



Effectiveness of Persona with Personality on Conceptual Design and Requirements

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Statement of Candidate

I certify that the work in this thesis entitled “Effectiveness of Persona with Personality on Conceptual Design and Requirements” has not previously been submitted for a degree nor has it been submitted as part of requirements for a degree to any other university or institution other than Macquarie University.

The thesis is an original piece of research and it has been written by me.

Any help and assistance that I have received in my research work and the preparation of the thesis itself have been appropriately acknowledged.

All the information sources and literature used are indicated in the thesis.

The research presented in this thesis was approved by Macquarie University Ethics Review Committee, reference number: 5201300553. The application was initially approved on Wed, Aug 14, 2013 at 8:28 AM. The first amendment was approved on Tue, 11 February 2014 at 12:27 PM. The second minor amendment was approved on Tue, Sep 23, 2014 at 10:49 AM. The third minor amendment was approved on Wed, Nov 19, 2014 at 4:46 PM. Transcripts of the approved emails are in Appendix N.

Farshid Anvari - 41451449

Russell Lea, 3rd of May 2016

Dedication

I dedicate this thesis to Minh-Hien. She has been my source of encouragement and everything else.

I remember my Mama and Baba who nurtured me. Wherever they are I hope they can see, guide and assist me.

Abstract

The design of software application is a multistage creative process. User Centred Design (UCD) is a methodology used to develop applications that consider the goals of the users as a primary requirement. UCD methodologies have been increasingly used during the past decade to develop software applications and products that are tailored to the needs of individuals and allow for human computer interactions on emotional and psychological levels. Users' tasks of consuming the information from an application or web browser are cognitively demanding. UCD designers and developers need to have special abilities, training and tools to design products that meet the demands of users. A persona, an archetypical user, is a representative of a class of end users of an application. Personas are used to facilitate the design of applications by focusing on target users and to communicate with stakeholders. Personas may take various forms: personas, mash-up personas, incomplete personas and unspoken personas. Different techniques have been used to author personas with alternative media and varying information content. However, personas do not take into consideration that personality affects the way users interact with a product or service. This thesis introduces Holistic Persona, a persona with five dimensions: factual, personality, knowledge, intelligence and cognitive process.

In this thesis influence of the personality of the Holistic Persona on perceived system requirements is empirically explored. The conceptual design prepared by participants from three studies, two studies in Australia and one study in Denmark, is presented. The participants were presented with four personas that were similar in all aspects except they had two factors of their personalities varied: extravert and emotionally stable, extravert and emotionally unstable, introvert and emotionally stable, introvert and emotionally unstable. The Holistic Personas also had one common health issue (over-weight) and three other minor memory issues. The participants collectively rated persona's personality, and prepared a conceptual design to assist the Holistic Persona (91 participants completed 218 design artefacts). In addition, the participants completed questionnaires about their demographics and personalities and took part in a spatial ability test.

The results indicate that the participants were able to identify the personality traits of the Holistic Personas and their ratings of the personalities match closely with the intended personalities.

The participants' design artefacts reflected views and priorities of system requirements and were influenced by the personality of the provided personas; for an introverted and

emotionally unstable personality, inclusion of a confidence builder and socializer features had a higher priority compared with the identified requirements for an extravert and emotionally stable personality. Overall participants identified 12 core requirements including requirements to reduce weight, increase fitness and assistance with memory issues. The majority of participants, who completed design and post design questionnaire, stated that their designs were tailored to meet the needs of the given personas' personality traits. The findings support that persona with personality traits can aid software engineers to produce requirements and conceptual designs tailored to the needs of specific personalities. Hence Holistic Personas can help participants to take into account personality traits in the conceptual design process.

This thesis also explores the effectiveness of the use of Holistic Personas for teaching conceptual design to Software Engineering students to allow them to deliver a useful product, particularly when access to real users is limited. In addition this thesis presents novel techniques to identify talented aspiring designers in use of persona with personality within UCD methodologies. Thirty-three participants, twenty-three of whom were undergraduate students, studying at Macquarie University, completed a spatial ability test, answered personality trait questionnaires and performed a design activity. The results indicate that participants who score high in the imagination personality factor and spatial ability tests are talented aspiring UCD designers. The implication of the study is that talented students who can design using UCD methodologies can be identified early in their studies and they can benefit by receiving advanced training. Likewise the less talented students can be given extra tutoring as abilities are not immutable and, interest and persistence is important in achieving expertise.

