore, T. W., Caruso, L., Clough-Gorr, K., & Heeren, T. (2005). 'It's just like you talk to a friend'relational agents for older adults. *Interacting with Computers*, *17*(6), 711–735.

Bjorklund, D. F. (2013). *Children's strategies: Contemporary views of cognitive development*. Psychology Press.

Blehm, C., Vishnu, S., Khattak, A., Mitra, S., & Yee, R. W. (2005). Computer Vision Syndrome: A Review. *Survey of Ophthalmology*, *50*(3), 253–262. https://doi.org/http://dx.doi.org/10.1016/j.survophthal.2005.02.008

Block, R. A., Hancock, P. A., & Zakay, D. (2010). How cognitive load affects duration judgments: A meta-analytic review. *Acta Psychologica*, *134*(3), 330–343.

Boaler, J., Dieckmann, J. A., Perez Núñez, G., Liu Sun, K., & Williams, C. (2018). Changing Students Minds & Achievement in Mathematics: The Impact of a Free Online Student Course. In *Frontiers in Education* (Vol. 3, p. 26). Frontiers.

Bogue, R. (2017). Domestic robots: Has their time finally come? *Industrial Robot: An International Journal*, *44*(2), 129–136.

Bohn, J., Coroamă, V., Langheinrich, M., Mattern, F., & Rohs, M. (2005). Social, economic, and ethical implications of ambient intelligence and ubiquitous computing. In *Ambient intelligence* (pp. 5–29). Springer.

Boksem, M. A. S., & Tops, M. (2008). Mental fatigue: costs and benefits. *Brain Research Reviews*, *59*(1), 125–139.

Bongiorno, C., Miccichè, S., & Mantegna, R. N. (2017). An empirically grounded agent based model for modeling directs, conflict detection and resolution operations in air traffic management. *PLoS One*, *12*(4), e0175036.

Boomgaard, G., Lavitt, F., & Treur, J. (2018). Computational Analysis of Social Contagion and Homophily Based on an Adaptive Social Network Model. In *10th International Conference on Social Informatics, SocInfo'18.* Saint Petersburg, Russia.

Bosse, T. (2005). Analysis of the Dynamics of Cognitive Processes (doctoral's thesis). *VU University Amsterdam, Netherland.*, 410.

Bosse, T., Both, F., Duell, R., Hoogendoorn, M., Klein, M. C. A., Van Lambalgen, R., Treur, J. (2013). An ambient agent system assisting humans in complex tasks by analysis of a human's state and performance. *International Journal of Intelligent Information and Database Systems*, *7*(1), 3–33.

Bosse, T., Both, F., Gerritsen, C., Hoogendoorn, M., & Treur, J. (2007). Model-based reasoning methods within an ambient intelligent agent model. In *European Conference on Ambient Intelligence* (pp. 352–370). Springer.

Bosse, T., Both, F., Gerritsen, C., Hoogendoorn, M., & Treur, J. (2012). Methods for model-based reasoning within agent-based Ambient Intelligence applications. *Knowledge-Based Systems*, *27*, 190–210.

Bosse, T., Both, F., Van Lambalgen, R., & Treur, J. (2008). An Agent Model for a

Human's Functional State and Performance. In *Proceedings of the 2008 IEEE/WIC/ACM International Conference on Web Intelligence and Intelligent Agent Technology-Volume 02* (pp. 302–307). IEEE Computer Society.

Bosse, T., Callaghan, V., & Lukowicz, P. (2010). On computational modeling of human-oriented knowledge in Ambient Intelligence. *JAISE*, *2*(1), 3–4.

Bosse, T., Duell, R., Memon, Z. A., Treur, J., & van der Wal, C. N. (2017). Computational model-based design of leadership support based on situational leadership theory. *Simulation*, 605–617. https://doi.org/10.1177/0037549717693324.

Bosse, T., Duell, R., Memon, Z., Treur, J., & van der Wal, C. N. (2015). Agent-Based Modeling of Emotion Contagion in Groups. *Cognitive Computation*, *7*(1), 111–136. https://doi.org/10.1007/s12559-014-9277-9

Bosse, T., Hoogendoorn, M., Klein, M. C. A., & Treur, J. (2011). An ambient agent model for monitoring and analysing dynamics of complex human behaviour. *Journal of Ambient Intelligence and Smart Environments*, *3*(4), 283–303.

Bosse, T., Hoogendoorn, M., Klein, M. C. A., van Lambalgen, R., van Maanen, P.-P., & Treur, J. (2011). Incorporating human aspects in ambient intelligence and smart environments. *Handbook of Research on Ambient Intelligence and Smart Environments: Trends and Perspectives (Pp. 128-164), IGI Global .*

Bosse, T., Jonker, C. M., Meij, L, van Der, & Treur, J. (2006). A Temporal Trace Language for the Formal Analysis of Dynamic Properties, 1–15.

Bosse, T., Jonker, C. M., van der Meij, L., Sharpanskykh, A., & Treur, J. (2009). Specification and verification of dynamics in agent models. *International Journal of Cooperative Information Systems*, *18*(01), 167–193.

Bosse, T., Jonker, C. M., van Der Meij, L., & Treur, J. (2005). LEADSTO: A Language and Environment for Analysis of Dynamics by SimulaTiOn. *International Journal on Artificial Intelligence Tools*, *3533*(03), 363–366. https://doi.org/10.1007/11550648_15

Bosse, T., Memon, Z. a., & Treur, J. (2011). a Recursive BDI Agent Model for Theory of Mind and Its Applications. *Applied Artificial Intelligence*, *25*, 1–44. https://doi.org/10.1080/08839514.2010.529259

Bosse, T., Pontier, M., & Treur, J. (2010). A computational model based on Gross' emotion regulation theory. *Cognitive Systems Research*, *11*(3), 211–230.

Bosse, T., & Provoost, S. (2015). Integrating conversation trees and cognitive models within an eca for aggression de-escalation training. In *18 International Conference on Principles and Practice of Multi-Agent Systems* (pp. 650–659). Lecture Notes in Artificial Intelligence, Springer Verlag.

Bosse, T., & Sharpanskykh, A. (2010). A framework for modeling and analysis of ambient agent systems: application to an emergency case. In *Ambient Intelligence and Future Trends-International Symposium on Ambient Intelligence (ISAmI 2010)* (pp. 121–129). Springer.

Both, F., Hoogendoorn, M., Klein, M. C. A., & Treur, J. (2009). Design and Analysis of an Ambient Intelligent System Supporting Depression Therapy. In *HEALTHINF* (pp. 142–148).

Both, F., Hoogendoorn, M., Klein, M. C. A., & Treur, J. (2015). A generic computational model of mood regulation and its use to model therapeutical interventions. *Biologically Inspired Cognitive Architectures*, *13*, 17–34.

Both, F., Hoogendoorn, M., van der Mee, A., Treur, J., & de Vos, M. (2012). An intelligent agent model with awareness of workflow progress. *Applied Intelligence*, *36*(2), 498–510.

Bouzeghoub, M., & Kedad, Z. (2000). A Logical Model for Data Warehouse Design and Evolution. In Y. Kambayashi, M. Mohania, & A. M. Tjoa (Eds.), *Data Warehousing and Knowledge Discovery SE - 18* (Vol. 1874, pp. 178–188). Springer Berlin Heidelberg. https://doi.org/10.1007/3-540-44466-1_18

Bovbel, P., & Nejat, G. (2014). Casper: An Assistive Kitchen Robot to Promote Aging in Place. *Journal of Medical Devices*, *8*(3), 30945.

Bradáč, V., & Kostolányová, K. (2017). Intelligent Tutoring Systems. In *E-Learning, E-Education, and Online Training: Third International Conference, eLEOT 2016, Dublin, Ireland, August 31–September 2, 2016, Revised Selected Papers* (pp. 71–78). Springer.

Braselton, S., & Decker, B. C. (1994). Using graphic organizers to improve the reading of mathematics. *The Reading Teacher*, 276–281.

Bratman, M. E. (1990). What is intention. *Intentions in Communication*, 15–32.

Brazier, F. M. T., Jonker, C. M., & Treur, J. (2000). Compositional design and reuse of a generic agent model. *Applied Artificial Intelligence*, *14*(5), 491–538.

Breazeal, C. (2003). Toward sociable robots. *Robotics and Autonomous Systems*, *42*(3), 167–175.

Breazeal, C. (2017). Social Robots: From Research to Commercialization. In *Proceedings of the 2017 ACM/IEEE International Conference on Human-Robot Interaction* (p. 1). ACM.

Breazeal, C., Dautenhahn, K., & Kanda, T. (2016). Social Robotics. In B. Siciliano & O. Khatib (Eds.), *In book: Springer Handbook of Robotics, Edition: 2nd* (pp. 1935–1937). Springer International Publishing. https://doi.org/10.1007/978-3-319-32552-1_72

Breazeal, C., Kidd, C. D., Thomaz, A. L., Hoffman, G., & Berlin, M. (2005). Effects of nonverbal communication on efficiency and robustness in human-robot teamwork. In *2005 IEEE/RSJ International Conference on Intelligent Robots and Systems.* (pp. 708–713). IEEE.

Breazeal, C. L. (2004). *Designing sociable robots*. MIT press.

Briggs, T. W., & Kennedy, W. G. (2016). Active shooter: an agent-based model of unarmed resistance. In *Proceedings of the 2016 Winter Simulation Conference* (pp. 3521–3531). IEEE Press.

Broadbent, E., Feerst, D. A., Lee, S. H., Robinson, H., Albo-Canals, J., Ahn, H. S., & MacDonald, B. A. (2018). How Could Companion Robots Be Useful in Rural Schools? *International Journal of Social Robotics*. https://doi.org/10.1007/s12369-017-0460-5

Brooke, J. (1996). SUS-A quick and dirty usability scale. *Usability Evaluation in Industry*, *189*(194), 4–7.

Brookhart, S. M. (2017). *How to give effective feedback to your students*. ASCD.

Brunken, R., Plass, J. L., & Leutner, D. (2003). Direct measurement of cognitive load in multimedia learning. *Educational Psychologist*, *38*(1), 53–61.

Brünken, R., Steinbacher, S., Plass, J. L., & Leutner, D. (2002). Assessment of cognitive load in multimedia learning using dual-task methodology. *Experimental Psychology*, *49*(2), 109.

Burgar, C. G., Lum, P. S., Shor, P. C., & van der Loos, H. F. M. (2000). Development of robots for rehabilitation therapy: the Palo Alto VA/Stanford experience. *Journal of Rehabilitation Research and Development*, *37*(6), 663–674.

Burgoyne, K., Baxter, B., & Buckley, S. (2013). Developing the reading skills of children with Down syndrome. *Educating Learners with Down Syndrome: Research, Theory and Practice with Children and Adolescents: Research, Theory, and Practice with Children and Adolescents*, 195.

Buscher, G., Dengel, A., Biedert, R., & Elst, L. V. (2012). Attentive documents: Eye tracking as implicit feedback for information retrieval and beyond. *ACM Transactions on Interactive Intelligent Systems (TiiS)*, *1*(2), 9.

Calderwood, C., Ackerman, P. L., & Conklin, E. M. (2014). What else do college students "do" while studying? An investigation of multitasking. *Computers & Education*, *75*, 19–29.

Cao, T., Wan, F., Wong, C. M., da Cruz, J. N., & Hu, Y. (2014). Objective evaluation of fatigue by EEG spectral analysis in steady-state visual evoked potential-based brain-computer interfaces. *Biomedical Engineering Online*, *13*(1), 28.

Carney, L. G., & Hill, R. M. (1982). The nature of normal blinking patterns. *Acta Ophthalmologica*, *60*(3), 427–433.

Cech, P. (2016). Smart Classroom Study Design for Analysing the Effect of Environmental Conditions on Students ' Comfort. In *5th International Workshop on Smart Offices and Other Workplaces, Intelligent Environemnt 2016* (pp. 14–23). https://doi.org/10.3233/978-1-61499-690-3-14.

Chandler, P., & Sweller, J. (1991). Cognitive load theory and the format of instruction. *Cognition and Instruction*, *8*(4), 293–332.

Chang, A., & Breazeal, C. (2011). TinkRBook: shared reading interfaces for storytelling. In *Proceedings of the 10th International Conference on Interaction Design and Children* (pp. 145–148). ACM. https://doi.org/10.1145/1999030.1999047

Chang, K., Nelson, J., Pant, U., & Mostow, J. (2013). Toward Exploiting EEG Input in a Reading Tutor. *International Journal of Artificial Intelligence in Education*, *22*(1), 19–38.

Chang, W., & Šabanović, S. (2015). Interaction Expands Function: Social Shaping of the Therapeutic Robot PARO in a Nursing Home. *Proceedings of the Tenth Annual ACM/IEEE International Conference on Human-Robot Interaction*, 343–350. https://doi.org/10.1145/2696454.2696472.

Chen, F., Ruiz, N., Choi, E., Epps, J., Khawaja, M. A., Taib, R., … Wang, Y. (2012). Multimodal behavior and interaction as indicators of cognitive load. *ACM Transactions on Interactive Intelligent Systems (TiiS)*, *2*(4), 22.

Chen, I.-J., & Chang, C.-C. (2009). Cognitive Load Theory: An Empirical Study of Anxiety and Task Performance in Language Learning. *Electronic Journal of Research in Educational Psychology*, *7*(2).

Chen, S., & Epps, J. (2013). Automatic classification of eye activity for cognitive load measurement with emotion interference. *Computer Methods and Programs in Biomedicine*, *110*(2), 111–124.

Chen, S., Epps, J., Ruiz, N., & Chen, F. (2011). Eye activity as a measure of human mental effort in HCI. In *Proceedings of the 16th international conference on Intelligent user interfaces* (pp. 315–318). ACM.

Chesney, T., Gold, S., & Trautrims, A. (2017). Agent based modelling as a decision support system for shadow accounting. *Decision Support Systems*, *95*, 110–116.

Chin, D. (2007). Information Filtering, Expertise and Cognitive Load. In D. Schmorrow & L. Reeves (Eds.), *Foundations of Augmented Cognition SE - 9* (Vol. 4565, pp. 75–83). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-540-73216-7_9

Chin, K. O., Gan, K. S., Alfred Rayner, Anthon Ypatricia, & Lukose, D. (2014). Agent Architecture: An Overview. *Transactions On Science And Technology*, *1*(1), 18–35.

Choi, H.-H., van Merriënboer, J. J. G., & Paas, F. (2014). Effects of the physical environment on cognitive load and learning: towards a new model of cognitive load. *Educational Psychology Review*, *26*(2), 225–244.

Chong, N.-Y., & Mastrogiovanni, F. (2011). *Handbook of Research on Ambient Intelligence and Smart Environments: Trends and Perspective*. Information Science Reference.

Cierniak, G., Scheiter, K., & Gerjets, P. (2009). Explaining the split-attention effect: Is the reduction of extraneous cognitive load accompanied by an increase in germane cognitive load? *Computers in Human Behavior*, *25*(2), 315–324. https://doi.org/http://dx.doi.org/10.1016/j.chb.2008.12.020

Clark, J. M., & Paivio, A. (1991). Dual coding theory and education. *Educational Psychology Review*, *3*(3), 149–210.

Cobanoglu, M. C., Kindiroglu, A. A., & Balcisoy, S. (2009). Comparison of mobile device navigation information display alternatives from the cognitive load perspective. In *Engineering Psychology and Cognitive Ergonomics* (pp. 149–157). Springer.

Cominelli, L., Mazzei, D., & De Rossi, D. E. (2018). SEAI: Social Emotional Artificial

Intelligence based on Damasio’s Theory of Mind. *Frontiers in Robotics and AI*, *5*, 6.

Conway, D., Dick, I., Li, Z., Wang, Y., & Chen, F. (2013). The Effect of Stress on Cognitive Load Measurement. In P. Kotzé, G. Marsden, G. Lindgaard, J. Wesson, & M. Winckler (Eds.), *Human-Computer Interaction – INTERACT 2013 SE - 58* (Vol. 8120, pp. 659–666). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-40498-6_58

Cormen, T. H. (2009). *Introduction to algorithms*. MIT press.

Cornelius, C. V. M., Lynch, C. J., & Gore, R. (2017). Aging out of crime: exploring the relationship between age and crime with agent based modeling. In *Proceedings of the Agent-Directed Simulation Symposium* (p. 3). Society for Computer Simulation International.

Corno, F., De Russis, L., & Sáenz, J. P. (2017). Pain Points for Novice Programmers of Ambient Intelligence Systems: an Exploratory Study. In *Computer Software and Applications Conference (COMPSAC), 2017 IEEE 41st Annual* (Vol. 1, pp. 250–255). IEEE.

Costa, A., Novais, P., & Julian, V. (2018). A Survey of Cognitive Assistants BT - Personal Assistants: Emerging Computational Technologies. In A. Costa, V. Julian, & P. Novais (Eds.) (pp. 3–16). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-62530-0_1

Crooks, A. T., & Hailegiorgis, A. B. (2014). An agent-based modeling approach applied to the spread of cholera. *Environmental Modelling & Software*, *62*, 164–177.

Csathó, Á., Van Der Linden, D., Hernádi, I., Buzás, P., & Kalmar, G. (2012). Effects of mental fatigue on the capacity limits of visual attention. *Journal of Cognitive Psychology*, *24*(5), 511–524.

D’Mello, S. K., Lehman, B., & Person, N. K. (2010). Expert Tutors Feedback Is Immediate, Direct, and Discriminating. In *FLAIRS Conference*.

Daitkar, A. R. (2017). Effect of Achievement Motivation on Personality Traits of Students. *The International Journal of Indian Psychology*, *4*(2), 25–29.

Das, R., Kamruzzaman, J., & Karmakar, G. (2018). Modelling majority and expert influences on opinion formation in online social networks. *World Wide Web*, *21*(3), 663–685.

Dautenhahn, K. (1995). Getting to know each other—artificial social intelligence for autonomous robots. *Robotics and Autonomous Systems*, *16*(2–4), 333–356.

Dautenhahn, K. (1997). I could be you: The phenomenological dimension of social understanding. *Cybernetics & Systems*, *28*(5), 417–453.

Dautenhahn, K., Nehaniv, C. L., Walters, M. L., Robins, B., Kose-Bagci, H., Mirza, N. A., & Blow, M. (2009). KASPAR–a minimally expressive humanoid robot for human–robot interaction research. *Applied Bionics and Biomechanics*, *6*(3–4), 369–397.

David, N. (2013). Validating simulations. In *Simulating Social Complexity* (pp. 135–171). Springer.

de Jong, M., Zhang, K., Roth, A. M., Rhodes, T., Schmucker, R., Zhou, C., … Veloso, M. (2018). Towards a Robust Interactive and Learning Social Robot. In *Proceedings of the 17th International Conference on Autonomous Agents and MultiAgent Systems* (pp. 883–891). International Foundation for Autonomous Agents and Multiagent Systems.

De Jong, T. (2010). Cognitive load theory, educational research, and instructional design: some food for thought. *Instructional Science*, *38*(2), 105–134.

DeStefano, D., & LeFevre, J.-A. (2007). Cognitive load in hypertext reading: A review. *Computers in Human Behavior*, *23*(3), 1616–1641. https://doi.org/http://dx.doi.org/10.1016/j.chb.2005.08.012

Detje, F., Dorner, D., & Schaub, H. (2003). *The Logic of Cognitive Systems: Proceedings of the Fifth International Conference on Cognitive Modeling, ICCM'03.* Universitäts-Verlag Bamberg.

Dey, N., & Ashour, A. S. (2017). Ambient Intelligence in Healthcare: A State-of-the-Art. *Global Journal of Computer Science and Technology*.

Dilshad, M., Adnan, A., & Akram, A. (2013). Gender Differences in Reading Habits of University Students: An Evidence from Pakistan. *Pakistan Journal of Social Sciences (PJSS)*, *33*(2), 311–320.

Drogoul, A., Vanbergue, D., & Meurisse, T. (2003). Multi-agent Based Simulation: Where Are the Agents? In J. Simão Sichman, F. Bousquet, & P. Davidsson (Eds.), *Multi-Agent-Based Simulation II SE - 1* (Vol. 2581, pp. 1–15). Springer Berlin Heidelberg. https://doi.org/10.1007/3-540-36483-8_1

Dubowsky, S., Genot, F., Godding, S., Kozono, H., Skwersky, A., Yu, H., & Yu, L. S.

(2000). PAMM-a robotic aid to the elderly for mobility assistance and monitoring: a "helping-hand" for the elderly. In *In Proceedings of IEEE International Conference on Robotics and Automation* (Vol. 1, pp. 570–576). IEEE.

Duell, R. (2016). Making Up Your Mind: An Exploration into Analysis and Support in Individual and Social Contexts (doctoral's thesis).

Duell, R., & Treur, J. (2012). A Computational Analysis of Joint Decision Making Processes. In K. Aberer, A. Flache, W. Jager, L. Liu, J. Tang, & C. Guéret (Eds.), *Social Informatics SE - 22* (Vol. 7710, pp. 292–308). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-35386-4_22.

Durães, D., Castro, D., Bajo, J., & Novais, P. (2017). Modelling an Intelligent Interaction System for Increasing the Level of Attention BT - Ambient Intelligence– Software and Applications – 8th International Symposium on Ambient Intelligence (ISAmI 2017). In J. F. De Paz, V. Julián, G. Villarrubia, G. Marreiros, & P. Novais (Eds.) (pp. 210–217). Cham: Springer International Publishing.

Durantin, G., Gagnon, J.-F., Tremblay, S., & Dehais, F. (2014). Using near infrared spectroscopy and heart rate variability to detect mental overload. *Behavioural Brain Research*, *259*, 16–23.

Dutta-Moscato, J., Solovyev, A., Mi, Q., Nishikawa, T., Soto-Gutierrez, A., Fox, I. J., & Vodovotz, Y. (2014). A multiscale agent-based in silico model of liver fibrosis progression. *Frontiers in Bioengineering and Biotechnology*, *2*, 18.

Eason, S. H., Goldberg, L. F., Young, K. M., Geist, M. C., & Cutting, L. E. (2012). Reader–text interactions: How differential text and question types influence cognitive skills needed for reading comprehension. *Journal of Educational Psychology*, *104*(3), 515.

Eguchi, A., & Okada, H. (2017). Social Robots: How Becoming an Active User Impacts Students' Perceptions. In *Proceedings of the Companion of the 2017 ACM/IEEE International Conference on Human-Robot Interaction* (pp. 111–112). ACM.

Eguchi, A., & Okada, H. (2018). If You Give Students a Social Robot?-World Robot Summit Pilot Study. In *Companion of the 2018 ACM/IEEE International Conference on Human-Robot Interaction* (pp. 103–104). ACM.

Elbaum, B., Vaughn, S., Tejero Hughes, M., & Watson Moody, S. (2000). How effective are one-to-one tutoring programs in reading for elementary students at risk for reading failure? A meta-analysis of the intervention research. *Journal of Educational Psychology*, *92*(4), 605.

Eldabi, T. T., & Young, T. (2007). Towards a framework for healthcare simulation. In *Simulation Conference, 2007 Winter* (pp. 1454–1460). IEEE.

Elliott, S. N., Kurz, A., Beddow, P., & Frey, J. (2009). Cognitive load theory: Instruction-based research with applications for designing tests. In *Proceedings of the National Association of School Psychologists' Annual Convention, Boston, MA, February* (Vol. 24).