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List of publications – related to the thesis

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- Anvari, F. and Tran, H. M. T. (2013) Persona ontology for user centred design professionals. In *Proceedings of the ICIME 4th International Conference on Information Management and Evaluation*, Ho Chi Minh City, Vietnam, May 2013. pp. 35-44.
- Anvari, F. and Tran, H. M. T. (2014) Holistic Personas and Reflective Concepts for Software Engineers. In *Proceedings of the ECIME 8th European Conference on IS Management and Evaluation*, Ghent, Belgium. September 2014. pp. 20-28.
- Anvari, F. and Richards, D. (2015) Using Personality Traits and a Spatial Ability Test to Identify Talented Aspiring Designers in User-Centred Design Methodologies. In *Proceedings of the ENASE 10th International Conference on Evaluation of Novel Approaches to Software Engineering*, Barcelona, Spain, April 2015. pp. 90-101 – Best Student Paper Award.
- Anvari, F., Richards, D., Hitchens, M. and Babar, M. A. (2015) Effectiveness of Persona with Personality Traits on Conceptual Design. In *Proceedings of the ICSE 37th International Conference on Software Engineering, Florence, Italy, May 2015*. pp. 263-272.
- Anvari, F. and Richards, D. (2016) A Method to Identify Talented Aspiring Designers in Use of Personas with Personality. in Maciaszek, A. L. and Filipe, J., (eds.) *Evaluation of Novel Approaches to Software Engineering: 10th International Conference, ENASE 2015, Barcelona, Spain, April 29-30, 2015, Revised Selected Papers*, Cham: Springer International Publishing. pp. 40-61.

Forward

I started upon this path of academic research, little knowing where it would lead me. One fine morning as I was looking across the bay thinking of events of the previous day and the meeting I had with management. I wondered how some personnel who are so clever and knowledgeable have so much problem understanding design concepts but others required only a brief explanation and can understand what were implied. I wondered how some are so eloquent in explaining complex phenomenon but some people who seemingly have good memories and are educated, yet cannot easily elucidate matters. I started reading literate papers.

Needless to say that the topic so intrigued me that it overtook my mind and became a labour of love in pursuit of learning “how human mind works?”. I am convinced I will never be able to find an answer to that question but facts and evidences that I find are intriguing and illuminating.

I often wondered why some students did not exert much effort in learning certain subjects such as algebra or geometry and yet did well in exam; some students practiced (some even memorised) all the examples in the book and yet did so poorly in the exam. Why the teachings of some teachers are remembered for life and others are forgotten soon after the test?

While engaging in design work, during my early years, I noticed that I could remember large amounts of information only if I could ‘bundle’ them and tag them and think of the information using the tag name. I was not familiar with schema neither knew about working memory and its limitation - I was an engineer. While developing an in-house application, it was often easy to communicate, by referring to a specific group of users by a pseudonym (we all knew who pseudonyms were referring to). Why is it that using a tag makes easier to remember during design activity and a pseudonym easier to communicate? Why for some, it is easier to comprehend when information are presented as colourful icons, graphs, charts and sketches but harder to comprehend when they are in textual format?

Answers to these questions require understanding of differences in knowledge needed, various cognitive processes to use the knowledge and personality of the person, in addition to myriad of other phenomenon that make the differences between humans, and use of tools such as schema and persona which make design easier. Every day brings a new revelation.

This thesis is the beginning of a long and enlightening journey which I am eager to follow.