Ellis, A. W. (2014). *Reading, writing and dyslexia: A cognitive analysis*. Psychology Press.

Ellner, S. P., & Guckenheimer, J. (2006). Dynamic Models in Biology. Princeton University press.

Endres, C. (2012). Real-time Assessment of Driver Cognitive Load as a prerequisite for the situation-aware Presentation Toolkit PresTK. In *Adjunct Proceedings of the 4th International Conference on Automotive User Interfaces and Interactive Vehicular Applications (AutomotiveUI 2012), Portsmouth, New Hampshire, USA* (pp. 76–79).

Esposito, F., Otto, T., Zijlstra, F. R. H., & Goebel, R. (2014). Spatially distributed effects of mental exhaustion on resting-state FMRI networks. *PloS One*, *9*(4).

Farrell, S., & Lewandowsky, S. (2010). Computational models as aids to better reasoning in psychology. *Current Directions in Psychological Science*, *19*(5), 329–335.

Fasola, J., & Mataric, M. (2011). Comparing physical and virtual embodiment in a socially assistive robot exercise coach for the elderly. *Center for Robotics and Embedded Systems, Los* …. Retrieved from http://cres.usc.edu/Research/files/Fasola_11_003.pdf

Feil-Seifer, D., & Mataric, M. J. (2011). Socially assistive robotics. *Robotics & Automation Magazine, IEEE*, *18*(1), 465–468. https://doi.org/10.1109/ICORR.2005.1501143.

Foasberg, N. M. (2011). Adoption of e-book readers among college students: A survey. *Information Technology and Libraries*, *30*(3).

Foasberg, N. M. (2014). Student reading practices in print and electronic media. *College & Research Libraries*, *75*(5), 705–723.

Fong, S. F., Lily, L. P. L., & Por, F. P. (2012). Reducing cognitive overload among students of different anxiety levels using segmented animation. *Procedia-Social and Behavioral Sciences*, *47*, 1448–1456.

Ford, M. Lou. (2014). Active Learning Strategies and First Grade Reading Achievement Using the TAKE 10! Program and Istation Assessment Tool: A Correlation Study. JONES INTERNATIONAL UNIVERSITY.

Formolo, D., Van Ments, L., & Treur, J. (2017). A computational model to simulate development and recovery of traumatised patients. *Biologically Inspired Cognitive Architectures*. https://doi.org/https://doi.org/10.1016/j.bica.2017.07.002

Fox, E., & Alexander, P. A. (2011). Learning to read. *Handbook of Research on Learning and Instruction*, 7–31.

Freedman, L. S., Midthune, D., Dodd, K. W., Carroll, R. J., & Kipnis, V. (2015). A statistical model for measurement error that incorporates variation over time in the target measure, with application to nutritional epidemiology. *Statistics in Medicine*.

Fritz, C., Ellis, A. M., Demsky, C. A., Lin, B. C., & Guros, F. (2013). Embracing work breaks. *Organizational Dynamics*, *42*, 274–280.

Gagliardi, F. (2007). Some Issues About Cognitive Modelling and Functionalism. In *AI* IA 2007: Artificial Intelligence and Human-Oriented Computing* (pp. 60–71). Springer.

Galy, E., Cariou, M., & Mélan, C. (2012). What is the relationship between mental workload factors and cognitive load types? *International Journal of Psychophysiology*, *83*(3), 269–275.

Gbenga, A. J. (2012). Mathematical modeling and analysis of HIV/AIDS control measures. University of the Western Cape.

Giachetti, R. E., Marcelli, V., Cifuentes, J., & Rojas, J. A. (2013). An agent-based simulation model of human-robot team performance in military environments. *Systems Engineering*, *16*(1), 15–28.

Gillmor, S. C., Poggio, J., & Embretson, S. (2015). Effects of reducing the cognitive load of mathematics test items on student performance. *Numeracy*, *8*(1), 4.

Giménez, A., Balaguer, C., Sabatini, A. M., & Genovese, V. (2003). The MATS robotic system to assist disabled people in their home environments. In *In Proceedings of 2003 IEEE/RSJ International Conference on Intelligent Robots and Systems* (Vol. 3, pp. 2612–2617). IEEE.

Glover, J. (2003). A robotically-augmented walker for older adults. *Technical Report,Computer Science Department, Carnegie Mellon University*.

Goedschalk, L., Treur, J., & Verwolf, R. (2018). A Network-Oriented Modeling Approach to Voting Behavior During the 2016 US Presidential Election. In F. la Prieta, Z. Vale, L. Antunes, T. Pinto, A. T. Campbell, V. Julián, … M. N. Moreno (Eds.), *Trends in Cyber-Physical Multi-Agent Systems. The PAAMS Collection - 15th International Conference, PAAMS 2017* (pp. 3–15). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-61578-3_1

Gog, T., Kirschner, F., Kester, L., & Paas, F. (2012). Timing and frequency of mental effort measurement: Evidence in favour of repeated measures. *Applied Cognitive Psychology*, *26*(6), 833–839.

Gordon, G., & Breazeal, C. (2015). Bayesian Active Learning-based Robot Tutor for Children's Word-Reading Skills. Retrieved from http://robotshelpingkids.yale.edu/sites/default/files/files/GordonBreazeal_AAAI_2015_final.pdf

Gordon, M., & Breazeal, C. (2015). Designing a virtual assistant for in-car child entertainment. In *Proceedings of the 14th International Conference on Interaction Design and Children* (pp. 359–362). ACM.

Griffin, P., Burns, M. S., & Snow, C. E. (1998). *Preventing reading difficulties in young children*. National Academies Press.

Groccia, J. E. (2018). What Is Student Engagement? *New Directions for Teaching and Learning*, *2018*(154), 11–20.

Grzeschik, K., Kruppa, Y., Marti, D., & Donner, P. (2011). Reading in 2110-reading behavior and reading devices: a case study. *The Electronic Library*, *29*(3), 288–302.

Hackel, M., Schwope, S., Fritsch, J., Wrede, B., & Sagerer, G. (2005). Humanoid robot platform suitable for studying embodied interaction. In *International Conference on Intelligent Robots and Systems,2005 IEEE/RSJ* (pp. 2443–2448). IEEE.

Haer, T., Botzen, W. J. W., & Aerts, J. C. J. H. (2016). The effectiveness of flood risk communication strategies and the influence of social networks—Insights from an agent-based model. *Environmental Science & Policy*, *60*, 44–52.

Hair, J. F., Black, W. C., Babin, B. J., & Anderson, R. E. (2010). Canonical correlation: A supplement to multivariate data analysis. *Multivariate Data Analysis: A Global Perspective. 7th Edn. Pearson Prentice Hall Publishing, Upper Saddle River*.

Hanken, K., Eling, P., & Hildebrandt, H. (2015). Is there a cognitive signature for MS-related fatigue? *Multiple Sclerosis Journal*, *21*(4), 376–381.

Hannon, B., & Ruth, M. (2014). Modeling Dynamic Biological Systems. In B. Hannon & M. Ruth (Eds.) (pp. 3–28). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-05615-9_1.

Hans, M., Graf, B., & Schraft, R. D. (2002). Robotic home assistant care-o-bot: Past-present-future. In *In Proceedings 11th IEEE International Workshop on Robot and Human Interactive Communication* (pp. 380–385). IEEE. Retrieved from http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=1045652.

Harbluk, J. L., Noy, Y. I., Trbovich, P. L., & Eizenman, M. (2007). An on-road assessment of cognitive distraction: Impacts on drivers' visual behavior and braking performance. *Accident Analysis & Prevention*, *39*(2), 372–379.

Hart, S. G., & Staveland, L. E. (1988). Development of NASA-TLX (Task Load Index): Results of empirical and theoretical research. *Advances in Psychology*, *52*, 139–183.

Hashim, S. F. S. M., Fikry, A., Ismail, Z., Musa, R., Hashim, R., Ahmad, S. S., … Samat, N. (2014). Humanoids in Autism Therapy: The Child Perspective. *Medical and Rehabilitation Robotics and Instrumentation (MRRI2013),Procedia Computer Science*, *42*(0), 351–356. https://doi.org/http://dx.doi.org/10.1016/j.procs.2014.11.073.

Heerink, M., Krose, B., Evers, V., & Wielinga, B. (2009). Measuring acceptance of an assistive social robot: a suggested toolkit. In *The 18th IEEE International Symposium on Robot and Human Interactive Communication* (pp. 528–533). Toyama, Japan: IEEE.

Heerink, M., Kröse, B., Evers, V., & Wielinga, B. (2010). Assessing Acceptance of Assistive Social Agent Technology by Older Adults: the Almere Model. *International Journal of Social Robotics*, *2*(4), 361–375. https://doi.org/10.1007/s12369-010-0068-5.

Henning, R. A., Jacques, P., Kissel, G. V, Sullivan, A. B., & Alteras-webb, S. M. (1997). Frequent short rest breaks from computer work: effects on productivity and well-being at two field sites. *Ergonomics*, *40*(1), 78–91. https://doi.org/10.1080/001401397188396.

Heras, S., Palanca, J., & Chesñevar, C. I. (2018). Argumentation-Based Personal Assistants for Ambient Assisted Living. In *Personal Assistants: Emerging Computational Technologies* (pp. 19–36). Springer.

Herbers, J. E., Cutuli, J. J., Supkoff, L. M., Heistad, D., Chan, C.-K., Hinz, E., & Masten, A. S. (2012). Early reading skills and academic achievement trajectories of students facing poverty, homelessness, and high residential mobility. *Educational*

Researcher, *41*(9), 366–374.

Ho, C., & Spence, C. (2005). Assessing the effectiveness of various auditory cues in capturing a driver's visual attention. *Journal of Experimental Psychology: Applied*, *11*(3), 157.

Hockey, G. R. J. (1997). Compensatory control in the regulation of human performance under stress and high workload: A cognitive-energetical framework. *Biological Psychology*, *45*(1), 73–93.

Hone, K., Akhtar, F., & Saffu, M. (2003). Affective agents to reduce user frustration: the role of agent embodiment. In *Proceedings of Human-Computer Interaction (HCI2003), Bath, UK*.

Hoogendoorn, M., Jaffry, S. W., van Maanen, P.-P., & Treur, J. (2014). Design and validation of a relative trust model. *Knowledge-Based Systems*, *57*(0), 81–94. https://doi.org/http://dx.doi.org/10.1016/j.knosys.2013.12.012

Hoogendoorn, M., Klein, M. C. A., Memon, Z. A., & Treur, J. (2013). Formal specification and analysis of intelligent agents for model-based medicine usage management. *Computers in Biology and Medicine*, *43*(5), 444–457.

Hoogendoorn, M., Merk, R.-J., & Treur, J. (2010). An agent model for decision making based upon experiences applied in the domain of fighter pilots. In *2010 IEEE/WIC/ACM International Conference on Web Intelligence and Intelligent Agent Technology* (pp. 101–108). IEEE.

Hoonakker, P., Carayon, P., Gurses, A. P., Brown, R., Khunlertkit, A., McGuire, K., & Walker, J. M. (2011). Measuring workload of ICU nurses with a questionnaire survey: the NASA task load index (TLX). *IIE Transactions on Healthcare Systems Engineering*, *1*(2), 131–143.

Hsu, S.-C., Weng, K.-W., Cui, Q., & Rand, W. (2016). Understanding the complexity of project team member selection through agent-based modeling. *International Journal of Project Management*, *34*(1), 82–93.

Hulme, C., & Mackenzie, S. (2014). *Working Memory and Severe Learning Difficulties (PLE: Memory)*. Psychology Press.

Hümeyra, G., & Gülözer, K. (2013). The effect of cognitive load associated with instructional formats and types of presentation on second language reading comprehension performance. *The Turkish Online Journal of Educational Technology*, *12*(4).

Hunt, L. C. (1970). The effect of self-selection, interest, and motivation upon independent, instructional, and frustational levels. *The Reading Teacher*, 146–158.

Hunter, E. M., & Wu, C. (2016). Give me a better break: Choosing workday break activities to maximize resource recovery. *Journal of Applied Psychology*, *101*(2), 302.

Hussain, M. S., Calvo, R. A., & Chen, F. (2013). Automatic cognitive load detection from face, physiology, task performance and fusion during affective interference. *Interacting with Computers*, *26*(3), iwt032.

Hussain, S., Chen, S., Calvo, R. A., & Chen, F. (2011). Classification of Cognitive Load from Task Performance & Multichannel Physiology during Affective Changes. In *MMCogEmS: Inferring Cognitive and Emotional States from Multimodal Measures, ICMI 2011 Workshop, Alicante, Spain*.

Huttunen, K., Keränen, H., Väyrynen, E., Pääkkönen, R., & Leino, T. (2011). Effect of cognitive load on speech prosody in aviation: Evidence from military simulator flights. *Applied Ergonomics*, *42*(2), 348–357.

Inoue, K., Wada, K., & Uehara, R. (2012). How Effective Is Robot Therapy?: PARO and People with Dementia. In Á. Jobbágy (Ed.), *5th European Conference of the International Federation for Medical and Biological Engineering SE - 204* (Vol. 37, pp. 784–787). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-23508-5_204

Jaber, M. Y., Givi, Z. S., & Neumann, W. P. (2013). Incorporating human fatigue and recovery into the learning–forgetting process. *Applied Mathematical Modelling*, *37*(12), 7287–7299.

Jalani, N. H., & Sern, L. C. (2015). The Example-Problem-Based Learning Model: Applying Cognitive Load Theory. *Procedia-Social and Behavioral Sciences*, *195*, 872–880.

Jayawardena, C., Kuo, I.-H., Broadbent, E., & MacDonald, B. A. (2016). Socially assistive robot healthbot: Design, implementation, and field trials. *IEEE Systems Journal*, *10*(3), 1056–1067.

Johal, W. (2015). Robots Interacting with Style. In *Proceedings of the Tenth Annual ACM/IEEE International Conference on Human-Robot Interaction Extended Abstracts* (pp. 191–192). ACM.

John, O. P., & Srivastava, S. (1999). The Big Five trait taxonomy: History, measurement, and theoretical perspectives. *Handbook of Personality: Theory and Research*, *2*(1999), 102–138.

Jonker, C. M., Treur, J., & Wijngaards, W. C. A. (2003). A temporal modelling environment for internally grounded beliefs, desires and intentions. *Cognitive Systems Research*, *4*(3), 191–210.

Joseph, S. (2013). *Measuring cognitive load: A comparison of self-report and physiological methods (doctoral's thesis)*. Arizona State University Tempe, AZ.

Jung, Y., & Lee, K. M. (2004). Effects of physical embodiment on social presence of social robots. *Proceedings of PRESENCE*, 80–87.

Kalyuga, S. (2011a). Cognitive Load in Adaptive Multimedia Learning. In R. A. Calvo & S. K. D'Mello (Eds.), *New Perspectives on Affect and Learning Technologies SE - 15* (Vol. 3, pp. 203–215). Springer New York. https://doi.org/10.1007/978-1-4419-9625-1_15

Kalyuga, S. (2011b). Cognitive Load Theory: How Many Types of Load Does It Really Need? *Educational Psychology Review*, *23*(1), 1–19. https://doi.org/10.1007/s10648-010-9150-7

Kalyuga, S. (2011c). Cognitive Load Theory: Implications for Affective Computing. In *In proceeding of the Twenty-fourth International Florida Artificial Intelligence Research society Conference*.

Kalyuga, S. (2012). Instructional benefits of spoken words: A review of cognitive load factors. *Educational Research Review*, *7*(2), 145–159. https://doi.org/http://dx.doi.org/10.1016/j.edurev.2011.12.002

Kalyuga, S., Ayres, P., Chandler, P., & Sweller, J. (2003). The expertise reversal effect. *Educational Psychologist*, *38*(1), 23–31.

Kalyuga, S., Chandler, P., & Sweller, J. (1999). Managing split-attention and redundancy in multimedia instruction. *Applied Cognitive Psychology*, *13*(4), 351–371.

Kalyuga, S., & Renkl, A. (2010). Expertise reversal effect and its instructional implications: Introduction to the special issue. *Instructional Science*, *38*(3), 209–215.

Kanda, T., Hirano, T., Eaton, D., & Ishiguro, H. (2003). Person identification and interaction of social robots by using wireless tags. In *In Proceedings IEEE/RSJ International Conference on Intelligent Robots and Systems* (Vol. 2, pp. 1657–1664). IEEE.

Kawaguchi, I., Kodama, Y., Kuzuoka, H., Otsuki, M., & Suzuki, Y. (2016). Effect of Embodiment Presentation by Humanoid Robot on Social Telepresence. In *Proceedings of the Fourth International Conference on Human Agent Interaction* (pp. 253–256). ACM.

Kawamura, K., Bagchi, S., Iskarous, M., & Bishay, M. (1995). Intelligent robotic systems in service of the disabled. *IEEE Transactions on Rehabilitation Engineering*, *3*(1), 14–21.

Khan, F. A., Graf, S., Weippl, E. R., & Tjoa, A. M. (2010). Identifying and Incorporating Affective States and Learning Styles in Web-based Learning Management Systems. *IxD&A*, *9*, 85–103.

Khawaja, M. A., Chen, F., Owen, C., & Hickey, G. (2009). Cognitive load measurement from user's linguistic speech features for adaptive interaction design. In *Human-Computer Interaction–INTERACT 2009* (pp. 485–489). Springer.

Kidd, C. D., & Breazeal, C. (2004). Effect of a robot on user perceptions. In *Proceedings International Conference on Intelligent Robots and Systems* . (Vol. 4, pp. 3559–3564). IEEE.

Kidd, C. D., & Breazeal, C. (2005). Sociable robot systems for real-world problems. In *International Workshop on Robot and Human Interactive Communication.* (pp. 353–358). IEEE.

Kidd, C. D., & Breazeal, C. (2008). Robots at home: Understanding long-term human-robot interaction. In *2008 IEEE/RSJ International Conference on Intelligent Robots and Systems* (pp. 3230–3235). IEEE.

Kirou, A., Ruszczycki, B., Walser, M., & Johnson, N. (2008). Computational Modeling of Collective Human Behavior: The Example of Financial Markets. In M. Bubak, G. van Albada, J. Dongarra, & P. A. Sloot (Eds.), *Computational Science – ICCS 2008 SE - 8* (Vol. 5101, pp. 33–41). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-540-69384-0_8

Kirschner, P. A. (2002). Cognitive load theory: implications of cognitive load theory on the design of learning. *Learning and Instruction*, *12*(1), 1–10. https://doi.org/https://doi.org/10.1016/S0959-4752(01)00014-7.

Klein, M. C. A., Manzoor, A., Middelweerd, A., Mollee, J. S., & te Velde, S. J. (2015). Encouraging Physical Activity via a Personalized Mobile System. *Internet Computing, IEEE*. https://doi.org/10.1109/MIC.2015.51.

Klein, M. C. A., Manzoor, A., & Mollee, J. S. (2017). Active2Gether: A Personalized m-

Health Intervention to Encourage Physical Activity. *Sensors*, *17*(6), 1436.

Kleinberger, T., Jedlitschka, A., Storf, H., Steinbach-Nordmann, S., & Prueckner, S. (2009). An approach to and evaluations of assisted living systems using ambient intelligence for emergency monitoring and prevention. In *International Conference on Universal Access in Human-Computer Interaction* (pp. 199–208). Springer.

Klingner, J., Boelé, A., Linan-Thompson, S., & Rodriguez, D. (2014). Essential Components of Special Education for English Language Learners With Learning Disabilities. *Position Statement of the Division for Learning Disabilities of the Council for Exceptional Children. Arlington, VA: Council for Exceptional Children Division for Learning Disabilities*.

Knoll, A., Wang, Y., Chen, F., Xu, J., Ruiz, N., Epps, J., & Zarjam, P. (2011). Measuring cognitive workload with low-cost electroencephalograph. In *Human-Computer Interaction–INTERACT 2011* (pp. 568–571). Springer.

Koedinger, K. R., & Aleven, V. (2007). Exploring the Assistance Dilemma in Experiments with Cognitive Tutors. *Educational Psychology Review*, *19*(3), 239–264. https://doi.org/10.1007/s10648-007-9049-0

Kolfschoten, G. L. (2011). Cognitive Load in Collaboration-Brainstorming. In *44th Hawaii International Conference on System Sciences (HICSS)* (pp. 1–9). IEEE.

Korn, G. A., & Korn, T. M. (2000). *Mathematical handbook for scientists and engineers: definitions, theorems, and formulas for reference and review*. Courier Corporation.

Korzun, D. G. (2017). Internet of Things Meets Mobile Health Systems in Smart Spaces: An Overview. In *Internet of Things and Big Data Technologies for Next Generation Healthcare* (pp. 111–129). Springer.

Kruzikas, D. T., Higashi, M. K., Edgar, M., Macal, C. M., Graziano, D. J., North, M. J., & Collier, N. T. (2014). Using agent-based modeling to inform regional health care system investment and planning. In *International Conference onComputational Science and Computational Intelligence (CSCI),* (Vol. 2, pp. 211–214). IEEE.

Kühnel, J., Zacher, H., de Bloom, J., & Bledow, R. (2017). Take a break! Benefits of sleep and short breaks for daily work engagement. *European Journal of Work and Organizational Psychology*, *26*(4), 481–491. https://doi.org/10.1080/1359432X.2016.1269750

Kumar, A., Prakash, J., & Dutt, V. (2014). Understanding Human Driving Behavior through Computational Cognitive Modeling. In R.-H. Hsu & S. Wang (Eds.), *Internet of Vehicles – Technologies and Services SE - 6* (Vol. 8662, pp. 56–65).

Springer International Publishing. https://doi.org/10.1007/978-3-319-11167-4_6

Kumar, P., Verma, P., Singh, R., & Patel, R. K. (2017). A Novel Design of Inexpensive, Heavy Payload and High Mobility ORQ Robot. In *Proceeding of International Conference on Intelligent Communication, Control and Devices* (pp. 979–989). Springer.

Kwakkel, G., Kollen, B. J., & Krebs, H. I. (2007). Effects of robot-assisted therapy on upper limb recovery after stroke: a systematic review. *Neurorehabilitation and Neural Repair*.

Lee, J. D. (2014). Dynamics of driver distraction: The process of engaging and disengaging. *Annals of Advances in Automotive Medicine*, *58*, 24.

Lee, Y.-C., Lee, J. D., & Boyle, L. N. (2007). Visual attention in driving: The effects of cognitive load and visual disruption. *Human Factors: The Journal of the Human Factors and Ergonomics Society*, *49*(4), 721–733.

Lehmann, H., Roncone, A., Pattacini, U., & Metta, G. (2016). Physiologically Inspired Blinking Behavior for a Humanoid Robot. In *International Conference on Social Robotics* (pp. 83–93). Springer.

Leppink, J. (2014). Managing the load on a reader's mind. *Perspectives on Medical Education*, *3*(5), 327–328.

Lewis, J. J. R., & Sauro, J. (2017). Revisiting the Factor Structure of the System Usability Scale. *Journal of Usability Studies*, *12*(4).

Leyzberg, D., Spaulding, S., & Scassellati, B. (2014). Personalizing robot tutors to individuals' learning differences. In *Proceedings of the 2014 ACM/IEEE international conference on Human-robot interaction* (pp. 423–430). ACM.

Liu, Y., Raker, J. R., & Lewis, J. E. (2018). Evaluating student motivation in organic chemistry courses: moving from a lecture-based to a flipped approach with peer-led team learning. *Chemistry Education Research and Practice*.

Lo, A. C., Guarino, P. D., Richards, L. G., Haselkorn, J. K., Wittenberg, G. F., Federman, D. G., … Volpe, B. T. (2010). Robot-assisted therapy for long-term upper-limb impairment after stroke. *New England Journal of Medicine*, *362*(19), 1772–1783.

Lopez, B., & Andres, I. (2014). *Powerpoint design based on cognitive load theory and cognitive theory of multimedia learning for introduction to statistics*. University of Southern California.

Lorist, M. M., Klein, M., Nieuwenhuis, S., De Jong, R., Mulder, G., & Meijman, T. F. (2000). Mental fatigue and task control: planning and preparation. *Psychophysiology*, *37*(5), 614–625.

Lytridis, C., Vrochidou, E., Chatzistamatis, S., & Kaburlasos, V. (2018). Social Engagement Interaction Games Between Children with Autism and Humanoid Robot NAO. In *The 13th International Conference on Soft Computing Models in Industrial and Environmental Applications* (pp. 562–570). Springer.

Macindoe, O., & Maher, M. (2005). Intrinsically Motivated Intelligent Rooms. In T. Enokido, L. Yan, B. Xiao, D. Kim, Y. Dai, & L. Yang (Eds.), *Embedded and Ubiquitous Computing – EUC 2005 Workshops SE - 20* (Vol. 3823, pp. 189–197). Springer Berlin Heidelberg. https://doi.org/10.1007/11596042_20

Mahoney, R. M., van Der Loos, H. F., Lum, P. S., & Burgar, C. (2003). Robotic stroke therapy assistant. *Robotica*, *21*(01), 33–44.

Makonin, S., Bartram, L., & Popowich, F. (2013). A smarter smart home: Case studies of ambient intelligence. *IEEE Pervasive Computing*, *12*(1), 58–66.

Mangen, A., Walgermo, B. R., & Brønnick, K. (2013). Reading linear texts on paper versus computer screen: Effects on reading comprehension. *International Journal of Educational Research*, *58*, 61–68.

Mann, J. A., MacDonald, B. A., Kuo, I.-H., Li, X., & Broadbent, E. (2015). People respond better to robots than computer tablets delivering healthcare instructions. *Computers in Human Behavior*, *43*, 112–117.

Marcora, S. M., Staiano, W., & Manning, V. (2009). Mental fatigue impairs physical performance in humans. *Journal of Applied Physiology*, *106*(3), 857–864.

Marschark, M., Sarchet, T., Convertino, C. M., Borgna, G., Morrison, C., & Remelt, S. (2012). Print exposure, reading habits, and reading achievement among deaf and hearing college students. *Journal of Deaf Studies and Deaf Education*, *17*(1), 61–74.

Marti, P., Giusti, L., & Bacigalupo, M. (2008). Dialogues beyond words. *Interaction Studies*.

Martín, D., Alcarria, R., Sánchez-Picot, Á., & Robles, T. (2015). An ambient intelligence framework for end-user service provisioning in a hospital pharmacy: a case study. *Journal of Medical Systems*, *39*(10), 116.

Martin, S. (2014). Measuring cognitive load and cognition: metrics for technologyenhanced learning. *Educational Research and Evaluation*, *20*(7–8), 592–621.

Martinez-Martin, E., & del Pobil, A. P. (2018). Personal Robot Assistants for Elderly Care: An Overview BT - Personal Assistants: Emerging Computational Technologies. In A. Costa, V. Julian, & P. Novais (Eds.) (pp. 77–91). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-62530-0_5

Mast, M., Burmester, M., Graf, B., Weisshardt, F., Arbeiter, G., Španěl, M., … Kronreif, G. (2015). Design of the human-robot interaction for a semi-autonomous service robot to assist elderly people. In *Ambient Assisted Living* (pp. 15–29). Springer.

Matarić, M. (2014). Socially assistive robotics: human-robot interaction methods for creating robots that care. In *Proceedings of the 2014 ACM/IEEE international conference on Human-robot interaction* (p. 333). ACM.

Mataric, M. J. (2005). The role of embodiment in assistive interactive robotics for the elderly. In *AAAI fall symposium on caring machines: AI for the elderly, Arlington, VA*.

Matarić, M. J., & Scassellati, B. (2016). Socially assistive robotics. In *Springer Handbook of Robotics* (pp. 1973–1994). Springer.

Mayer, R. E. (1996). Learning strategies for making sense out of expository text: The SOI model for guiding three cognitive processes in knowledge construction. *Educational Psychology Review*, *8*(4), 357–371.

Mayer, R. E. (1997). Multimedia learning: Are we asking the right questions? *Educational Psychologist*, *32*(1), 1–19. https://doi.org/10.1207/s15326985ep3201_1

Mayer, R. E. (2002). Multimedia learning. *Psychology of Learning and Motivation*, *41*, 85–139.

Mayer, R. E. (2005). *The Cambridge handbook of multimedia learning*. Cambridge University Press.

Mayer, R. E., & Moreno, R. (2003). Nine ways to reduce cognitive load in multimedia learning. *Educational Psychologist*, *38*(1), 43–52.

Mc Auley, M., & Mooney, K. (2018). Chapter 7 - Using Computational Models to Study Aging. In J. L. Ram & P. M. B. T.-C. H. of M. for H. A. (Second E. Conn (Eds.) (pp. 79–91). Academic Press. https://doi.org/https://doi.org/10.1016/B978-0-12-811353-0.00007-5

McCarthy, R., & Achenie, L. E. K. (2017). Agent-based modeling–Proof of concept application to membrane separation and hydrogen storage in a MOF. *Computers & Chemical Engineering*, *107*, 151–157.

McMullan, M. (2018). Evaluation of a medication calculation mobile app using a cognitive load instructional design. *International Journal of Medical Informatics*.

Medeiros, L., & Bosse, T. (2017). An Empathic Agent that Alleviates Stress by Providing Support via Social Media. In *Proceedings of the 16th Conference on Autonomous Agents and MultiAgent Systems* (pp. 1634–1636). International Foundation for Autonomous Agents and Multiagent Systems.

Medeiros, L., & van der Wal, C. N. (2017). An Agent-Based Model Predicting Group Emotion and Misbehaviours in Stranded Passengers. In *Portuguese Conference on Artificial Intelligence* (pp. 28–40). Springer.

Michalowski, M. P., Sabanovic, S., & Kozima, H. (2007). A dancing robot for rhythmic social interaction. In *2nd ACM/IEEE International Conference on Human-Robot Interaction (HRI),* (pp. 89–96). IEEE.

Miller, G. A. (1956). The magical number seven, plus or minus two: some limits on our capacity for processing information. *Psychological Review*, *63*(2), 81.

Mills, C., Bosch, N., Graesser, A., & D'Mello, S. (2014). To Quit or Not to Quit: Predicting Future Behavioral Disengagement from Reading Patterns. In *Intelligent Tutoring Systems* (pp. 19–28). Springer.

Mills, C., Fridman, I., Soussou, W., Waghray, D., Olney, A. M., & D'Mello, S. K. (2017). Put your thinking cap on: detecting cognitive load using EEG during learning. In *Proceedings of the Seventh International Learning Analytics & Knowledge Conference* (pp. 80–89). ACM.

Mizuno, K., Tanaka, M., Yamaguti, K., Kajimoto, O., Kuratsune, H., & Watanabe, Y. (2011). Mental fatigue caused by prolonged cognitive load associated with sympathetic hyperactivity. *Behavioral and Brain Functions*, *7*(1), 1–7. https://doi.org/10.1186/1744-9081-7-17

Möckel, T., Beste, C., & Wascher, E. (2015). The effects of time on task in response selection-an erp study of mental fatigue. *Scientific Reports*, *5*, 10113.

Mohammed, H., Aziz, A. A., & Ahmad, R. (2015). Exploring the need of an assistive robot to support reading process: A pilot study. In *2015 International Symposium on Agents, Multi-Agent Systems and Robotics (ISAMSR)* (pp. 35–40). Kuala Lumpur: IEEE.

Mollee, J. S., & Klein, M. C. A. (2017a). Empirical Validation of a Computational Model of Influences on Physical Activity Behavior. In *International Conference on Industrial, Engineering and Other Applications of Applied Intelligent Systems* (pp. 353–363). Springer.

Mollee, J. S., & Klein, M. C. A. (2017b). Empirical Validation of a Computational Model of Influences on Physical Activity Behavior BT - Advances in Artificial Intelligence: From Theory to Practice. In S. Benferhat, K. Tabia, & M. Ali (Eds.) (pp. 353–363). Cham: Springer International Publishing.

Mollee, J., & van der Wal, C. N. (2013). A Computational Agent Model of Influences on Physical Activity Based on the Social Cognitive Theory. In G. Boella, E. Elkind, B. Savarimuthu, F. Dignum, & M. Purvis (Eds.), *PRIMA 2013: Principles and Practice of Multi-Agent Systems SE - 37* (Vol. 8291, pp. 478–485). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-44927-7_37

Moody, D. L. (2004). Cognitive load effects on end user understanding of conceptual models: An experimental analysis. In *Advances in Databases and Information Systems* (pp. 129–143). Springer.

Moradmand, N., Datta, A., & Oakley, G. (2014). An Interactive Multimedia Development Life Cycle Model Based on a Cognitive Theory of Multimedia Learning. In *World Conference on Educational Multimedia, Hypermedia and Telecommunications* (Vol. 2014, pp. 746–761).

Mori, M. (1970). Bukimi no tani [the Uncanny Valley]. *Energy*, *7(4)*, 33–35.

Mostafa, S. A., Ahmad, M. S., Mustapha, A., & Mohammed, M. A. (2017). A Concise Overview of Software Agent Research, Modeling, and Development. *Software Engineering*, *5*, 8–25.

Mui, L., Mohtashemi, M., & Halberstadt, A. (2002). A Computational Model of Trust and Reputation. *In Proceedings of the 35th Hawaii International Conference on System Sciences*, *00*(c), 1–9. https://doi.org/10.1109/HICSS.2002.994181

Mumm, J., & Mutlu, B. (2011). Designing motivational agents: The role of praise, social comparison, and embodiment in computer feedback. *Computers in Human Behavior*, *27*(5), 1643–1650.

Mustapha, R., Yousif, Y., & Aziz, A. aziz. (2017). A Computational Agent Model of Automaticity for Driver's Training. *IOP Conference Series: Materials Science and Engineering*, *226*(1), 12083. Retrieved from http://stacks.iop.org/1757-899X/226/i=1/a=012083

Nadolski, R. J., Kirschner, P. A., van Merriënboer, J. J. G., & Wöretshofer, J. (2005). Development of an instrument for measuring the complexity of learning tasks. *Educational Research and Evaluation*, *11*(1), 1–27.

Nakashima, H., Hirata, K., & Ochiai, J. (2017). Realization of Mobility as a Service in View of Ambient Intelligence. In *Serviceology for Smart Service System* (pp. 111–116). Springer.

Naze, S., & Treur, J. (2012). A computational model for development of post-traumatic stress disorders by hebbian learning. In T. Huang, Z. Zeng, C. Li, & C. Leung (Eds.), *Neural Information Processing SE - 18* (Vol. 7664, pp. 141–151). Springer. https://doi.org/10.1007/978-3-642-34481-7_18

Neerincx, M. A., Harbers, M., Lim, D., & van der Tas, V. (2014). Automatic feedback on cognitive load and emotional state of traffic controllers. In *Engineering Psychology and Cognitive Ergonomics* (pp. 42–49). Springer.

Neerincx, M. A., Veltman, J. A., Grootjen, M., & Veenendaal, J. (2003). A model for cognitive task load prediction: Validation and application. In *Proceedings of the 15th Triennial Congress of the the International Ergonomics Association*. Seoul, Korea.

Newell, A., & Simon, H. A. (1976). Computer science as empirical inquiry: Symbols and search. *Communications of the ACM*, *19*(3), 113–126.

Nicholls, S., Amelung, B., & Student, J. (2017). Agent-based modeling: A powerful tool for tourism researchers. *Journal of Travel Research*, *56*(1), 3–15.

Nicholson, B., & O'Hare, D. (2014). The effects of individual differences, prior experience and cognitive load on the transfer of dynamic decision-making performance. *Ergonomics*, (August 2015), 1–13. https://doi.org/10.1080/00140139.2014.933884

Niculescu, A., Cao, Y., & Nijholt, A. (2010). Manipulating stress and cognitive load in conversational interactions with a multimodal system for crisis management support. In *Development of Multimodal Interfaces: Active Listening and Synchrony* (pp. 134–147). Springer.

Nikolic, I., & Ghorbani, A. (2011). A method for developing agent-based models of socio-technical systems. In *2011 ieee international conference on Networking, sensing and control (icnsc),* (pp. 44–49). IEEE.

Noels, K. A., Clément, R., & Pelletier, L. G. (1999). Perceptions of teachers' communicative style and students' intrinsic and extrinsic motivation. *The Modern Language Journal*, *83*(1), 23–34.

Norling, E. (2004). Folk psychology for human modelling: Extending the BDI paradigm. In *Proceedings of the Third International Joint Conference on Autonomous Agents and Multiagent Systems-Volume 1* (pp. 202–209). IEEE Computer Society.

Norling, E. J. (2009). *Modelling human behaviour with BDI agents, PhD thesis*. University of Melbourne. Retrieved from http://hdl.handle.net/11343/37081

Nourbakhsh, N., Wang, Y., & Chen, F. (2013). GSR and blink features for cognitive load classification. In *Human-Computer Interaction–INTERACT 2013* (pp. 159–166). Springer.

Nourbakhsh, N., Wang, Y., Chen, F., & Calvo, R. A. (2012). Using galvanic skin response for cognitive load measurement in arithmetic and reading tasks. In *Proceedings of the 24th Australian Computer-Human Interaction Conference* (pp. 420–423). ACM.

Orzechowski, J. (2010). Working Memory Capacity and Individual Differences in Higher-Level Cognition. In A. Gruszka, G. Matthews, & B. Szymura (Eds.), *Handbook of Individual Differences in Cognition SE - 21* (pp. 353–368). Springer New York. https://doi.org/10.1007/978-1-4419-1210-7_21

Oviatt, S. (2006). Human-centered design meets cognitive load theory: designing interfaces that help people think. In *Proceedings of the 14th annual ACM international conference on Multimedia* (pp. 871–880). ACM.

Paas, F., Camp, G., & Rikers, R. (2001). Instructional compensation for age-related cognitive declines: Effects of goal specificity in maze learning. *Journal of Educational Psychology*, *93*(1), 181.

Paas, F. G. (1992). Training strategies for attaining transfer of problem-solving skill in statistics: A cognitive-load approach. *Journal of Educational Psychology*, *84*(4), 429.

Paas, F. G. W. C., van Merriënboer, J. J. G., & Adam, J. J. (1994). Measurement of cognitive load in instructional research. *Perceptual and Motor Skills*, *79*(1), 419–430.

Paas, F., & Sweller, J. (2012). An evolutionary upgrade of cognitive load theory: Using the human motor system and collaboration to support the learning of complex cognitive tasks. *Educational Psychology Review*, *24*(1), 27–45.

Paas, F., Tuovinen, J. E., Tabbers, H., & Van Gerven, P. W. M. (2003). Cognitive load measurement as a means to advance cognitive load theory. *Educational Psychologist*, *38*(1), 63–71.

Paas, F., Tuovinen, J., van Merriënboer, J. G., & Aubteen Darabi, A. (2005). A motivational perspective on the relation between mental effort and performance: Optimizing learner involvement in instruction. *Educational Technology Research and Development*, *53*(3), 25–34. https://doi.org/10.1007/BF02504795

Paas, F. W. C., & van Merriënboer, J. G. (1994). Instructional control of cognitive load in the training of complex cognitive tasks. *Educational Psychology Review*, *6*(4), 351–371. https://doi.org/10.1007/BF02213420

Paauwe, R. A., Hoorn, J. F., Konijn, E. A., & Keyson, D. V. (2015). Designing robot embodiments for social interaction: affordances topple realism and aesthetics. *International Journal of Social Robotics*, *7*(5), 697–708.

Palinko, O., Kun, A. L., Shyrokov, A., & Heeman, P. (2010). Estimating cognitive load using remote eye tracking in a driving simulator. In *Proceedings of the 2010 Symposium on Eye-Tracking Research & Applications* (pp. 141–144). ACM.

Pandey, N. M., & Tiwari, S. C. (2018). Behavioural Intervention Programme for Promoting Healthcare Practices in the Community: An Initiative. In *Psychosocial Interventions for Health and Well-Being* (pp. 215–223). Springer.

Parks, L., & Guay, R. P. (2009). Personality, values, and motivation. *Personality and Individual Differences*, *47*(7), 675–684. https://doi.org/http://dx.doi.org/10.1016/j.paid.2009.06.002

Peffers, K., Tuunanen, T., Gengler, C. E., Rossi, M., Hui, W., Virtanen, V., & Bragge, J. (2006). The design science research process: a model for producing and presenting information systems research. In *Proceedings of the first international conference on design science research in information systems and technology (DESRIST 2006)* (pp. 83–106).

Piacenza, S. E., Richards, P. M., & Heppell, S. S. (2017). An agent-based model to evaluate recovery times and monitoring strategies to increase accuracy of sea turtle population assessments. *Ecological Modelling*, *358*, 25–39.

Plaisant, C., Druin, A., Lathan, C., Dakhane, K., Edwards, K., Vice, J. M., & Montemayor, J. (2000). A storytelling robot for pediatric rehabilitation. In *In Proceedings of the fourth international ACM conference on Assistive technologies* (pp. 50–55). Arlington,: ACM.

Pontier, M., Van Gelder, J.-L., & de Vries, R. (2013). A Computational Model of Affective Moral Decision Making That Predicts Human Criminal Choices. In G. Boella, E. Elkind, B. Savarimuthu, F. Dignum, & M. Purvis (Eds.), *PRIMA 2013: Principles and Practice of Multi-Agent Systems SE - 40* (Vol. 8291, pp. 502–509).

Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-44927-7_40

Poole, D. L., & Mackworth, A. K. (2010). *Artificial Intelligence: foundations of computational agents*. Cambridge University Press.

Powers, A., Kiesler, S., Fussell, S., & Torrey, C. (2007). Comparing a computer agent with a humanoid robot. In *Proceedings of the ACM/IEEE international conference on Human-robot interaction* (pp. 145–152). New York, USA: IEEE.

Prescott, T. J., Mitchinson, B., & Conran, S. (2017). MiRo: An Animal-like Companion Robot with a Biomimetic Brain-based Control System. In *Proceedings of the Companion of the 2017 ACM/IEEE International Conference on Human-Robot Interaction* (pp. 50–51). ACM.

Rammstedt, B., & John, O. P. (2007). Measuring personality in one minute or less: A 10-item short version of the Big Five Inventory in English and German. *Journal of Research in Personality*, *41*(1), 203–212.

Rao, A. S., & Georgeff, M. P. (1997). Modeling rational agents within a BDI-architecture. *Readings in Agents*, 317–328.

Rayner, K., Pollatsek, A., Ashby, J., & Clifton, C. (2012). *Psychology of Reading: 2nd Edition*. Taylor & Francis. Retrieved from https://books.google.com/books?id=hI55AgAAQBAJ

Refat, N., & Kassim, H. (2018). Impact of Extraneous Cognitive Load on Multimedia-Based Grammar Learning. *Advanced Science Letters*, *24*(10), 7790–7794.

Ritchie, J., Lewis, J., Nicholls, C. M., & Ormston, R. (2013). *Qualitative research practice: A guide for social science students and researchers*. Sage.

Riva, G. (2018). MARIO: Robotic Solutions to Give Dementia Patients a Better Quality of Life. *Cyberpsychology, Behavior, and Social Networking*, *21*(2), 145.

Robins, B., & Dautenhahn, K. (2014). Tactile Interactions with a Humanoid Robot: Novel Play Scenario Implementations with Children with Autism. *International Journal of Social Robotics*, *6*(3), 397–415. https://doi.org/10.1007/s12369-014-0228-0

Rogers, J. D., & Cegielski, W. H. (2017). Opinion: Building a better past with the help of agent-based modeling. *Proceedings of the National Academy of Sciences*, *114*(49), 12841–12844.

Rose, C. L., Murphy, L. B., Byard, L., & Nikzad, K. (2002). The role of the Big Five personality factors in vigilance performance and workload. *European Journal of Personality*, *16*(3), 185–200.

Rosenthal, R. (1966). Experimenter effects in behavioral research. *New York :Appleton*.

Roy, N., Baltus, G., Fox, D., Gemperle, F., Goetz, J., Hirsch, T., … Schulte, J. (2000). Towards personal service robots for the elderly. In *In Proceeding of the Workshop on Interactive Robots and Entertainment (WIRE 2000)* (Vol. 25, p. 184). Pittsburgh.

Roy, R. N., Bonnet, S., Charbonnier, S., & Campagne, A. (2013). Mental fatigue and working memory load estimation: Interaction and implications for eeg-based passive bci. In *Engineering in Medicine and Biology Society (EMBC), 2013 35th Annual International Conference of the IEEE* (pp. 6607–6610). IEEE.

Ruiz, N., Taib, R., Shi, Y. D., Choi, E., & Chen, F. (2007). Using pen input features as indices of cognitive load. In *Proceedings of the 9th international conference on Multimodal interfaces* (pp. 315–318). ACM.

Rupley, W. H., & Gwinn, P. B. (1978). Reading in the real world. *Reading World*, *18*(2), 117–122. https://doi.org/10.1080/19388077809557463

Russell, S., & Norvig, P. (1995). A modern approach. *Artificial Intelligence. Prentice-Hall, Egnlewood Cliffs*, *25*, 27.

Santos, J., Campos, D., Duarte, F., Pereira, F., Domingues, I., Leão, J., … Penas, M. (2018). A Personal Robot as an Improvement to the Customers' In-Store Experience. In *Service Robots*. InTech.

Sawicka, A. (2008). Dynamics of cognitive load theory: A model-based approach. *Computers in Human Behavior*, *24*(3), 1041–1066.

Scassellati, B. (2002). Theory of mind for a humanoid robot. *Autonomous Robots*, *12*, 13–24.

Schaffner, A. K., Wagner, G., & Neckel, S. (2017). *Burnout, Fatigue, Exhaustion: An Interdisciplinary Perspective on a Modern Affliction*. Palgrave Macmillan. https://doi.org/10.1007/978-3-319-52887-8

Scheiter, K., Gerjets, P., Vollmann, B., & Catrambone, R. (2009). The impact of learner characteristics on information utilization strategies, cognitive load experienced, and performance in hypermedia learning. *Learning and Instruction*, *19*(5), 387–401. https://doi.org/http://dx.doi.org/10.1016/j.learninstruc.2009.02.004

Schicchi, D., & Pilato, G. (2018). A Social Humanoid Robot as a Playfellow for Vocabulary Enhancement. In *2018 Second IEEE International Conference on Robotic Computing (IRC)* (pp. 205–208). IEEE.

Schiefele, U., Schaffner, E., Möller, J., & Wigfield, A. (2012). Dimensions of reading motivation and their relation to reading behavior and competence. *Reading Research Quarterly*, *47*(4), 427–463.

Schmeck, A., Opfermann, M., van Gog, T., Paas, F., & Leutner, D. (2015). Measuring cognitive load with subjective rating scales during problem solving: differences between immediate and delayed ratings. *Instructional Science*, *43*(1), 93–114.