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1 Introduction

During the early phase of the software development life cycle (SDLC), software engineers elicit system requirements typically from end users. Products that cannot meet the needs of the users are not only unusable but they affect the economy (Goldberg et al. 2011). Software applications or products that are to be used by people have to be designed with the needs of the users in mind. To meet the goals of the users, Norman and Draper (1986) proposed the User-Centred Design (UCD) methodology. A persona, an archetypical user and fictional character that represents a typical user of a system (Cooper 2004), is a tool within UCD methodologies. Personas are used to design a software application or product and complement other quantitative and qualitative methods (LeRouge et al. 2013, Pruitt and Grudin 2003, Rosson and Carroll 2009). Scenarios are the actions carried out by the personas interacting with the system to achieve goals (Goodwin 2009, p.11).

Conceptual design is considered an important and influential phase of early lifecycle stages of developing a software application. Conceptual design plays an important role in determining the structural and behavioural aspects of a system (Christiaans and Almendra 2010, Gero and Kannengiesser 2004, Norman 1986, p. 57). Identifying and understanding a real-world problem and specifying requirements are considered pre-requisite inputs to conceptual design.

In this thesis the historical perspectives, current trends and practices in uses of personas are examined and the deficiencies of the persona is outlined. This thesis through empirical studies, presents the benefits of using persona with personality within UCD methodologies during the conceptual phase of the design. The thesis also presents novel technique that seeks to identify talented aspiring designers in use of personas with personality within UCD methodologies from among participants by their performance in a spatial ability test and their answers to questionnaires which determine their personality traits.

1.1 Background and Thesis

In industry, software engineers usually interact with customers and users to elicit system requirements for conceptual design activities, or even involve key stakeholders in the design according to UCD principles. However, it can be challenging to get end users involved in requirements elicitation. Furthermore, concerning later cycles of the SDLC, it is often expensive and time consuming to involve end users during product design and development or run pilot studies (Vredenburg et al. 2002). In some cases, such as e-health, the end users may not be available to software engineers due to the sensitive nature of data about the

patients' condition (Anvari and Tran 2014, Vincent and Blandford 2014) or in the case of mass-user products there can be wide varieties of end users (Aoyama 2007). Given these types of constraints, software development professionals resort to alternative means of helping software analysts and designers to elicit requirements and support high-level design. One of such alternative means is the use of Persona, which is gaining significant adoption as a supplement or an alternative to end users' direct involvement in SDLC.

The Software Engineering (SE) community has been increasingly advocating the importance of imparting appropriate design knowledge and skills in SE students. SE is an applied discipline that incorporates theoretical concepts and practical approaches from a wide variety of disciplines such as Computer Science, Mathematics, Engineering, Business and Psychology. SE students are expected to learn a wide range of theoretical concepts and a good mix of practical approaches to identifying, understanding and solving challenging and complex problems by developing and delivering appropriate software-based solutions. SE educators are expected to provide students with hands-on learning activities that challenge them to solve authentic (i.e., real or very close to real world) problems by applying the relevant SE concepts and principles. There is an increasing realization and focus on problem based and experienced based teaching and learning in SE education of different phases of SE such as requirements elicitation, design, implementation, and testing. Real stakeholders are also often not available in the educational context (Zowghi 2009). While role-plays or other methods can seek to simulate this process, there is the further problem of validation that the users' requirements have been fulfilled in a software design. To address this problem, the Human Computer Interaction (HCI) community has been actively developing and using Personas, which have also made their way in SE research and practices (Acuña et al. 2012) and education, for example Cleland-Huang et al. (2014) reported a study on teaching student design using Architecturally Savvy Personas.

The performance of designers in carrying out novel tasks depend on their abilities and training, as well as their motivations (Maslow et al. 1987). The relationship between performance in creative professions and personality has been studied by a number of researchers (Feist 1998, Furnham and Bachtar 2008, Poropat 2009). It has been found that professionals who have been successful in domains such as architecture, engineering and programming are good in spatial ability (Mohler 2006). In a longitudinal study of mechanical engineering students, Field (2007) found that their performance in design subjects was more related with their intuition and spatial ability and less related with their logical and mathematical ability. A specific link between design, spatial ability and personality has not been explored within SE and UCD methodologies.