Schnotz, W., Fries, S., & Horz, H. (2009). Motivational aspects of cognitive load theory. *Contemporary Motivation Research: From Global to Local Perspectives*, 69–96.

Schnotz, W., & Kürschner, C. (2007). A Reconsideration of Cognitive Load Theory. *Educational Psychology Review*, *19*(4), 469–508. https://doi.org/10.1007/s10648-007-9053-4

Schultheis, H., & Jameson, A. (2004). Assessing Cognitive Load in Adaptive Hypermedia Systems: Physiological and Behavioral Methods. In P. E. De Bra & W. Nejdl (Eds.), *Adaptive Hypermedia and Adaptive Web-Based Systems SE - 26* (Vol. 3137, pp. 225–234). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-540-27780-4_26

Sefelin, R., Tscheligi, M., & Giller, V. (2003). Paper prototyping-what is it good for?: a comparison of paper-and computer-based low-fidelity prototyping. In *CHI'03 extended abstracts on Human factors in computing systems* (pp. 778–779). ACM.

Shamsuddin, S., Yussof, H., Ismail, L. I., Mohamed, S., Hanapiah, F. A., & Zahari, N. I. (2012a). Humanoid Robot NAO Interacting with Autistic Children of Moderately Impaired Intelligence to Augment Communication Skills. *Procedia Engineering*, *41*(0), 1533–1538. https://doi.org/http://dx.doi.org/10.1016/j.proeng.2012.07.346

Shamsuddin, S., Yussof, H., Ismail, L. I., Mohamed, S., Hanapiah, F. A., & Zahari, N. I. (2012b). Initial Response in HRI- a Case Study on Evaluation of Child with Autism Spectrum Disorders Interacting with a Humanoid Robot NAO. *In International Symposium on Robotics and Intelligent Sensors,Procedia Engineering*, *41*(0), 1448–1455. https://doi.org/http://dx.doi.org/10.1016/j.proeng.2012.07.334

Sharpanskykh, A., & Treur, J. (2010a). A temporal trace language for formal modelling and analysis of agent systems. In *Specification and verification of multi-agent systems* (pp. 317–352). Springer.

Sharpanskykh, A., & Treur, J. (2010b). Adaptive Modelling of Social Decision Making by Agents Integrating Simulated Behaviour and Perception Chains. In J.-S. Pan, S.-M. Chen, & N. Nguyen (Eds.), *Computational Collective Intelligence. Technologies and Applications SE - 31* (Vol. 6421, pp. 284–295). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-16693-8_31

Sharpanskykh, A., & Zia, K. (2014). Understanding the role of emotions in group dynamics in emergency situations. In *Transactions on Computational Collective Intelligence XV* (pp. 28–48). Springer.

Shelburne, W. A. (2009). E-book usage in an academic library: User attitudes and behaviors. *Library Collections, Acquisitions, and Technical Services*, *33*(2–3), 59–72.

Shen, C.-Y., & Chu, H.-P. (2014). The Relations between Interface Design of Digital Game-Based Learning Systems and Flow Experience and Cognitive Load of Learners with Different Levels of Prior Knowledge. In P. L. P. Rau (Ed.), *Cross-Cultural Design SE - 55* (Vol. 8528, pp. 574–584). Springer International Publishing. https://doi.org/10.1007/978-3-319-07308-8_55

Short, E. S., & J Mataric´, M. (2017). Towards Socially Assistive Robotics for Inter-Generational Family Groups. In *Refereed Workshop 20th ACM Conference on Computer-Supported Cooperative Work (CSCW), Workshop on Robots in Groups and Teams*. Portland.

Shute, V. J. (2008). Focus on formative feedback. *Review of Educational Research*, *78*(1), 153–189.

Siegel, M., Breazeal, C., & Norton, M. (2009). Persuasive robotics: The influence of robot gender on human behavior. In *IEEE/RSJ International Conference on Intelligent Robots and Systems. IROS 2009.* (pp. 2563–2568). IEEE.

Siegel, M. S. (2008). Persuasive robotics: how robots change our minds. Massachusetts Institute of Technology.

Simpson, R., & Levine, S. (1997). Development and evaluation of voice control for a smart wheelchair. In *In Proceedings of the Rehabilitation Engineering Society of North America Annual Conference* (pp. 417–419). Pittsburgh.

Snow, C. (2002). *Reading for understanding: Toward an R&D program in reading comprehension*. Rand Corporation.

Soleimani, A., & Kobti, Z. (2012). A mood driven computational model for gross emotion regulation process paradigm. *Proceedings of the World Congress on Engineering* *and Computer Science 2012 Vol I WCECS , October 24-26, San Francisco, USA*, *I*.

Sonnentag, S., & Zijlstra, F. R. H. (2006). Job characteristics and off-job activities as predictors of need for recovery, well-being, and fatigue. *Journal of Applied Psychology*, *91*(2), 330.

Stange, T. V. (2013). Exploring text level difficulty and matching texts for reading achievement. *Education Matters: The Journal of Teaching and Learning*, *1*(2).

StataCorp. (2013). *stata multivariate statistics reference manual*. Texas: Stata Press.

Steephen, J. E. (2013). Hed: A computational model of affective adaptation and emotion dynamics. *IEEE Transactions on Affective Computing*, (2), 197–210.

Stodolsky, S. S., & Grossman, P. L. (1995). The impact of subject matter on curricular activity: An analysis of five academic subjects. *American Educational Research Journal*, *32*(2), 227–249.

Stoller, F. L. (2015). Viewing extensive reading from different vantage points. *Reading in a Foreign Language*, *27*(1), 1.

Streitz, N. (2017). Reconciling Humans and Technology: The Role of Ambient Intelligence. In *European Conference on Ambient Intelligence* (pp. 1–16). Springer.

Suárez-Coalla, P., & Cuetos, F. (2015). Reading difficulties in Spanish adults with dyslexia. *Annals of Dyslexia*, 1–19.

Sullivan, S. A., & Puntambekar, S. (2015). Learning with digital texts: Exploring the impact of prior domain knowledge and reading comprehension ability on navigation and learning outcomes. *Computers in Human Behavior*, *50*, 299–313.

Sun, N. Z., Anand, P. A., & Snell, L. (2017). Optimizing the design of high-fidelity simulation-based training activities using cognitive load theory–lessons learned from a real-life experience. *Journal of Simulation*, *11*(2), 151–158.

Sun, R. (2008). Introduction to computational cognitive modeling. *Cambridge Handbook of Computational Psychology*, 3–19.

Svenstrup, M., Bak, T., Maler, O., Andersen, H. J., & Jensen, O. B. (2008). Pilot Study of Person Robot Interaction in a Public Transit Space. In *Eurobot Conference* (pp. 96–106). Springer.

Sweller, J. (1988). Cognitive load during problem solving: Effects on learning. *Cognitive*

Science, *12*(2), 257–285.

Sweller, J. (2011). Cognitive Load Theory and E-Learning. In G. Biswas, S. Bull, J. Kay, & A. Mitrovic (Eds.), *Artificial Intelligence in Education SE - 3* (Vol. 6738, pp. 5–6). Springer Berlin Heidelberg. https://doi.org/10.1007/978-3-642-21869-9_3

Sweller, J. (2016). Cognitive Load Theory: What We Learn and How We Learn BT - Learning, Design, and Technology: An International Compendium of Theory, Research, Practice, and Policy. In M. J. Spector, B. B. Lockee, & M. D. Childress (Eds.) (pp. 1–17). Cham: Springer International Publishing. https://doi.org/10.1007/978-3-319-17727-4_50-1

Sweller, J. (2017). Cognitive load theory and teaching English as a second language to adult learners. *Contact Magazine*, *43*(1), 10–14.

Sweller, J., Ayres, P., & Kalyuga, S. (2011). *cognitive load theory*. New York: Springer.

Sweller, J., Van Merrienboer, J. J. G., & Paas, F. G. W. C. (1998). Cognitive architecture and instructional design. *Educational Psychology Review*, *10*(3), 251–296.

Takase, N., Botzheim, J., Kubota, N., Takesue, N., & Hashimoto, T. (2016). Practical Robot Edutainment Activities Program for Junior High School Students. In *International Conference on Intelligent Robotics and Applications* (pp. 111–121). Springer.

Takayama, L., & Pantofaru, C. (2009). Influences on proxemic behaviors in human-robot interaction. In *IIROS 2009. IEEE/RSJ International Conference on ntelligent Robots and Systems.* (pp. 5495–5502). IEEE.

Tapus, A., Peca, A., Aly, A., Pop, C., Jisa, L., Pintea, S., … David, D. O. (2012). Children with autism social engagement in interaction with Nao, an imitative robot: A series of single case experiments. *Interaction Studies*, *13*(3), 315–347.

Togelius, J. (2003). Evolution of the layers in a subsumption architecture robot controller. University of Sussex.

Tomé Klock, A., da Cunha, L., de Carvalho, M., Eduardo Rosa, B., Jaqueline Anton, A., & Gasparini, I. (2015). Gamification in e-Learning Systems: A Conceptual Model to Engage Students and Its Application in an Adaptive e-Learning System. In P. Zaphiris & A. Ioannou (Eds.), *Learning and Collaboration Technologies SE - 56* (Vol. 9192, pp. 595–607). Springer International Publishing. https://doi.org/10.1007/978-3-319-20609-7_56

Torgesen, J. K. (2002). The prevention of reading difficulties. *Journal of School Psychology*, *40*(1), 7–26.

Treptow, M. A., Burns, M. K., & McComas, J. J. (2007). Reading at the frustration, instructional, and independent levels: The effects on students' reading comprehension and time on task. *School Psychology Review*, *36*(1), 159.

Treur, J. (2011). A virtual human agent model with behaviour based on feeling exhaustion. *Applied Intelligence*, *35*(3), 469–482.

Treur, J. (2016a). Dynamic modeling based on a temporal–causal network modeling approach. *Biologically Inspired Cognitive Architectures*, *16*, 131–168.

Treur, J. (2016b). Making Smart Applications Smarter. In *NetwTreur, J. (2016). Making Smart Applications Smarter. In Network-Oriented Modeling (pp. 463–471). Springer.ork-Oriented Modeling* (pp. 463–471). Springer.

Treur, J. (2016). *Network-Oriented Modeling: Addressing Complexity of Cognitive, Affective and Social Interactions*. Springer International Publishing. Retrieved from https://books.google.com.my/books?id=LcowDQAAQBAJ

Treur, J. (2016c). Network-Oriented Modeling, (October). https://doi.org/10.1007/978-3-319-45213-5

Treur, J. (2016d). Verification of temporal-causal network models by mathematical analysis. *Vietnam Journal of Computer Science*, *3*(4), 207–221.

Treur, J. (2017a). Do Network Models Just Model Networks? On the Applicability of Network-Oriented Modeling. In *International Conference and School on Network Science* (pp. 21–33). Springer.

Treur, J. (2017b). Modelling and analysis of the dynamics of adaptive temporal–causal network models for evolving social interactions. *Computational Social Networks*, *4*(1), 4.

Treur, J. (2017c). On the applicability of Network-Oriented Modelling based on temporal-causal networks: why network models do not just model networks. *Journal of Information and Telecommunication*, *1*(1), 23–40.

Treur, J. (2018). The Ins and Outs of Network-Oriented Modeling: from Biological Networks and Mental Networks to Social Networks and Beyond. In *Proc. of the 10th International Conference on Computational Collective Intelligence, ICCCI*. Bristol: Springer Verlag.

Tsai, G., & Yang, M. C. (2017). How It Is Made Matters: Distinguishing Traits of Designs Created by Sketches, Prototypes, and CAD. In *Proceedings of the ASME 2017 International Design Engineering Technical Conferences and Computers and Information in Engineering Conference*. Cleveland, Ohio, USA: American Society of Mechanical Engineers.

Ullman, D., & Malle, B. F. (2017). Human-Robot Trust: Just a Button Press Away. In *Proceedings of the Companion of the 2017 ACM/IEEE International Conference on Human-Robot Interaction* (pp. 309–310). ACM.

Upton, E., & Halfacree, G. (2014). *Raspberry Pi user guide*. John Wiley & Sons.

van Breemen, A., Yan, X., & Meerbeek, B. (2005). iCat: an animated user-interface robot with personality. In *Proceedings of the fourth international joint conference on Autonomous agents and multiagent systems* (pp. 143–144). ACM.

van Cutsem, J., Marcora, S., De Pauw, K., Bailey, S., Meeusen, R., & Roelands, B. (2017). The Effects of Mental Fatigue on Physical Performance: A Systematic Review. *Sports Medicine*, *47*(8), 1569–1588. https://doi.org/10.1007/s40279-016-0672-0

van den Beukel, S., Goos, S. H., & Treur, J. (2017). Understanding Homophily and More-Becomes-More Through Adaptive Temporal-Causal Network Models. In *International Conference on Practical Applications of Agents and Multi-Agent Systems* (pp. 16–29). Springer.

van Gerven, P., van Merriënboer, J., Paas, F., & Schmidt, H. (2000). COGNITIVE LOAD THEORY AND THE ACQUISITION OF COMPLEX COGNITIVE SKILLS IN THE ELDERLY: TOWARDS AN INTEGRATIVE FRAMEWORK. *Educational Gerontology*, *26*(6), 503–521. https://doi.org/10.1080/03601270050133874

van Gerven, P. W. M., Paas, F., van Merriënboer, J. J. G., & Schmidt, H. G. (2006). Modality and variability as factors in training the elderly. *Applied Cognitive Psychology*, *20*(3), 311–320.

van Gog, T., & Paas, F. (2008). Instructional efficiency: Revisiting the original construct in educational research. *Educational Psychologist*, *43*(1), 16–26.

van Maris, A., Lehmann, H., Natale, L., & Grzyb, B. (2017). The Influence of a Robot's Embodiment on Trust: A Longitudinal Studyvan Maris, A., Lehmann, H., Natale, L., & Grzyb, B. (2017). The Influence of a Robot's Embodiment on Trust: A Longitudinal Study. In Proceedings of the Companion of the 2017 ACM/IEEE Inte. In *Proceedings of the Companion of the 2017 ACM/IEEE International Conference on Human-Robot Interaction* (pp. 313–314). ACM.

van Merriënboer, J. G., & Sweller, J. (2005). Cognitive Load Theory and Complex Learning: Recent Developments and Future Directions. *Educational Psychology Review*, *17*(2), 147–177. https://doi.org/10.1007/s10648-005-3951-0

van Snellenberg, J., Conway, A. A., Spicer, J., Read, C., & Smith, E. (2014). Capacity estimates in working memory: Reliability and interrelationships among tasks. *Cognitive, Affective, & Behavioral Neuroscience*, *14*(1), 106–116. https://doi.org/10.3758/s13415-013-0235-x

vandewaetere, M., & Clarebout, G. (2013). Cognitive load of learner control: extraneous or germane load? *Education Research International*, *2013*.

Voogd, J. (2016). Verification and Validation for CIPRNet. In *Managing the Complexity of Critical Infrastructures* (pp. 163–193). Springer.

Vossen, S., Ham, J., & Midden, C. (2009). Social influence of a persuasive agent: the role of agent embodiment and evaluative feedback. In *Proceedings of the 4th International Conference on Persuasive Technology* (p. 46). ACM.

Wada, K., Shibata, T., Saito, T., & Tanie, K. (2002). Analysis of factors that bring mental effects to elderly people in robot assisted activity. In *In Proceeding IEEE/RSJ International Conference on Intelligent Robots and Systems* (Vol. 2, pp. 1152–1157). Lausanne,switzerland: IEEE.

Wainer, J., Feil-Seifer, D. J., Shell, D. a., & Matarić, M. J. (2006). The role of physical embodiment in human-robot interaction. In *Proceedings - IEEE International Workshop on Robot and Human Interactive Communication* (pp. 117–122). Hatfield, United Kingdom: IEEE. https://doi.org/10.1109/ROMAN.2006.314404

Wainer, J., Feil-Seifer, D. J., Shell, D., & Mataric, M. J. (2007). Embodiment and human-robot interaction: A task-based perspective. In *IEEE Proceedings of the International Workshop on Robot and Human Interactive Communication* (pp. 872–877). Jeju Island, South Korea: IEEE.

Walker, M., Takayama, L., & Landay, J. A. (2002). High-fidelity or low-fidelity, paper or computer? Choosing attributes when testing web prototypes. In *Proceedings of the human factors and ergonomics society annual meeting* (Vol. 46, pp. 661–665). SAGE Publications Sage CA: Los Angeles, CA.

Walters, M. L., Dautenhahn, K., Te Boekhorst, R., Koay, K. L., Kaouri, C., Woods, S., … Werry, I. (2005). The influence of subjects' personality traits on personal spatial zones in a human-robot interaction experiment. In *Robot and Human Interactive Communication* (pp. 347–352). IEEE.

Wang, H., Zhang, J., & Zeng, W. (2017). Intelligent simulation of aquatic environment economic policy coupled ABM and SD models. *Science of The Total Environment*.

Wang, Y., Bao, J., Ou, L., Thorn, F., & Lu, F. (2013). Reading behavior of emmetropic schoolchildren in China. *Vision Research*, *86*, 43–51.

Wästlund, E. (2007). Experimental studies of human-computer interaction: working memory and mental workload in complex cognition. Department of Psychology: Gothenburg University.

Wästlund, E., Reinikka, H., Norlander, T., & Archer, T. (2005). Effects of VDT and paper presentation on consumption and production of information: Psychological and physiological factors. *Computers in Human Behavior*, *21*(2), 377–394. https://doi.org/http://dx.doi.org/10.1016/j.chb.2004.02.007

Weinhardt, J. M., & Vancouver, J. B. (2012). Computational models and organizational psychology: Opportunities abound. *Organizational Psychology Review*, *2*(4), 267–292.

Weir, C., & Khalifa, H. (2008). A cognitive processing approach towards defining reading comprehension. *Cambridge ESOL: Research Notes*, *31*, 2–10.

Weiss, G., Braubach, L., & Giorgini, P. (2010). Intelligent Agents. In *The Handbook of Technology Management* (pp. 360–372). Wiley.

Westlund, J., & Breazeal, C. (2015). The Interplay of Robot Language Level with Children's Language Learning during Storytelling. *In Proceeding of the Tenth Annual ACM/IEEE International Conference on Human-Robot InteractionI*, 65–66. https://doi.org/10.1145/2701973.2701989

Williams, K., & Breazeal, C. (2013). Reducing driver task load and promoting sociability through an affective intelligent driving agent (AIDA). In *IFIP Conference on Human-Computer Interaction* (pp. 619–626). Springer.

Williams, K., Flores, J. A., & Peters, J. (2014). Affective Robot Influence on Driver Adherence to Safety, Cognitive Load Reduction and Sociability. In *Proceedings of the 6th International Conference on Automotive User Interfaces and Interactive Vehicular Applications* (pp. 1–8). ACM.

Williams, K. J., Peters, J. C., & Breazeal, C. L. (2013). Towards leveraging the driver's mobile device for an intelligent, sociable in-car robotic assistant. In *Intelligent Vehicles Symposium (IV), 2013 IEEE* (pp. 369–376). IEEE.

Wittrock, M. C. (1989). Generative processes of comprehension. *Educational Psychologist*, *24*(4), 345–376.

Woo, J.-C. (2014). Digital Game-Based Learning Supports Student Motivation, Cognitive Success, and Performance Outcomes. *Journal of Educational Technology & Society*, *17*(3).

Wooldridge, M. (2009). *An introduction to multiagent systems*. John Wiley & Sons.

Wooldridge, M. J. (2000). *Reasoning about rational agents*. MIT press.

Wooldridge, M., & Jennings, N. R. (1995). Intelligent agents: Theory and practice. *The Knowledge Engineering Review*, *10*(2), 115–152.

Wrobel, J., Wu, Y.-H., Kerhervé, H., Kamali, L., Rigaud, A.-S., Jost, C., … Duhaut, D. (2013). Effect of agent embodiment on the elder user enjoyment of a game. In *ACHI 2013-The Sixth International Conference on Advances in Computer-Human Interactions*.

Wu, P.-H., Hwang, G.-J., Su, L.-H., & Huang, Y.-M. (2012). A context-aware mobile learning system for supporting cognitive apprenticeships in nursing skills training. *Educational Technology & Society*, *15*(1), 223–236.

Xie, J., Xu, G., Wang, J., Li, M., Han, C., & Jia, Y. (2016). Effects of mental load and fatigue on steady-state evoked potential based brain computer interface tasks: a comparison of periodic flickering and motion-reversal based visual attention. *PloS One*, *11*(9), e0163426.

Yanco, H. (2002). Evaluating the performance of assistive robotic systems. *In NIST Proceedings of the Workshop on Performance Metrics for Intelligent Systems,* 21–25.

Yang, Y., & Diez-Roux, A. V. (2013). Using an agent-based model to simulate children's active travel to school. *International Journal of Behavioral Nutrition and Physical Activity*, *10*(1), 67.

Yang, Z. (2014). Effective Methods to Improving Reading Skills in English Study. In *International Conference on Education, Language, Art and Intercultural Communication (ICELAIC-14)*. Atlantis Press.

Young, G., Zavelina, L., & Hooper, V. (2008). Assessment of workload using NASA Task Load Index in perianesthesia nursing. *Journal of PeriAnesthesia Nursing*, *23*(2), 102–110.

Young, J. Q., & Sewell, J. L. (2015). Applying cognitive load theory to medical education: construct and measurement challenges. *Perspectives on Medical Education*, *4*(3), 107–109. https://doi.org/10.1007/s40037-015-0193-9

Young, J. Q., Van Merrienboer, J., Durning, S., & Ten Cate, O. (2014). Cognitive load theory: Implications for medical education: AMEE guide no. 86. *Medical Teacher*, *36*(5), 371–384.

Zentall, S. R., & Morris, B. J. (2010). "Good job, you're so smart": The effects of inconsistency of praise type on young children's motivation. *Journal of Experimental Child Psychology*, *107*(2), 155–163. https://doi.org/https://doi.org/10.1016/j.jecp.2010.04.015

Zhang, Z., Igoshin, O., Cotter, C., & Shimkets, L. (2018). Agent-based Model for Developmental Aggregation in Myxococcus xanthus Bacteria. *Bulletin of the American Physical Society*.

Zhu, Z.-T., Yu, M.-H., & Riezebos, P. (2016). A research framework of smart education. *Smart Learning Environments*, *3*(1), 4. https://doi.org/10.1186/s40561-016-0026-2

Ziemke, T. (2001). Are robots embodied. In *First international workshop on epigenetic robotics Modeling Cognitive Development in Robotic Systems* (Vol. 85). Citeseer.

Zlotowski, J., Sumioka, H., Nishio, S., Glas, D. F., Bartneck, C., & Ishiguro, H. (2016). Appearance of a robot affects the impact of its behaviour on perceived trustworthiness and empathy. *Paladyn, Journal of Behavioral Robotics*, *7*(1).

Appendix A

Consent Form

Dear participant,

You are asked to participate in an experimental research conducted by Hayder Mohammed Ali, doctoral candidate, Azizi Ab Aziz, *Ph.D.*, and Faudziah Ahmad, *Ph.D.*, from School of Computing at Universiti Utara Malaysia (UUM). The result of this experiment will be used as an essential part in the doctoral thesis of Hayder Mohammed Ali. You were selected as a possible participant in this research because you have indicated that you are ready to provide identical feedback which is extremely appreciated in evaluating a reading companion robot that was developed to accompany and assist readers during their reading. You should read the provided information below, and ask questions about anything you don't understand before proceeding to participate. Your participation in this experiment is highly respected and you are free to decide whether to be in it or not.

- **PURPOSE OF THE RESEARCH**

The main goal of this experimental study is to evaluate the first prototype of a reading companion robot that called IQRA'. It was developed to support readers during reading tasks. The obtained results of this experiment will help to validate to what extend the designed robot is accepted and useful to help readers.

- **CONFIDENTIALITY**

Any information that is obtained in connection with this survey and that can be identified with you will remain confidential and will be used only for research purpose.

- **IDENTIFICATION OF RESEARCHERS**

If you have any additional questions or concerns about this survey, please feel free and do not hesitate to contact:

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Appendix B

Survey Evaluation Items

I. DEMOGRAPHIC DETAILS (Please mark (√) in the appropriate place provided)

1. Gender?

☐ Male ☐ Female

2. Nationality**?**

☐ Malaysian ☐ Not Malaysian, state …………………

3. Email address……………………………………….

4. Age group?

☐15-20 ☐21-30 ☐31-40 ☐ > 40

5. Highest Education level?

☐ Diploma ☐ Matriculation/STPM/A level ☐ High Secondary School

II. THE ROBOT USABILITY MEASUREMENT

Instruction: For each of the following statements, please circle the number that best describes your reactions toward using IQRA':

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

1. I think that I would like to use the robot frequently.	1	2	3	4	5	6	7
2. I found the unnecessarily complex.	1	2	3	4	5	6	7
3. I thought the robot was easy to use.	1	2	3	4	5	6	7
4. I think that I would need assistance to be able to use the robot.	1	2	3	4	5	6	7
5. I found the various functions in the robot were well integrated	1	2	3	4	5	6	7
6. I thought there was too much inconsistency in the robot.	1	2	3	4	5	6	7
7. I would imagine that most people would learn to use the robot very quickly.	1	2	3	4	5	6	7
8. I found the robot very cumbersome/ awkward to use.	1	2	3	4	5	6	7
9. I felt very confident using the robot.	1	2	3	4	5	6	7
10. I needed to learn a lot of things before I could get going with the robot.	1	2	3	4	5	6	7

III. PERCEPTION TOWARD THE DEVELOPED ROBOT

Instructions: For each of the following sub-sections, please circle the number that best describes your impression toward IQRA'.

SECTION A: Please rate your impression of the robot on these scales:

a) Perceived Likeability

Dislike	1	2	3	4	5	6	7	Like
Unfriendly	1	2	3	4	5	6	7	Friendly
Unkind	1	2	3	4	5	6	7	Kind
Unpleasant	1	2	3	4	5	6	7	Pleasant
Awful	1	2	3	4	5	6	7	Nice

b) Perceived Intelligence

Incompetent	1	2	3	4	5	6	7	Competent
Ignorant	1	2	3	4	5	6	7	Knowledgeable
Irresponsible	1	2	3	4	5	6	7	Responsible
Unintelligent	1	2	3	4	5	6	7	Intelligent
Foolish	1	2	3	4	5	6	7	Sensible

c) Perceived Animacy

Dead	1	2	3	4	5	6	7	Alive
Stagnant	1	2	3	4	5	6	7	Lively
Mechanical	1	2	3	4	5	6	7	Organic
Artificial	1	2	3	4	5	6	7	Lifelike
Inert	1	2	3	4	5	6	7	Interactive
Apathetic	1	2	3	4	5	6	7	Responsive

SECTION B: For each of the following statements, please circle the number that best describes your opinion toward using the developed robot,

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

• **Perceived Sociability**							
1. I consider the robot a pleasant conversational partner.	1	2	3	4	5	6	7
2. I find the robot pleasant to interact with.	1	2	3	4	5	6	7
3. I feel the robot understands me.	1	2	3	4	5	6	7
4. I think the robot is nice.	1	2	3	4	5	6	7
• **Perceived Usefulness**							
5. I think the robot is useful to me.	1	2	3	4	5	6	7
6. It would be convenient for me to have the robot.	1	2	3	4	5	6	7
7. I think the robot can help me with many things.	1	2	3	4	5	6	7
• **Social Presence**							
8. When interacting with the robot I felt like I'm talking to a real person.	1	2	3	4	5	6	7
9. It sometimes felt as if the robot was really looking at me.	1	2	3	4	5	6	7
10. I can imagine the robot to be a living creature.	1	2	3	4	5	6	7
11. I often think the robot is not a real person.	1	2	3	4	5	6	7
12. Sometimes the robot seems to have real feelings.	1	2	3	4	5	6	7

SECTION C: For each of the following statements, please circle the number that best describes your opinion toward using the developed robot.

1. I would like to continue using the robot.	Not at all	1	2	3	4	5	6	7	Very Much
2. I am satisfied with support given by the robot	Not at all	1	2	3	4	5	6	7	Very Much
3. The robot was able to motivate me.	Not at all	1	2	3	4	5	6	7	Very Much

SECTION D: Cognitive Load Measurement: Please circle the number that best describes the difficulty of the task?

Very, very easy	1	2	3	4	5	6	7	Very, very difficult

Appendix C

Formal Specifications in the Integration Algorithm

NOMENCLATURES OF AGENT'S OBSERVATIONS

No	Agent's observations	Representation
1	Agent observes reading task	*o*(*A, Rt*)
2	Agent observes academic level	*o*(*A, Al*)
3	Agent observes Subject matter	*o*(*A, Sr*)
4	Agent observes Sound	*o*(*A, Sd*)
5	Agent observes duration to complete	*o*(*A, Ra*)
6	Agent observes graphical presentation	*o*(*A, Gp*)
7	Agent observes brightness	*o*(*A, Br*)
8	Agent observes comprehensive information	*o*(*A, Ci*)
8	Agent observes temperature	*o*(*A, Te*)

NOMENCLATURES OF AGENT'S BASIC BELIEFS

No	Agent's basic beliefs	Representation
1	Agent believes reading	*b*(*A, Ra*)
2	Agent believes task level	*b*(*A, Tl*)
3	Agent believes study subject matter	*b*(*A, Ss*)
4	Agent believes adequate time	*b*(*A, Ad*)
5	Agent believes task structure	*b*(*A, Ts*)
6	Agent believes noise	*b*(*A, Ns*)
7	Agent believes ambient temperature	*b*(*A, At*)
8	Agent believes lighting	*b*(*A, Ln*)
9	Agent believes personality	*b*(*A, Ps*)
10	Agent believes task familiarity	*b*(*A, Tf*)
11	Agent believes exposure	*b*(*A, Ep*)
12	Agent believes basic knowledge	*b*(*A, Bk*)
13	Agent believes reading skills	*b*(*A, Rs*)
14	Agent believes language competency	*b*(*A, Lc*)
15	Agent believe time spent	*b*(*A, Ts*)

NOMENCLATURES OF AGENT'S DERIVED BELIEFS

No	Agent's derived beliefs	Representation
1	Agent believes reading task complexity	$d(A, Tc)$
2	Agent believes time pressure	$d(A, Tp)$
3	Agent believes task presentation	$d(A, Tn)$
4	Agent believes physical environment	$d(A, Pe)$
5	Agent believes personal profile	$d(A, Pp)$
6	Agent believes experience level	$d(A, El)$
7	Agent believes prior knowledge	$d(A, Pk)$
8	Agent believes reading norm	$d(A, Rn)$

NOMENCLATURES OF AGENT"S ASSESSMENTS

No	Agent's assessments	Representation
1	Agent assesses cognitive load	$a(A, Cl)$
2	Agent assesses persistence	$a(A, Pr)$
3	Agent assesses accumulative exhaustion	$a(A, Ae)$
4	Agent assesses reading performance	$a(A, Rp)$

NOMENCLATURES OF AGENT'S DISPLAY TO THE READER

No	Agent's display	Representation
1	Agent displays the first confirmation to confirm room conditions	$s(A, Cp_i)$
2	Agent displays the second confirmation to tell the actual belief on environment condition	$s(A, Cp_{i+1})$
2	Agent display the confirmation to confirm reader's conditions	$s(A, Cc)$
3	Agent displays the first confirmation to confirm the reader is exhausted	$s(A, Ce_i)$
4	Agent displays the second confirmation to tell the actual belief on exhaustion	$s(A, Ce_{i+1})$
5	Agent display the first confirmation to confirm the low level of persistence	$s(A, Cs_i)$
6	Agent display the second confirmation to confirm the low level of persistence	$s(A, Cs_{i+1})$

NOMENCLATURES OF AGENT'S ACTIONS TO THE READER

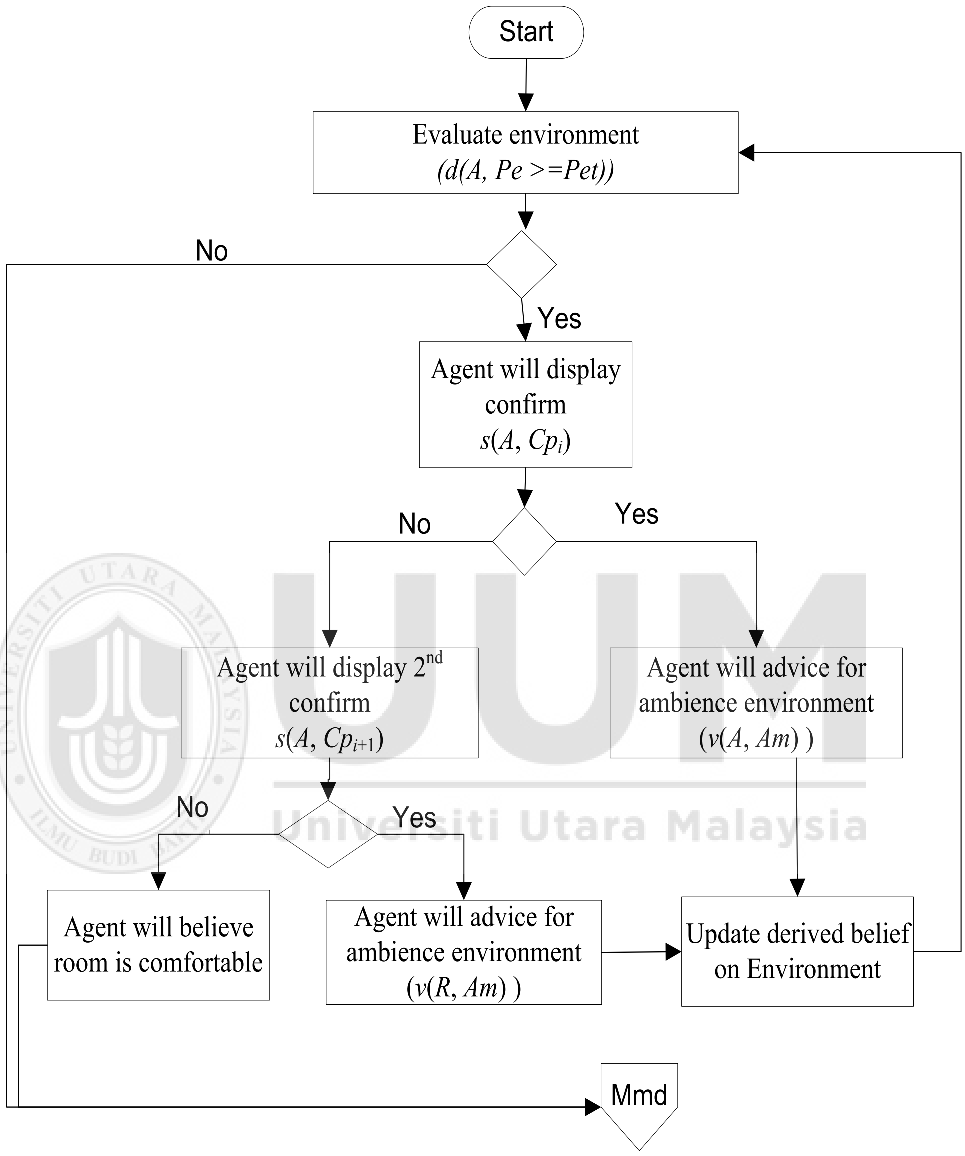
No	Agent's actions	Representation
1	Agent advises to make the environment ambience	*v*(*A, Am*)
2	Agent provides praising for good progress	*p*(*A, Pg*)
2	Agent provides praising for maintaining good progress	*p*(*A, Pm*)
3	Agent advises for short break	*v*(*A, Sb*)
4	Agent provides motivational talk	*p*(*A, Mt*)

NOMENCLATURES OF AGENT'S EVALUATION ON READER'S CONDITIONS

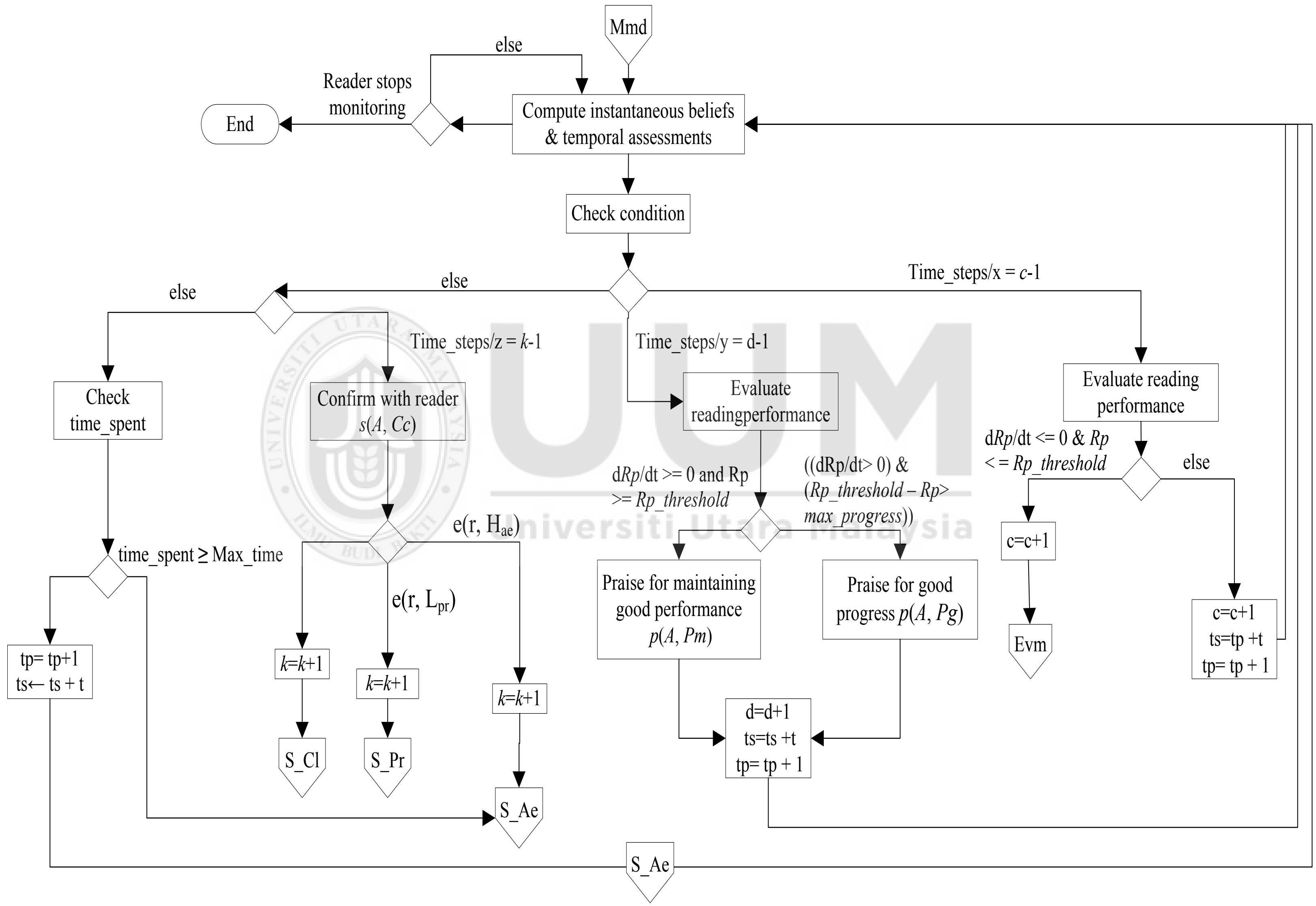
No	Reader conditions	Representation
1	An Agent performs constant checking	*f*(*A*, *Cc)*
2	Agent displays a confirmation screen	*s*(*A*, *Cr*)
2	Agent evaluates whether a reader experiences high cognitive load	*e(r, Hcl)*
3	Agent evaluates whether a reader experiences high exhaustion	*e(r, Hae)*
4	Agent evaluates whether a reader experiences low persistence	*e(r, Lpr)*