1.2 Motivation for the Thesis

A number of researchers and practitioners found that persona creation is ad hoc and not well documented. Chapman and Milham (2006), and Massanari (2010) argued that personas may not be determined using real data but are more likely to be developed by teams in political conflict. Matthews et al. (2012) in a study of a global corporation, found that designers do not use personas as they find personas to be abstract, impersonal, misleading and distracting. There are no methodologies to adequately outline authorship of persona; some authors used market research (Adlin and Pruitt 2010, Goodwin 2009) others used specifications (Switzky 2012).

Personality affects the way people use systems. For example in an e-learning application extraverts and people who are imaginative would do better in a less controlled environment; they prefer to set their own pace of learning and select topics of study (Orvis et al. 2010). Dennis et al. (2015) reported that patients who are low in conscientiousness would require different types of reminders for the ASICA (Achieving Self-directed Integrated Cancer) Aftercare Skin-Checker application. Hence, the persona technique should not be seen as a one size fits all approach, but recognize that potential users of a software product or service have individual differences (Lopez-Lorca et al. 2014). Some researchers have considered including more information in persona so that it can more closely resemble the end users. For example, Behrenbruch et al. (2012) used personality to evaluate the adaptation of an application operating on a mobile phone platform and authored personas with personality for future development of applications.

In my professional career as a software engineer I was engaged in conception and detailed design of software applications (Anvari and Tran 2013). I found that the current concept of persona is inadequate to represent the users during conceptual design stages; a concept that more closely resembles the users of the system is needed to facilitate design and conceive usable systems. Hence I introduced Holistic Persona; a persona with five dimension: factual, personality, intelligence, knowledge and cognitive process (Anvari and Tran 2013).

The present research concentrates on the personality dimension of the Holistic Persona. In future work, the other dimensions of the Holistic Persona will be investigated. This thesis postulates that providing Holistic Personas with personality to students, irrespective of their previous training in taking into account the personality traits of a persona, will enable them to conceive tailored designs taking into account the needs of the Holistic Persona on a mental and psychological level.

1.3 Research Question and Approach

Based on the studies of Anvari and Tran (2013), Behrenbruch et al. (2012) Dennis et al. (2015) Svendsen et al. (2013) and McElroy et al. (2007) the personality of the users affects their adaptation and use of technology, hence it is essential to consider personality during the design stage. This thesis answers the following principal research question:

Does the use of personas with different personalities result in different system or software requirements and conceptual designs tailored to that personality?

In order to answer the research question, three empirical studies were conducted involving four personas (Table 4.2) that were identical except for their personality (chapter 5 and chapter 8). In these controlled experiments the testable hypothesis investigated was that resultant systems or software requirements were tailored to the personality of a Holistic Persona by manipulating the independent variables, the personalities of the Holistic Personas. This was an investigation of the existence of a cause-effect relationship (Easterbrook et al. 2008).

1.4 Scope and Outline of the Thesis

This thesis presents the results of three empirical studies into the effectiveness of the personality dimension of the Holistic Persona during conceptual design. In particular two aspects of personality are considered: Extraversion and Emotional stability.

This thesis does not cover the assessment of the usability of the conceived designs, methodologies and practices used for detailed design, requirements elicitation and application development processes (e.g. agile, scrum).

This thesis does not cover the methodology to author personas. It briefly covers the addition of the five dimensions to an already authored persona with emphasis on the personality dimension.

Following this introduction, chapter 2 covers a literature search to identify past research done in this area: software and requirements engineering, cognitive processes, design, giftedness, spatial ability and its importance in Science, Technology, Engineering, Mathematics (STEM), introduction to HCI, UCD, persona and scenario, Holistic Persona, personality and the Big-Five factor markers.

Chapter 3 covers research questions, overall research approach, activities and data collection. Details of the research methodology are discussed in chapters 4, 5, 6 and 8.

Chapter 4 covers description of the Persona with personality. This chapter presents an overview of how the Holistic Personas are authored. As this thesis is centred on the

personality dimension of the Holistic Persona, this chapter provides details on authoring Holistic Persona's personality dimension and provides an outline for authoring other dimensions.

Chapter 5 covers the procedure for the first study (referred to as Study I).

Chapter 6 covers the design rubric used to assess the design artefacts with detailed samples of assessments and requirements categorization placed in Appendix O.