Appendix D
Integration Modules Flow Charts

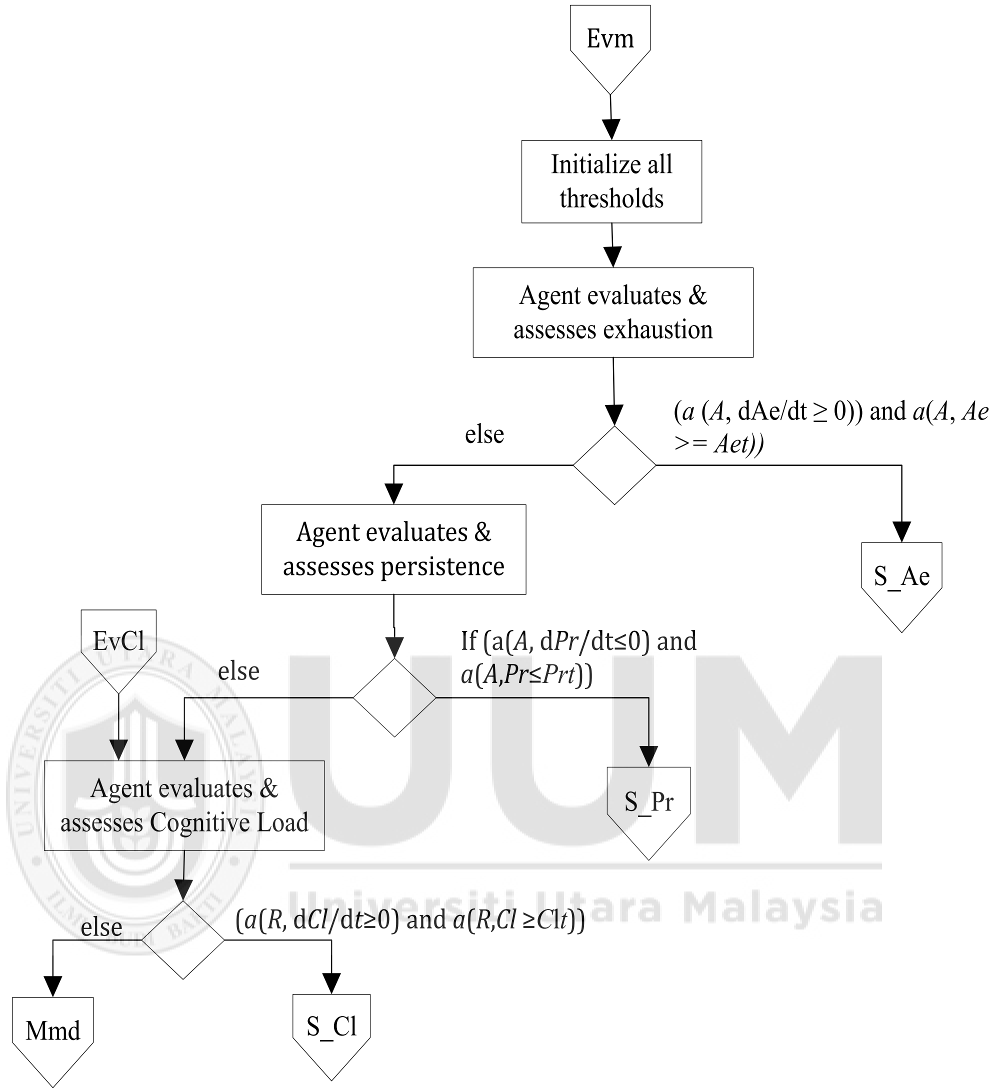
ENVIRONMENT EVALUATION FLOW CHART



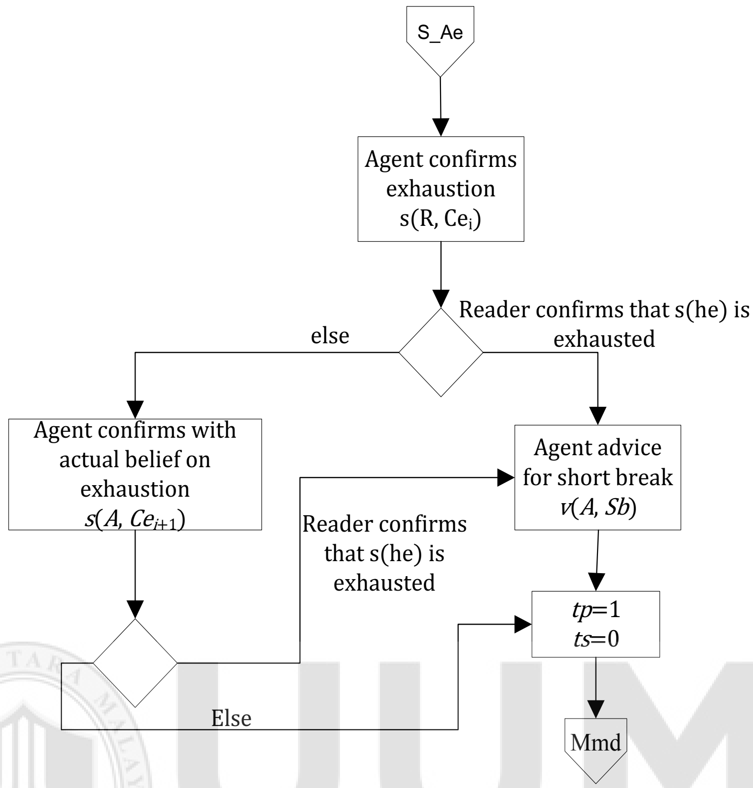
MONITORING MODULE FLOW CHART



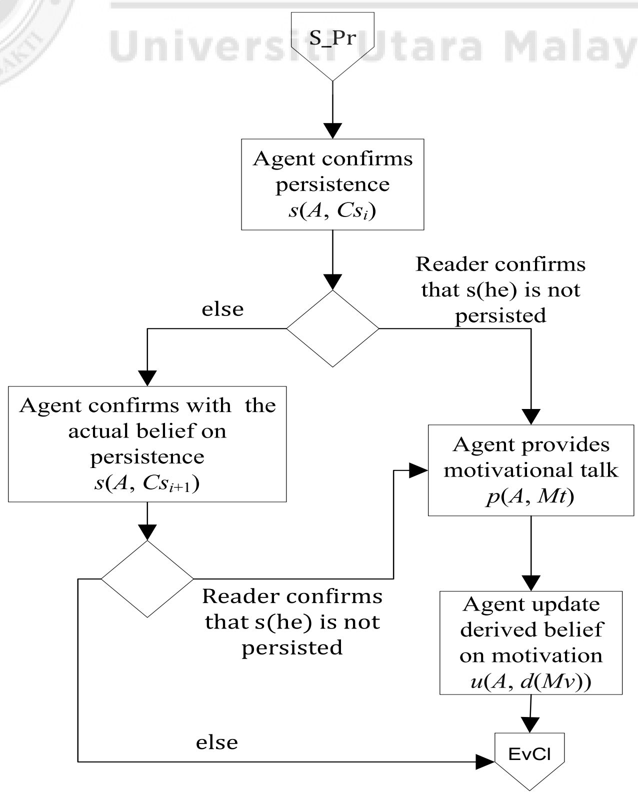
EVALUATION MODULE FLOW CHART



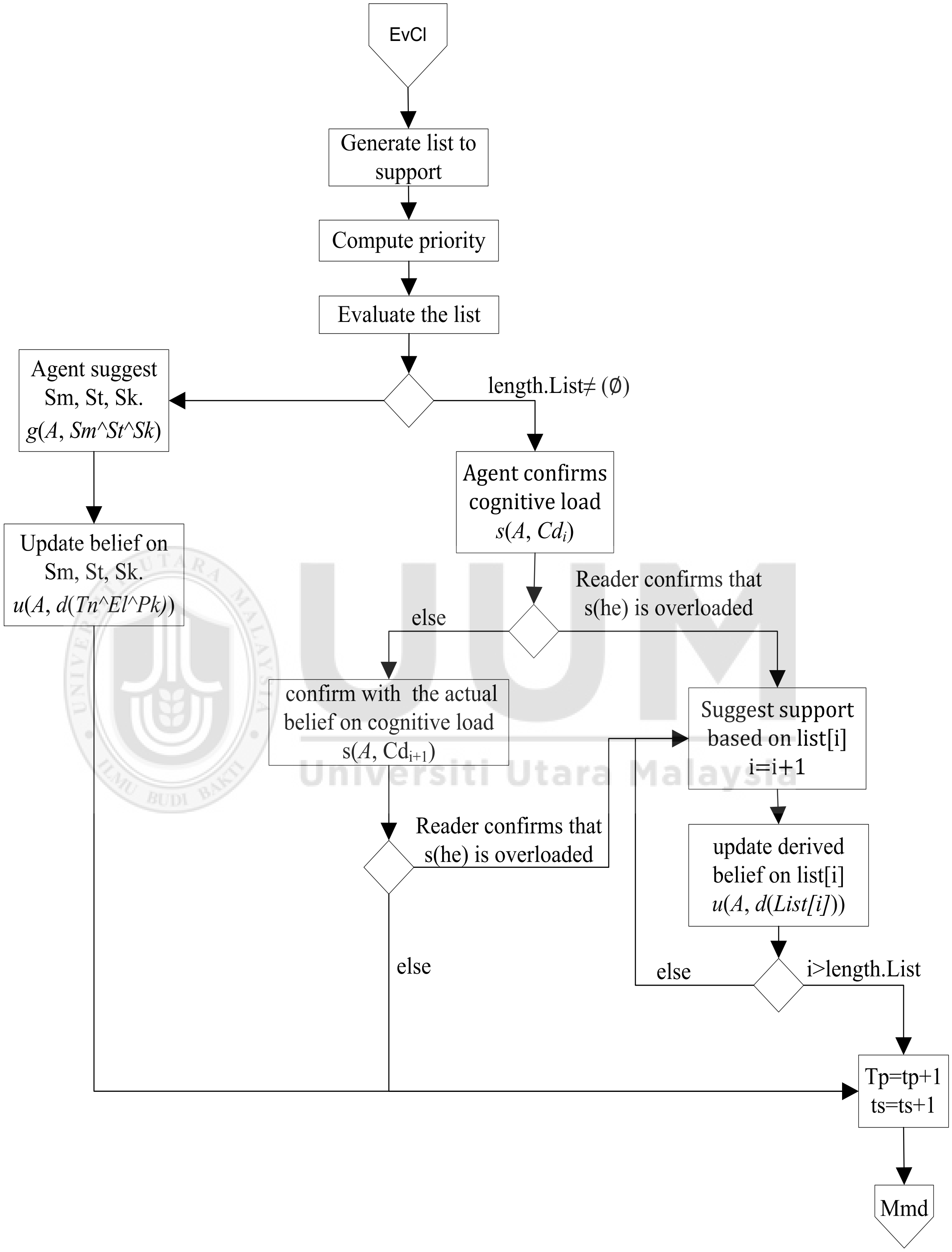
EXHAUSTION SUPPORT MODULE



PERSISTENCE MODULE FLOW CHART



COGNITIVE LOAD MODULE FLOW CHART



Appendix E

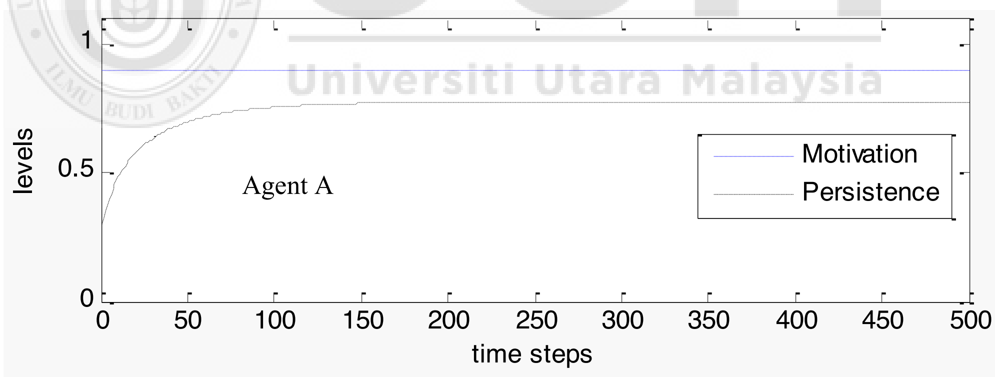
Further Simulation Results

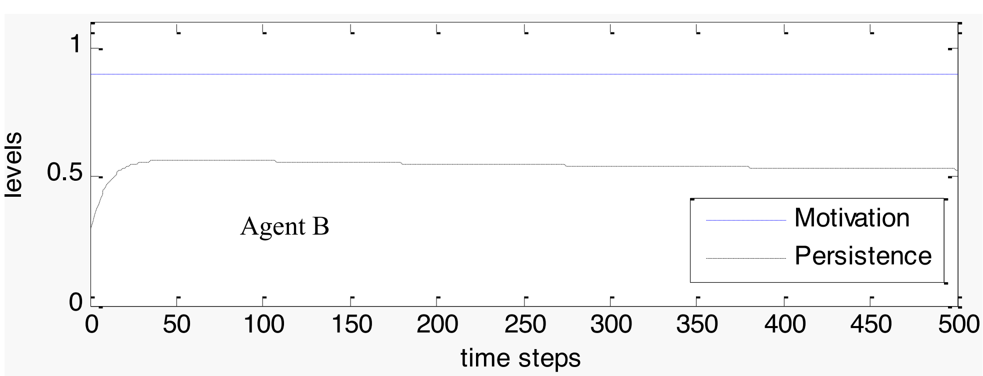
1) Simulation Results for Cognitive Agent Model

a) Motivation and Persistence

The simulation traces pertinent to motivation and persistence are presented based on different settings for two fictional agents as follows.

Exogenous factors	Initial settings	
	Agent A	Agent B
Tc	0.9	0.9
Tp	0.9	0.9
Pp	0.9	0.9
Tn	0.1	0.1
Pe	0.1	0.1
Pk	0.9	0.1
El	0.9	0.1
Rn	0.9	0.1



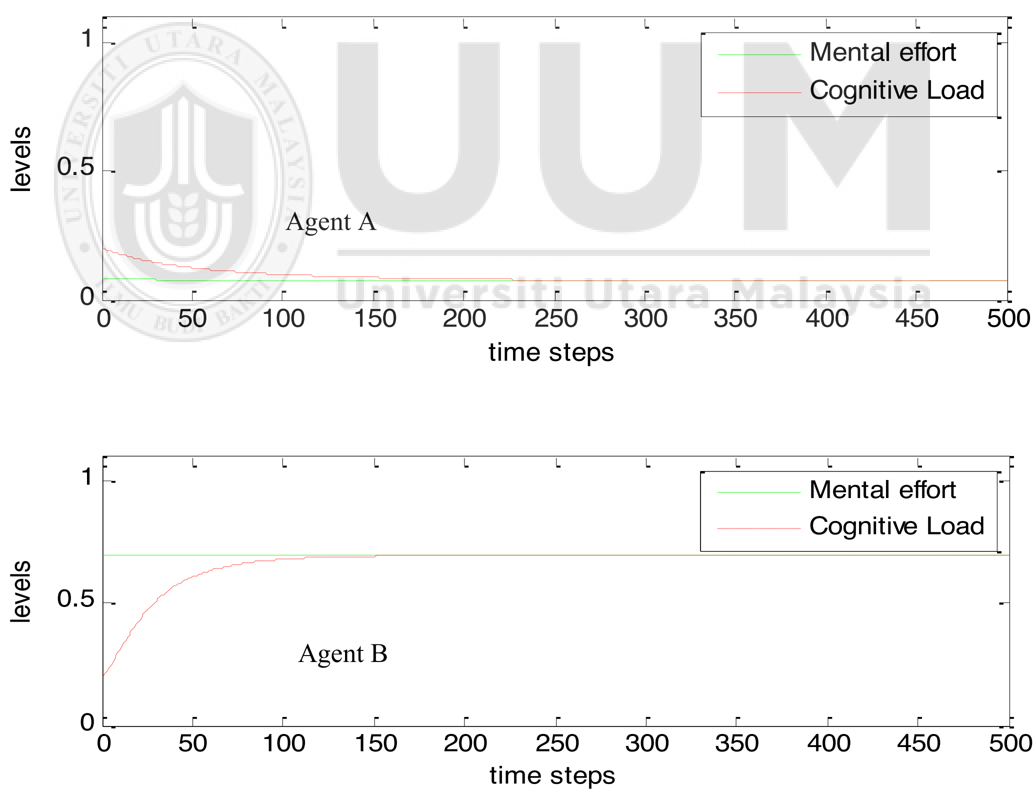


Simulation Results of Motivation and Persistence

b) Cognitive Load and Mental Effort

For simulating cognitive load and mental effort levels, simulation traces were generated based on different settings for two fictional agents as follows.

Exogenous factors	**Initial settings**	
	Agent A	**Agent B**
Tc	0.9	0.9
Tp	0.9	0.9
Pp	0.9	0.1
Tn	0.1	0.1
Pe	0.1	0.9
Pk	0.9	0.1
El	0.9	0.1
Rn	0.9	0.1

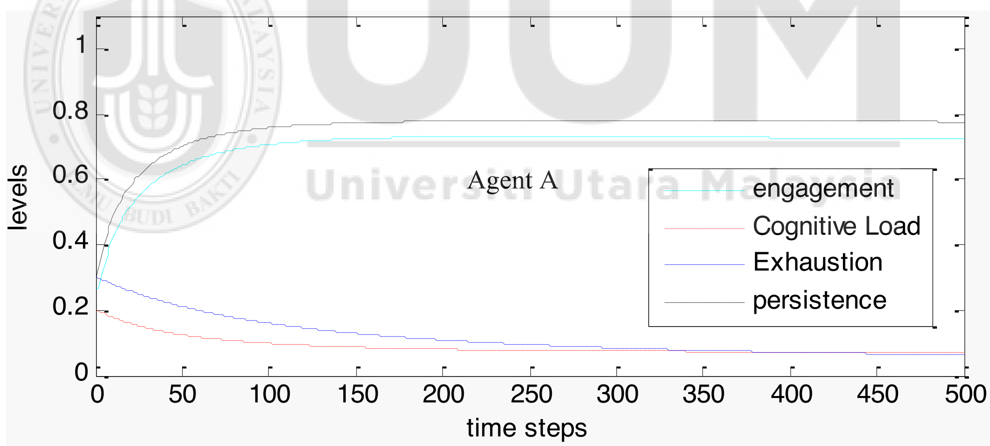


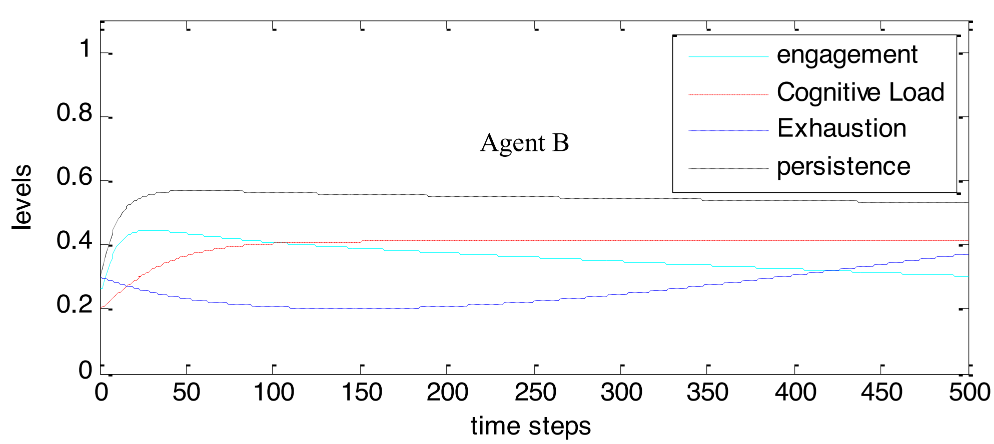
Simulation results of Cognitive Load and Mental Effort

c) Reader's Engagement

Engagement level during performing a reading task depends upon a persistence level. However, regardless of a reader being focused, a reader tends to disengage due to cognitive load and exhaustion effects. The results are depicted for two fictional agents as follows.

Exogenous factors	Initial settings	
	Agent A	**Agent B**
Tc	0.9	0.9
Tp	0.9	0.9
Pp	0.9	0.9
Tn	0.1	0.1
Pe	0.1	0.1
Pk	0.9	0.1
El	0.9	0.1
Rn	0.9	0.1



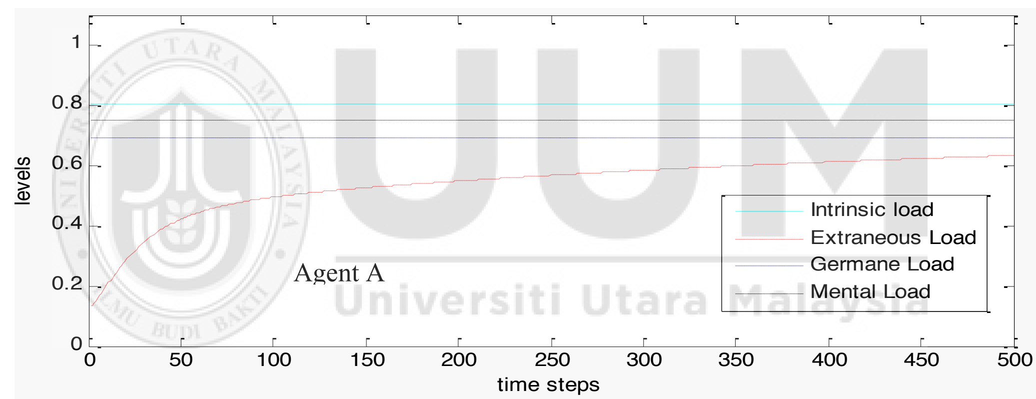


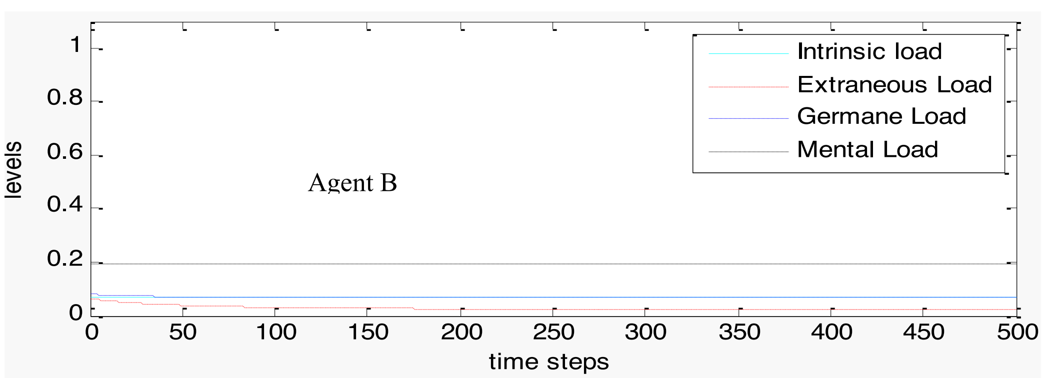
Simulation Results of Reading Engagement

d) Mental Load

Mental load was computed as the weighted sum of intrinsic load, extraneous load, and germane load. Two fictional agents were simulated as follows.

Exogenous factors	**Initial settings**	
	Agent A	**Agent B**
Tc	0.9	0.9
Tp	0.9	0.9
Pp	0.1	0.9
Tn	0.1	0.1
Pe	0.9	0.1
Pk	0.1	0.9
El	0.1	0.9
Rn	0.1	0.9



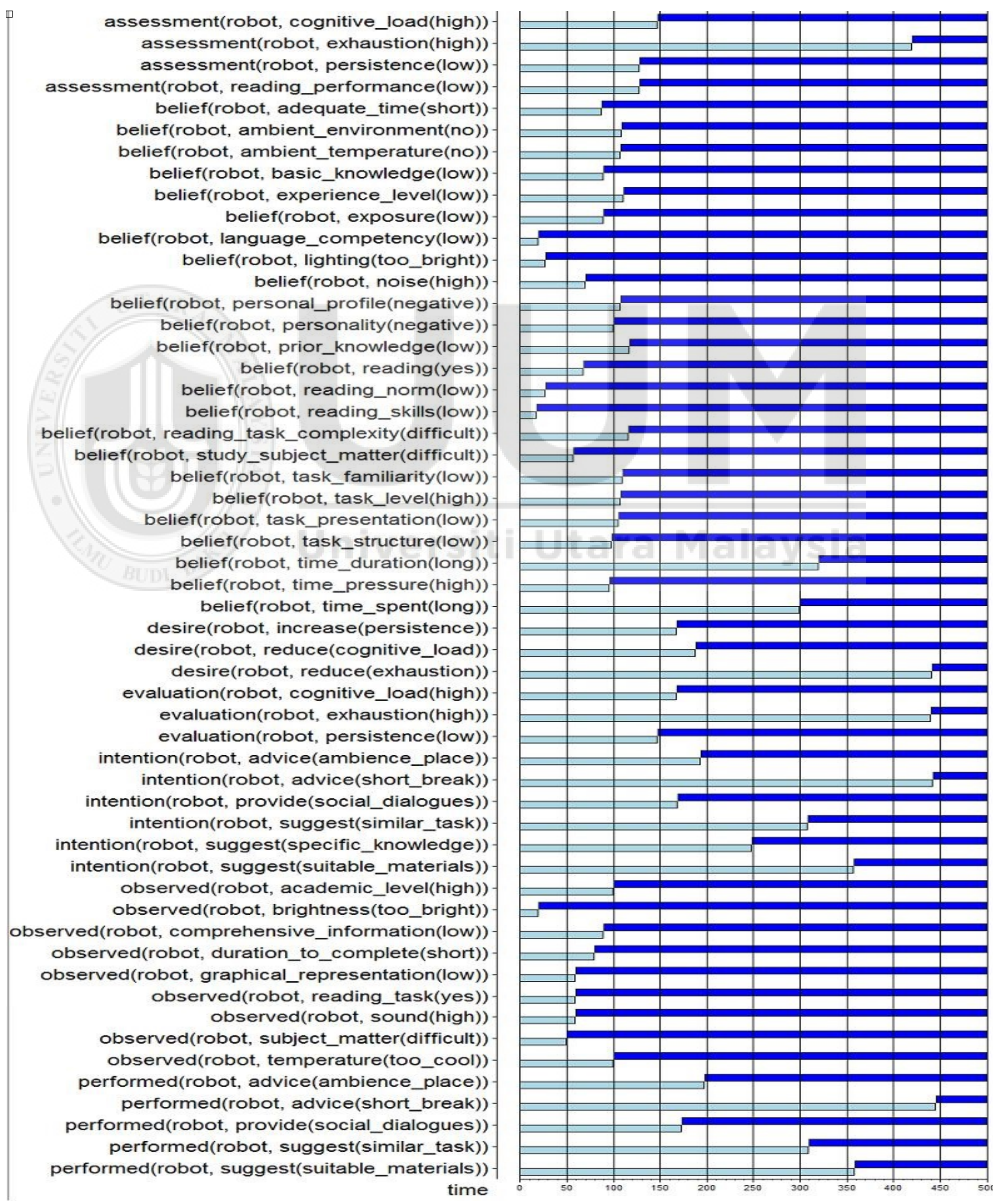


Simulation Results of Mental Load and Its precursors

2) Simulations for Ambient Agent Model

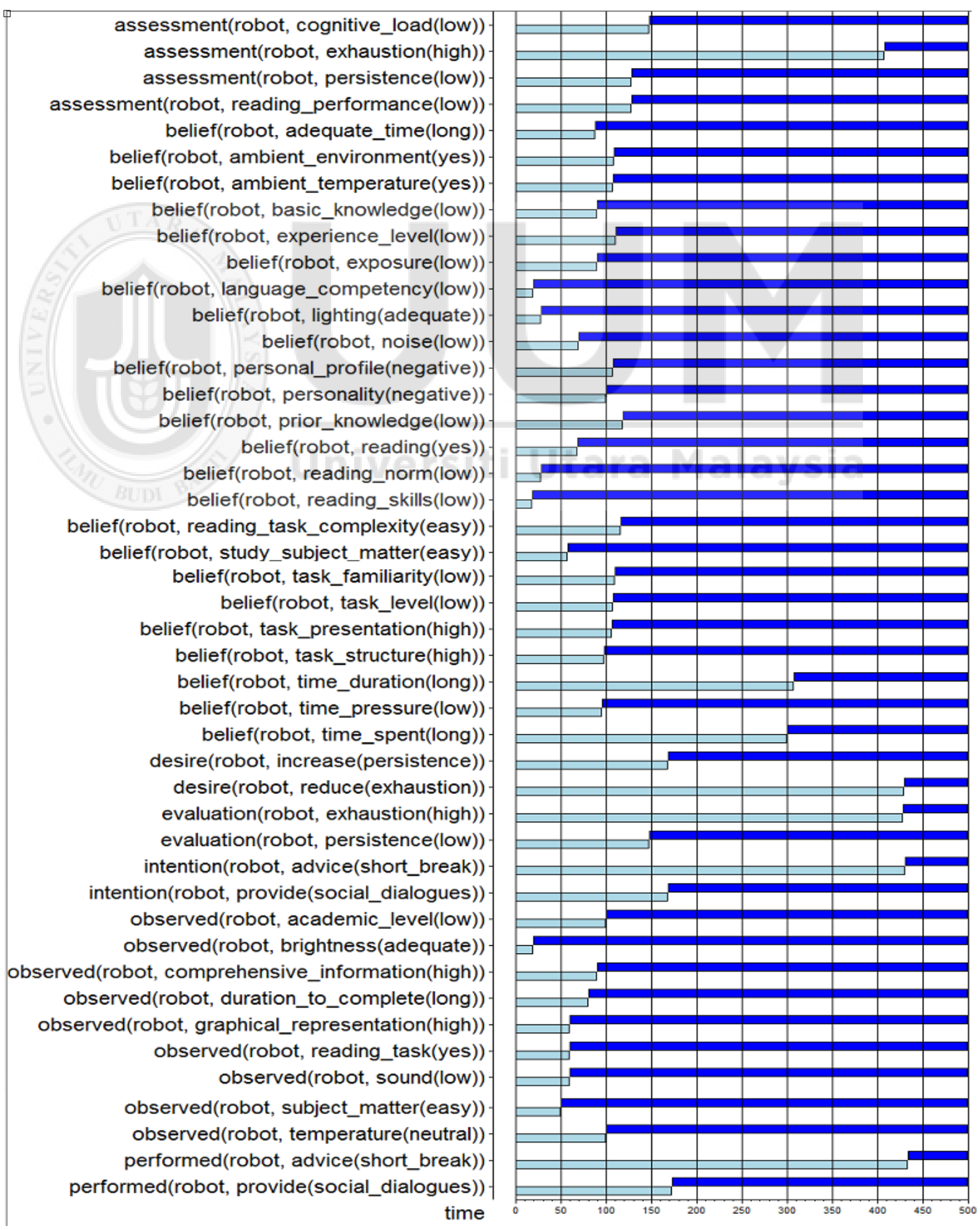
a) Demanding Task with Insufficient Reader's Resources.

In this simulation, the agent observes several conditions concerning reading task, such as; difficult subject meant for a higher academic level, distraction environment due to high level of sound, temperature, and brightness. Likewise, reading task is not presented with comprehensive and graphical information. A reader also has no enough knowledge and experience on the reading task. As a result, the agent will be able to assess reader's condition as time progresses and an appropriate action will be performed if all beliefs hold true. The detrimental conditions are high exhaustion, high cognitive load, low persistence, and low reading performance. The results are presented in the following figure.



b) Not Demanding Task with Insufficient Reader's Resources

If the agent observed that reading task has no impact on reader conditions where it was not difficult, meant for the right academic level, and presented with graphical and comprehensive information. The environment was not distraction as well. In addition, the agent believes that the reader is not skilled enough to perform the task. In this case, the agent will be able to assess three unwanted conditions through the time which are low persistence, high exhaustion, and low reading performance. With the time, the agent is able to tackle all the unwanted conditions as appropriate actions will be performed to each condition. The results are shown in the following figure.



Appendix F

Preliminary Study Questionnaire

Consent to participate in survey research of
"Designing a sociable robot to support reading process"

You are asked to participate in a research study conducted by Hayder Mohammed Ali, doctoral candidate, Azizi Ab Aziz, *Ph.D.*, and Rahayu Ahmad, *Ph.D.*, from School of Computing at Universiti Utara Malaysia (UUM). The result of this survey will be used as apart in the doctoral thesis of Hayder Mohammed Ali. You were selected as a possible participant in this study because you have indicated that you are ready to provide identical feedback which is extremely appreciated in designing sociable robot. You should read the provided information below, and ask questions about anything you don't understand before proceeding to participate. Your participation in this research is completely unpaid and you are free to decide whether to be in it or not.

- **PURPOSE OF THE STUDY**

The purpose of this study is to acquire further information on major problems people might encounter during reading process and what types of technologies are to be incorporated in providing aid for them. Based on the result, a personal robot will be designed to support people during reading.

- **CONFIDENTIALITY**

Any information that is obtained in connection with this survey and that can be identified with you will remain confidential and will be used only for research purpose.

- **IDENTIFICATION OF RESEARCHERS**

If you have any additional questions or concerns about this survey, please feel free and do not hesitate to contact:

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Hayder Mohammed Ali, (Graduate researcher)
College of Arts and Sciences/ School of Computing
Universiti Utara Malaysia
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SECTION A: DEMOGRAPHIC DETAILS

Please mark (√) in the appropriate place provided.

1. Please indicate your gender?
   ☐ Male ☐ Female
2. Which of the following age categories do you belong to?
   ☐ <15 ☐ 15 - 20 ☐ 21- 30 ☐ 31- 40 ☐ > 41
3. Please identify your highest educational level?
   ☐ Ph.D. ☐ Master ☐ Diploma ☐ Undergraduate/ degree
   ☐ Matriculation/STPM/A level ☐ Others, Please state…………………
4. Please, specify your nationality**?**
   ☐ Malaysian ☐ Non- Malaysian, Please state……………………………..

5. Monthly earning/ pocket money in ringgit Malaysia (**RM/MYR**)
☐ < 1000 ☐ 1000 -2000 ☐ 2001- 3000 ☐ 3001- 4000 ☐ > 4000
6. Living situation
☐ Living alone ☐ Living with housemate ☐ Living with spouse
☐ Living with children ☐ Living with roommate ☐ Living with other relatives

SECTION B: PERSONALITY MEASUREMENT

Here are a number of characteristics that may or may not apply to you. For example, do you agree that you are someone who likes to spend time with others? Please write a number next to each statement to indicate the extent to which you agree or disagree with that statement

Disagree Strongly	Disagree a little	Neither agree nor disagree	Agree a little	Agree strongly
1	2	3	4	5

I see Myself as Someone Who...

___1. Is talkative
___2. Tends to find fault with others
___3. Does a thorough job
___4. Is depressed, blue
___5. Is original, comes up with new ideas
___6. Is reserved
___7. Is helpful and unselfish with others
___8. Can be somewhat careless
___9. Is relaxed, handles stress well
___10. Is curious about many different things
___11. Is full of energy
___12. Starts quarrels with others
___13. Is a reliable worker
___14. Can be tense
___15. Is ingenious, a deep thinker
___16. Generates a lot of enthusiasm
___17. Has a forgiving nature
___18. Tends to be disorganized
___19. Worries a lot
___20. Has an active imagination
___21. Tends to be quiet
___22. Is generally trusting
___23. Tends to be lazy
___24. Is emotionally stable, not easily upset
___25. Is inventive
___26. Has an assertive personality
___27. Can be cold and aloof
___28. Perseveres until the task is finished
___29. Can be moody
___30. Values artistic, aesthetic experiences
___31. Is sometimes shy, inhibited
___32. Is considerate and kind to almost everyone
___33. Does things efficiently
___34. Remains calm in tense situations
___35. Prefers work that is routine
___36. Is outgoing, sociable
___37. Is sometimes rude to others
___38. Makes plans and follows through with them
___39. Gets nervous easily
___40. Likes to reflect, play with ideas
___41. Has few artistic interests
___42. Likes to cooperate with others
___43. Is easily distracted
___44. Is sophisticated in art, music, or literature

Please check: Did you write a number in front of each statement?

SECTION C: READING HABITS

1. **Instructions**: Please circle the number that best represents your opinion to the following questions below

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

1.	Reading is very important in your daily life	1	2	3	4	5	6	7
2.	I prefer to read digital materials (screen-based)	1	2	3	4	5	6	7
3.	I prefer to read printed materials (Paper-based)	1	2	3	4	5	6	7
4.	Reading with your companions/ friends is better than reading alone	1	2	3	4	5	6	7

5.	It's easy for me to get distracted/ lose concentration during reading process	1	2	3	4	5	6	7
6.	Short rest/ pause after long duration of reading will help me to stay focus	1	2	3	4	5	6	7
7.	Reading for a very long duration causes me fatigue such as eye strain and backache.	1	2	3	4	5	6	7
8.	Reading for a very long duration causes me mental exhaustion such as lack of focus and tiredness	1	2	3	4	5	6	7

Please mark (√) in the appropriate place provided.

2. If you live with another person(s), do they support your efforts to read any materials?

☐ Yes
☐ No

If yes, please proceed with question 3

3. What kinds of support do they normally provide to you? **(***You can choose more than one***)**

☐ Encouraging words to keep you reading
☐ Sharing conversations about what you are reading
☐ Provide refreshments to you
☐ Don't make noise to let you focus
☐ Others, please state…………………………………………………

4. Do you have a person(s) who will support you when you are reading something?

☐ Yes
☐ No

If yes, please proceed with question 5

5. What kinds of support do they normally provide to you? **(***You can choose more than one***)**

☐ Encouraging words to keep me reading
☐ Sharing conversations about what you are reading
☐ Provide refreshments to me
☐ Don't make noise to let me focus
☐ Others please state……………………………………………………..

6. What type of reading techniques do you most apply during reading? (*you can choose more than one)*

☐ Skimming (*confirm the general idea of the text*)
☐ Scanning (*seeking for specific piece of information*)
☐ Close reading (*paying very close attention / complete searching*)

7. What type of reading materials you usually prefer to read during reading process? (You *can choose more than one*)

☐ Newspapers
☐ Magazines
☐ Novel/ Story book
☐ Textbook/ Journal
☐ Comics
☐ Websites
☐ Others, please state……………………………………………

8. Where do you normally read? (*you can choose more than one*)

☐ At the library
☐ At the table

☐ At school
☐ At other homes
☐ On the bed
☐ In the living room
☐ In front of the TV or computer
☐ Public place (*e.g. airport, bus/train station*)
☐ Coffee shop/ Restaurant
☐ Anywhere I can
☐ Others, please state…………………………………..

9. When you read, how much time do you spend reading?

☐ About 15 minutes
☐ About half an hour
☐ About an hour
☐ More than an hour

10. How often do you read something?

☐ 1-2 times a week
☐ 2-3 times a week
☐ 4-5 times a week
☐ Every day
☐ Others, please state……………………………………………..

11. If you are losing concentration during reading, what are the reasons do you think that cause the problem? (*You can choose more than one*)

☐ Drowsiness
☐ Prior commitment (*e.g. appointment, scheduled activities*)
☐ Difficult to understand
☐ Tiredness
☐ Noise
☐ Bored
☐ Stress
☐ Hungry
☐ Others, please state ……………………………………………

12. If you are given a digital device for reading, what device will you use during reading process? (*you can choose more than one*)

☐ E-book readers (*e.g. Amazon kindle*)
☐ Tablet
☐ Desktop
☐ Laptop
☐ Smart phone
☐ Others, please state ……………………………………………..

13. What make you prefer digital devices during reading process (*you can choose more than one)*

☐ Zoom in and Zoom out
☐ Highlighting particular text
☐ Easy to copy and paste
☐ Very fast in searching
☐ Multimedia (*interactive*)
☐ Portability
☐ Annotation (*make notes*)
☐ Others, please state……………………………………

SECTION D: PERSONAL ROBOTS

Introduction: Personal robots are robotic technologies that have been developed to engage/ interact with people and also to partake in people's daily lives in rich and rewarding ways to help them live healthier lives, connect with others and learn well.

Please mark (√) in the appropriate place provided.

1. Based on the photos above, what image of personal robots do you have?

☐ Good (It is good for helping human)
☐ Bad (It constitutes danger and replaces man)
☐ Neutral (It depends on what is done with it)

2. Do you have any personal experiences with personal robots?

☐ Yes
☐ No
☐ Uncertain

3. How do you prefer the embodiment/presentation of your personal robot?

☐ Physical embodiment
☐ Virtual embodiment (on the screen/ avatar)
☐ Uncertain

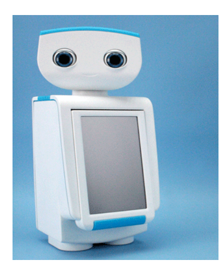
4. How do you prefer your personal robot to look like?

☐ Human-like
☐ Machine- like
☐ Animal- like
☐ Uncertain

Vignette:
AUTOM is a personal robot (coach robot for weight loss) that has been developed to professionally interact/ engage with people to keep track their losing weight progress. It became an integral part in their daily lives.

Some of Autom's features:

1. It possesses expressive, blue eyes that even offer up the occasional wink
2. It is able to motivate its users to continue their diet program
3. It is able to remind its users to eat healthy
4. It has short conversation to communicate with its users (No two conversations are alike)
5. It is able to adapt with its users' needs and daily activities



AUTOM

5. Based on the concepts above, please circle the number that best represents your opinion about designing a personal robot that can help you during reading?

Strongly Disagree	1	2	3	4	5	6	7	Strongly Agree

1.	I like the idea of having a personal robot that can support me during reading	1	2	3	4	5	6	7
2.	I can afford to have a personal robot at home	1	2	3	4	5	6	7
3.	Personal robot can encourage/motivate me during reading	1	2	3	4	5	6	7
4.	Personal robot can help me to reduce my fatigue such as backache and eye strain during reading	1	2	3	4	5	6	7
5.	Personal robot can help me to reduce my mental exhaustion such lack of focus and tiredness during reading	1	2	3	4	5	6	7

6. If one of these objects will be represented as a personal robot to assist your reading process, kindly, circle the priority for each object**?**

1. Table lamp	LOWEST PRIORITY	1	2	3	4	5	HIGHEST PRIORITY
2. Mug/ Cup	LOWEST PRIORITY	1	2	3	4	5	HIGHEST PRIORITY
3. Pen holder	LOWEST PRIORITY	1	2	3	4	5	HIGHEST PRIORITY
4. Table fan	LOWEST PRIORITY	1	2	3	4	5	HIGHEST PRIORITY
5. Clock	LOWEST PRIORITY	1	2	3	4	5	HIGHEST PRIORITY

Please check: No two objects can have the same priority.

7. If there is a personal robot to assist/ accompany you during reading, what is the function the robot should do? (*You can choose more than one*)

- ☐ Remind me to take a break
- ☐ To control the intensity of light
- ☐ Motivate me for reading
- ☐ Play music
- ☐ Short conversation
- ☐ Others, please state what other functions you might think that robot should do?

8. What are the qualities you prefer to be added to the personal robot that can assist you during reading? (*You can choose more than one*)

- ☐ Intelligence (*the capacity for knowing your needs*)
- ☐ Empathy (*the capacity for recognizing your feeling*)
- ☐ Rationality (*the capacity for reasoning and respond logically towards you)*
- ☐ Reliability *(the capacity of robot to be trusted by you)*
- ☐ Others, Please state ……………………………………………..

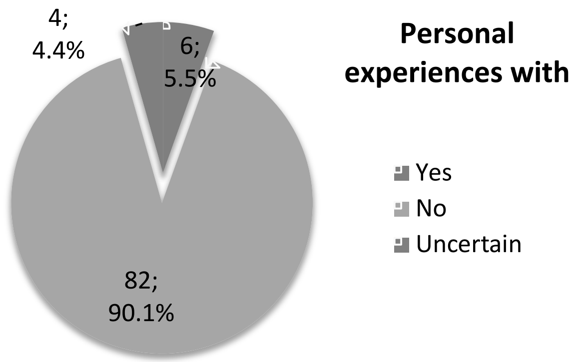
Appendix G

Survey Results

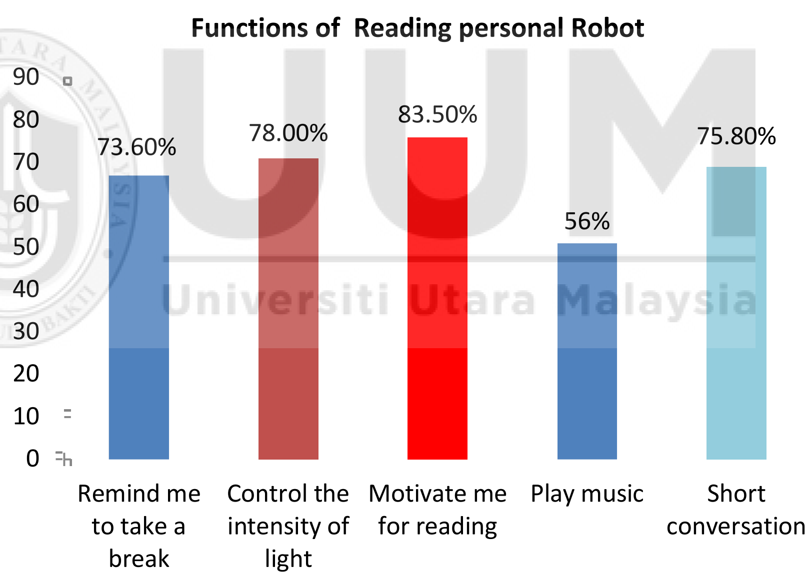
Overview of Demographic Information

	Frequency	Valid %
Respondent's Gender		
Male	44	48.4
Female	47	51.6
Total	91	100.0
Respondent's Age		
15 – 20	4	4.4
21- 30	69	75.8
31- 40	11	12.1
> 40	7	7.7
Total	91	100.0
Respondent's Living situation		
Living alone	17	18.7
Living with housemate	2	2.2
Living with spouse	7	7.7
Living with children	2	2.2
Living with roommate	57	62.6
Living with other relatives	6	6.6
Total	91	100.0
Respondent's Monthly income		
< 1000	53	58.2
1000 -2000	16	17.6
2001- 3000	15	16.5
3001- 4000	3	3.3
> 4000	4	4.4
Total	91	100.0
Respondent's level of education		
Ph.D.	10	11.0
Master	39	42.9
Diploma	1	1.1
Undergraduate/ degree	33	36.3
Matriculation/STPM/A level	8	8.8
Total	91	100.0
Respondent's Nationality		
Malaysian	62	68.1
Non- Malaysian	29	31.9
Total	91	100.0

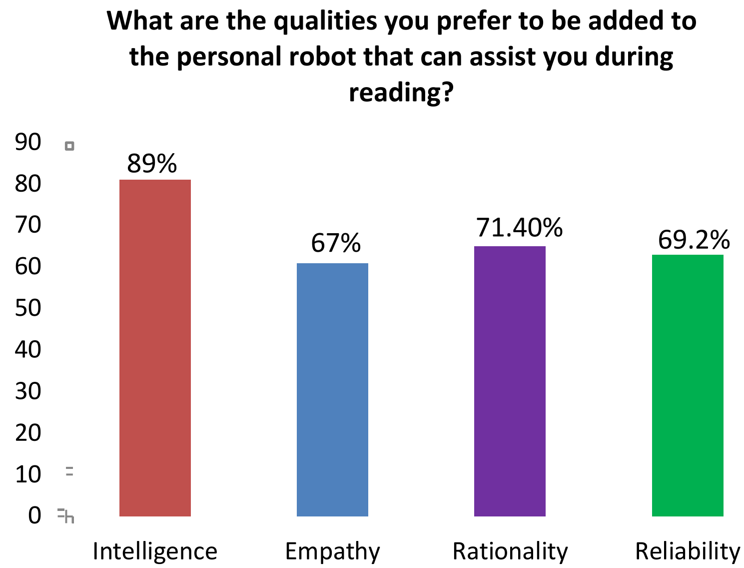
- Readers' personal experiences towards using personal robots were surveyed and revealed that 90.1 percent of the respondents got no experiences with robot.



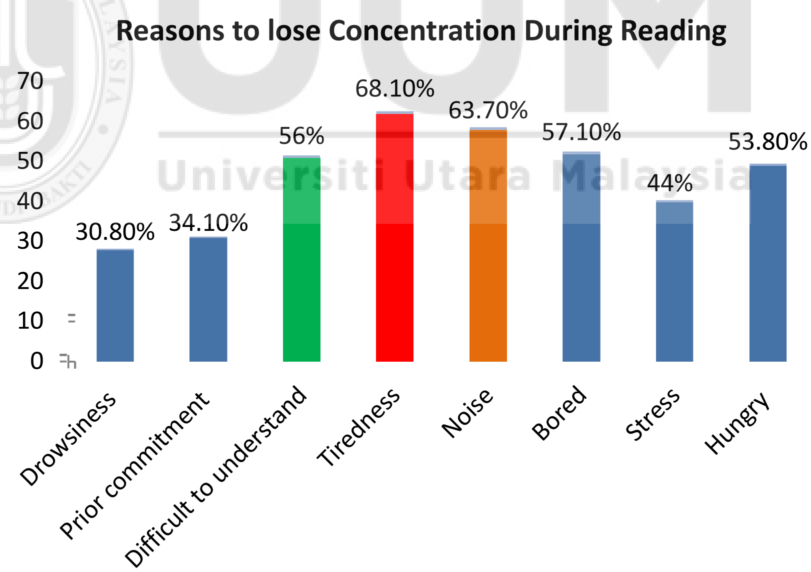
- Apart from determining what object is preferred to be represented as a robot, readers determined what functions they wish the robot has and the result is as follows:



- Respondents specified the qualities they wish the robot should have. Respondents prefer the robot to have some qualities such as *intelligence* (the capacity for knowing your needs), *empathy* (the capacity for recognizing your feeling), *rationality* (the capacity for reasoning and respond logically towards you), and *reliability* (the capacity of robot to be trusted by you). The result is shown as follows.



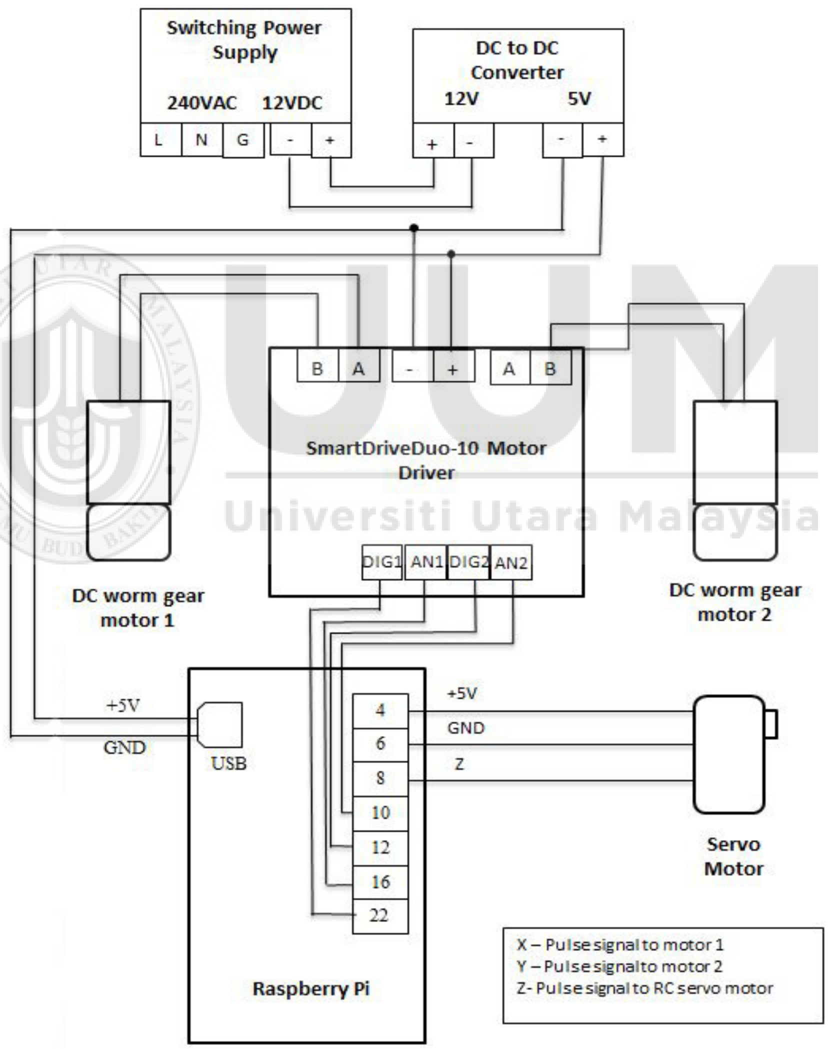
- Respondents were highlighted the reasons that have major impacts on reading. The results were shown as follows.



Appendix H
Hardware Components Specifications

- **Electronic Circuit Design**

The electronic circuit diagram for all the hardware components was made. This circuit visualized how robot's electronic components can be powered from any typical power source with 220/240V AC using a switching power supply and a DC- to- DC converter.



Electronic Circuit Diagram for IQRA'

First, the switching power supply converts 240V (AC current) to 12V (DC current). Next, the 12VDC-to-5VDC converter is used to power the Raspberry Pi and the motor driver (SmartDriveDuo-10) with 5V. Furthermore, Raspberry Pi powers the servo motor (using General-Purpose Input/Output (GPIO) pin 4 / GPIO4) while the motor driver powers the other two DC motors. It is interesting to mention that the Raspberry Pi microprocessor controls the direction (Cartesian coordinates) of the DC motors (DIG1 and DIG2) using GPIO12 and GPIO22 by sending analogue signals (AN1 and AN2) via GPIO10 and GPIO16. Also, it controls the servo direction by sending a PWM (Pulse Width Modulation) signal using GPIO8.

- **Physical Driver Components**

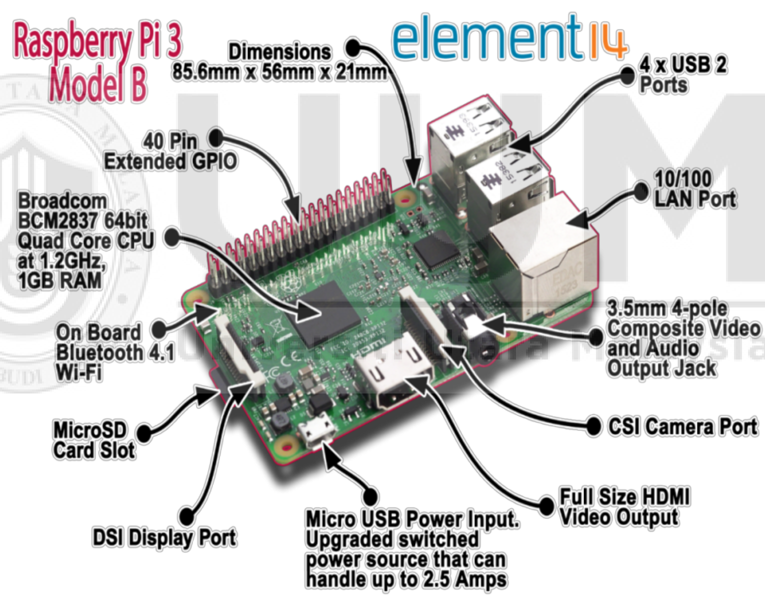
IQRA' was designed to support four-degrees-of freedom (4DOF). The first 2-DOF allows the robot head to rotate from left to right directions (within 55 to 130 degrees). Another 2-DOF permits the entire body (robot's arms) to move forward and backward direction (to allow changes in social space interaction within the range of 0-30 degrees). Although the maximum rotational degrees of servo motors are between 0-180 degrees, the 55 to 130 degrees range have been chosen as the results from extensive experiments to determine the optimal positions for the robotic head. Moreover, it is more realistic to mimic a maximum rotational position of a human neck as a basis for subtle social human-robot interaction to take place. In addition to the motors movements, the interface of the robot (the head-mounted Android mobile phone) has an interactive animated character to give a sense of a living and sociable object (animacy).

- **Robot Microcontrollers**

This section explains the essential micro-electronic devices that are used to construct IQRA'. There are three different devices, namely; Raspberry Pi, Android mobile phone, and Smart Motor Drive were used to control the entire behaviours of the robot. The detailed descriptions of these devices are explained as follows.

I. Raspberry Pi

The huge advancement in electronic devices make it easily for developers to get palm size and low-cost electronic boards, like Raspberry Pi microcontroller that carry extraordinary capabilities like a normal personal computer processor. The figure below shows the Raspberry Pi design and its physical components. Due to its versatility and costs, Raspberry Pi is selected as a platform to control the movement of the robot. IQRA' utilizes the Raspberry Pi 3 Model B -version 1.2 as a microcontroller platform and was purchased online via https://www.element14.com website.

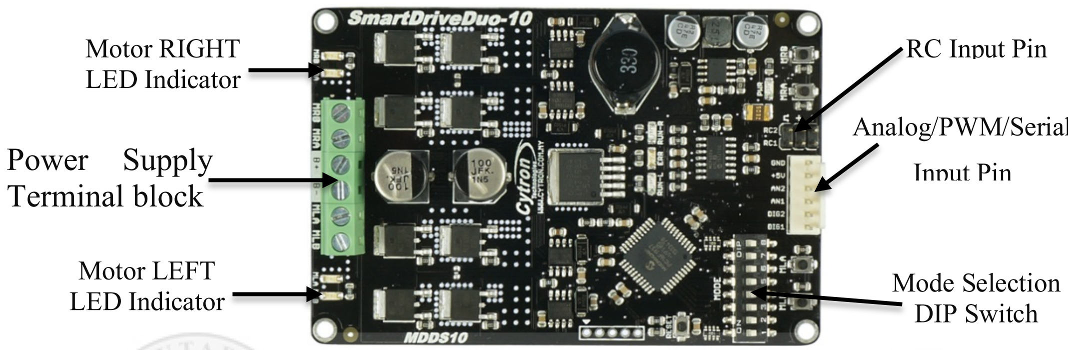


Physical Components of Raspberry Pi (from https://www.element1 4.com website)

The detailed explanations of Raspberry Pi variants and its capabilities can be obtained in Upton and Halfacree (2014).

II. SmartDriveDuo10

As Raspberry Pi is limited only to handle up to 5V, and any overloading current can cause damage or burn itself, the smart motor driver dual channels is needed to allow extra voltage for certain drivers. In this study, the SmartDriveDuo10 is preferred as an additional device to power robot’s DC motors. This component is designed to drive a medium power brushed DC motor with a maximum current capacity up to 30A peak (few seconds) and 10A continuously. Primarily, this driver is designed specially to control a differential-drive mobile robot. The following figure depicts the SmartDriveDuo10 motor driver.



Motor Driver SmartDriveDuo10 (from https://www.cytron.io website)

This motor driver was purchased online from https://www.cytron.io. The detailed specifications (including user manual) for SmartDriveDuo10 motor driver can be found from the mentioned website.

III. Android Phone

The Android-based smartphone was chosen to serve as a robotic face and its main computational unit due to the versatility and robustness to process real time data from Raspberry Pi microcontroller. Moreover, this decision was made due to its popularity, low developmental cost, open source platform and its rich hardware and Java platform support. In fact, an Android platform requires low development costs due to no licensing fees or expensive development tools are needed. Given the extensive set of Java libraries supported by Android OS and its comprehensive Software Development Kit (SDK), it facilitates any Java developers to create or extend the application even with a little bit Android experiences.

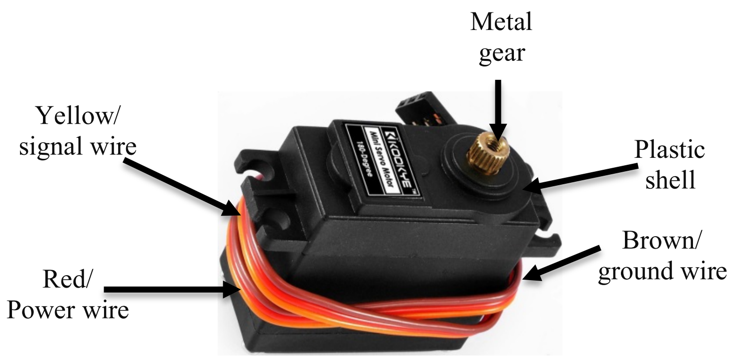
Once an Android OS based smartphone is chosen, the next step is to select the model in implementing the robotic tasks. For this purpose, a model name ASUS ME172 V 4.1.1 is selected due to the screen size, weight, and its resolution to display vibrant animations. This ability is needed to transform the phone into a believable mediated friendly character.

ASUS ME172V 4.1.1

Besides that, the ASUS phone is reasonable choice due to its lightweight design and maximum load of the motor carrying capacity for stall torque conditions.

- **Servo and DC Motors**

Within robotic hardware components, both servo and DC motors are considered as the main components for the robotic development. For example, the servo motor is used to manipulate the robot head movement for realistic and subtle human-robot interactions. Therefore, to fulfil this requirement, a high torque RC servo motor with straight mounting that capable to perform 180 degrees rotation is chosen. The key reason to use this servo motor for IQRA' is because of it is affordable, capable to support high torque, and can be communicated with the Raspberry Pi microcontroller. The selected servo motor that controls left/right movement of IQRA' robotic head is depicted as follows.



Similarly, two DC "Dual shaft self-locking DC worm gear motor" motors powered by Raspberry Pi are used to control the physical robot movement during the interaction. The figure below shows the type of a DC motor that was used in the robot's construction process.

Robot's DC Motor

- **Technical specifications** for both servo and DC motors as well as circuitry design related to the switching power supply, and DC- to- DC converter are detailed out as follows.

SmartDriveDuo-10 Motor Driver Specifications:

- Input Voltage (Motor): 7 - 35VDC
- Single power operation
- Dual Channels, means it can drive two brushes motor independently, or mixed.
- Operating modes: RC (RC servo signal), Analog, PWM, simplified and packetized UART.
- Two manual/test buttons for each channel.
- Two output indicator LEDs for each channel.

Dual shaft self-locking DC worm gear motor Specifications:

- Rated Voltage: 12V.
- No load speed: 16 RPM
- Power Supply: Regulated DC power supply

High Torque RC Servo Motor with Straight Mounting

- Max rotating angle: 180°
- Operating torque: 15Kg.cm at 6.0V; 16Kg.cm at 7.4V
- Operating speed: 0.16sec/60° at 6v; 0.14sec/60°at7.4v
- Idle running current: <500m

Switching Power Supply 240V to 12V

- Size: 15.8 x 9.7 x 4.2cm
- Input Voltage: 100~120V AC, 200~240V AC (Preset 220V)
- Output Voltage: 12V DC
- Output Current: 0~10.0A
- Shell Material: Metal case / Aluminum base
- Protection: Shortage Protection, Overload Protection, Over Voltage Protection

DC to DC Converter

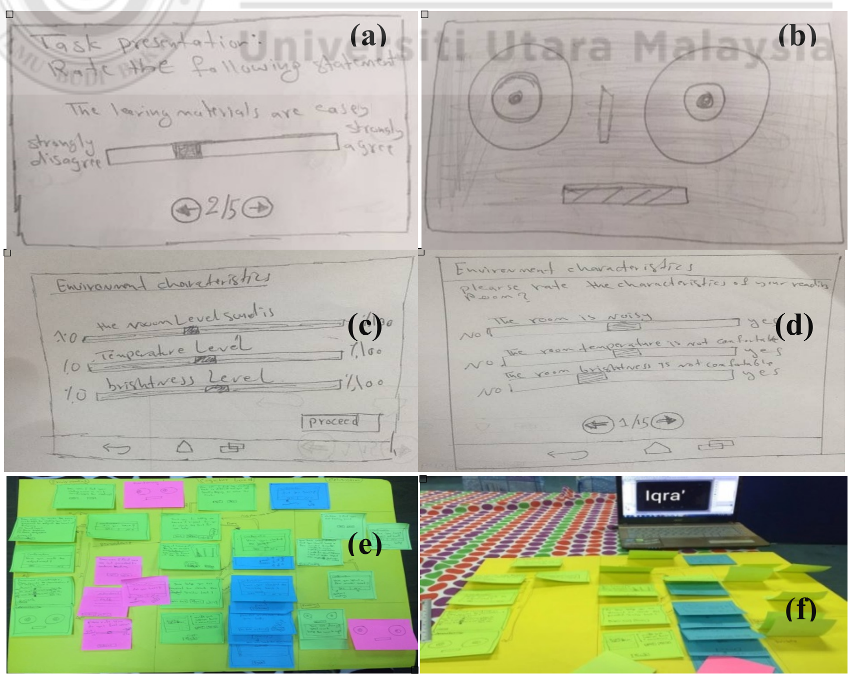
- Input: DC 8-20V, (12V changes to 5V)
- Output: DC 5V, 3A, 15W.
- Size: 46mm X 27mm X 14mm.
- Synchronous rectification, the conversion rate is ≥96%, very low heat.
- With overload/over-current/over temperature/short circuit protection and it can work in normal condition when restored.
- All epoxy sealed containers with Waterproof Housing.
- Compact design, high efficiency, easy installation and use.

Appendix I

Low and High-Fidelity Prototypes

Low-Fidelity Prototype (Lo-Fi)

Basically, the low fidelity (paper prototyping) provides a limited functionality and restricted amount of interaction. It helps to generate various design alternatives for fast and crude prototype development manners to demonstrate the basic system functionalities. In other words, it visualizes the fundamental design ideas at the beginning of the design process. The outcome from this process is a conceptual prototype which is simple, cost saving, and fast (Sefelin, Tscheligi, & Giller, 2003). In this study, all the system interfaces were sketched on papers to get better understanding and design alternatives prior to the real working prototype deployment. Following figure shows some results from the Lo-Fi prototyping stage.

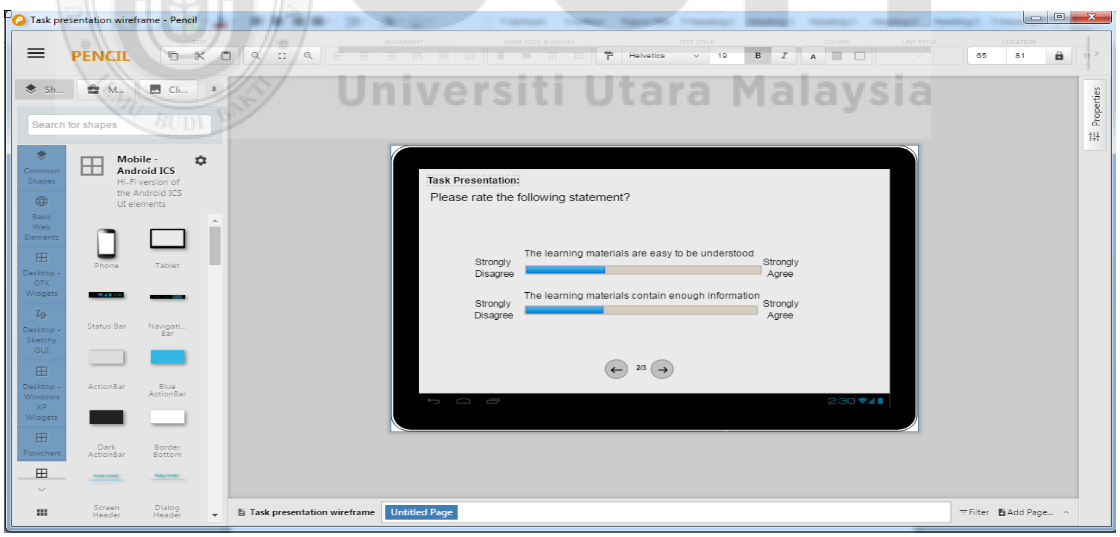


Low Fidelity Prototypes

The examples of the paper-based prototyping design (Lo-Fi) related to the robotic interfaces are; a) the animated face of the robot in (b), and the slider bar designs for the input processes (a, c, and d). Correspondingly, the whole Lo-Fi results for the human-robot interfaces are shown in (e) and (f). Next, all the obtained conceptual designs from this this stage provide an underlying construct for software developmental process (High-Fidelity prototyping) as described in the next section.

High-Fidelity Prototype (Hi-Fi)

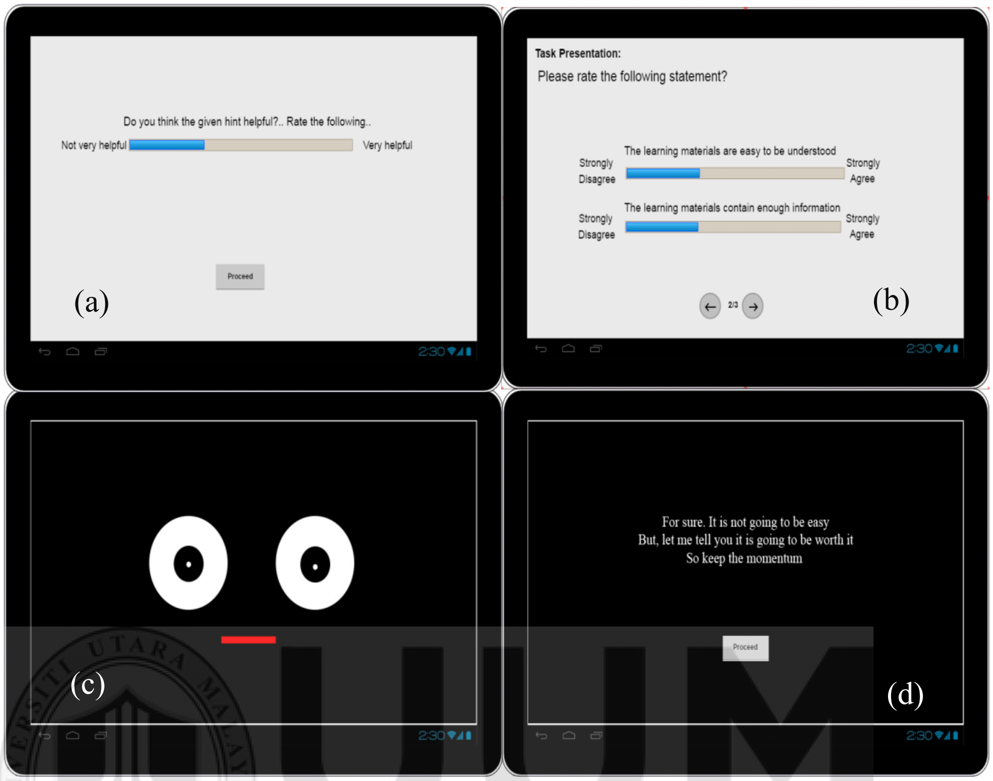
The High- Fidelity prototype (high fidelity wireframe) aims to visualize the final design of the user interface with all system functionalities. The Hi-Fi prototype has a higher degree of realism and it is always considered identical to the final product (Walker et al., 2002; Tsai & Yang, 2017). Moreover, the Hi-Fi prototype enables application developers to test entire system (e.g., the flow of the system) prior to the real /final development stage.



Pencil Developmental Platform Software

As such, once the Lo-Fi prototype for the robot interfaces has been completed, the Hi-Fi prototype is developed by using an open-source wireframe tool called Pencil.

Consequently, a few examples from the high-fidelity stage are depicted as follows.



High Fidelity Prototypes

The figure shows the Hi-Fi design output of a slider bar to capture user's confirmation for provided support (as in a), and user's inputs for robot's computational derived beliefs about the task presentation (as in (b)). Also, both screenshots in (c) and (d) depict the robotic believable interface and motivational spoken text on screen respectively.

Appendix J

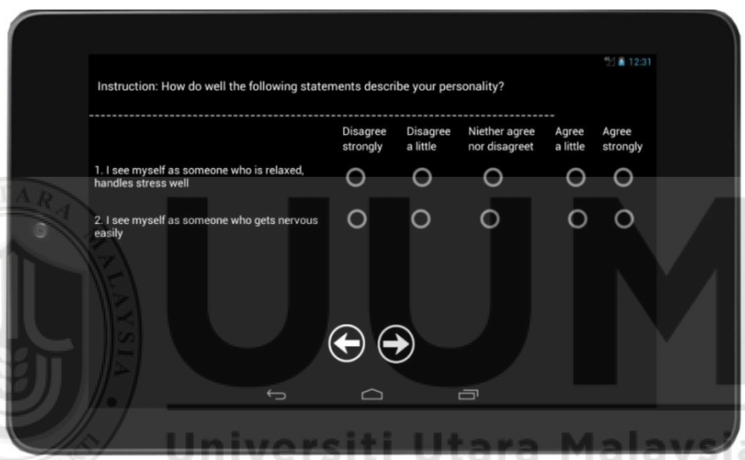
Robot User Interface

Robot's Observation Interfaces:

Initially, the reading companion robot collects individual data (data acquisition). Towards this end, the robot will show different screens asking the users to answer several questions related to its observation. Next, users will key-in their answers using enabled touch slider where the user has to select the slider based on a range between 0 and 100. The followings are examples of the robot interfaces for data acquisition.

Robot Data acquisition

Furthermore, the personality of the user was collected following the Big-Five inventory where two questions were used to measure neuroticism. Not here, personality in this work refers to general concept of positive or negative personality where neurotic person was determined as a person with negative personality (represented as 0) while a person with any of the other four personalities (openness, extroversion, introversion, conscientiousness) was determined with positive personality (represented as 1). As such, the interface to measure the personality of the reader was as follows:



The value from the interface was calculated as follows. First, the answer from the question one was reversed as explained in the descriptions of Big Five Inventory scoring (i.e., if a reader selected *agree strongly* which represents 5, then the value must be reversed to be 1 and vice versa). Later, the following formula was used to measure the derived belief for personal profile.

$$Normalize\_Q_j = N_i / N_{maxi}$$

$$Neu\_score = \sum Normalize\_Q_j / 2 \text{ Then,}$$

$$Personal\_profile = 1 - Neu\_score$$

For example, if a reader's answers for question one is *disagree strongly* (1) and for question two is a*gree strongly* (5), the personal profile value was computed as follows:

Reverse ***Disagree strongly*** to 5. Then,

$$Normalize\_Q_1 = 5/5 = 1 \text{ And,}$$

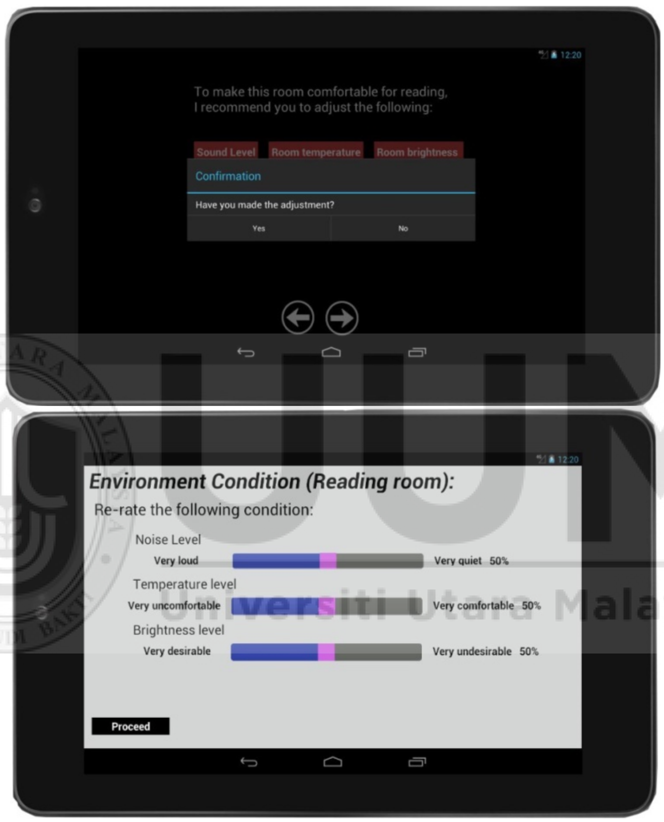
$Normalize\_Q_2 = 5/5 = 1$

$Neu\_score = 1+1/2 = 1$, this leads to:

$Personal\_profile = 1-1 = 0$,

It means the personality of the reader is negative.

Robot's Discrepancy Evaluation Interface



A screen showing spoken evaluation dialogue printed to screen

Robot's supports actions Interface