Chapter 7 covers the results of study I.

Chapters 8 - 9 cover the procedure and results of the second and third studies (referred to as Study II and Study III). As the details of Study I (chapter 5) and Studies II and III (chapter 8) are slightly different, some of the results from each study are presented separately in chapters 7 for Study I and chapter 9 for Studies II and III.

Chapter 10 covers the combined results from the three studies.

Chapter 11 covers the discussion of the results of the three studies.

Chapter 12 covers the conclusion and planned future work and the importance of this research for industry and software engineering.

1.5 Abbreviation, Glossary and Synonymous

Following are glossary, synonymous and abbreviation used in this thesis

1.5.1 Abbreviation

BFF: Big-Five factor markers or Big-Five factors of personality (Goldberg 1992)

BFI: Big Factor Inventory (John and Srivastava 1999)

HCI: Human Computer Interaction

NEO-PI-R: NEO Personality Inventory, Revised by Costa and McCrae (1992)

PVR: Purdue Visualization of Rotations

SDLC: System Development Life Cycle

SE: Software Engineering

STEM: Science, Technology, Engineering, Mathematics

TDA: Trait Descriptive Adjective (Goldberg 1990, Goldberg 1992)

1.5.2 *Glossary*

Big-Five factor (BFF) markers: Extraversion, agreeableness, Conscientiousness, Emotional Stability and Imagination.

Persona: archetypical user of a software application, product or service

Spatial ability: ability to allow a person to see depth and to manipulate and rotate three-dimensional objects

Design ability: ability to produce a design that scores high using a design rubric

Design rubric: a rubric used to mark design artefact (please see chapter 6)

Design score: using the design rubric to mark design artefacts. For the Study I there was only one design activity hence it was used for assessment. For the second and third studies where each participant produced four design artefacts, an overall assessment was made which is based on highest scores from each item of design rubric.

In-depth design: design is in depth when the statements made in the design notes can be supported by the literature on personality.

Talented designer: a designer who produces an in-depth design given a short period of time, without prior contemplation.

Aspiring UCD designer: a designer who completes the design activities.

1.5.3 *Synonyms*

For interest of readability, in this thesis, the following terms are used synonymously

Big-Five factor markers - Big-Five factors of personality

Holistic Persona – persona with personality

Software application – software application or service or product

Software Engineer – software engineer or requirements engineer or designer

Personality trait – personality factor (one of the BFF of personality)

Design – conceptual design of a software application, service or product.

Study I or II or III - First or second or third study

She – refers to she/he when the gender of the person is not known

Her – refers to her/his when the gender of the person is not known

2 Literature Search

This chapter covers the previous research done by scholars on requirements elicitation and development, the designer characteristics and cognitive processes during design stage, persona and the role it plays in design and communication with stakeholders, and the importance and effect of personality of users on usability of an application. The literature search begins by looking at software and requirements engineering (section 2.1) and their role in the design and development of software applications for use by users. Intelligence, Knowledge and Cognitive Processes are covered in section 2.2. Spatial ability and its importance in Science, Technology, Engineering and Mathematics are covered in section 2.3. Researchers recognise that the most influential phase of design is the conceptual design phase (section 2.4) where essential characteristics of the software application are shaped. A brief introduction to HCI and UCD suggested by Norman as a methodology to address the issue of usability is outlined in section 2.5. Section 2.6 covers persona and scenario and section 2.6.1 covers criticism of the use of persona. Human personality traits and models play an important role in the use of software applications or products (section 2.6.2). Section 2.7 presents the result of investigation into human personality traits and models and their relevance to use of software applications or products.

2.1 Software Engineering and Requirements Elicitation

Software Engineering has evolved over time with methodologies and best practices that are influenced by system-driven philosophies. SE covers areas such as Computer Science (e.g., Data Structures, Algorithms, and Programming Languages), Engineering Knowledge (e.g., Architecture, Project Management, and Effort Estimation) and the Economic and Social context (e.g., Economics, Marketing, and Psychology) (LeBlanc et al. 2006, Shaw 2005). Based on three generations of software development at Intel Corporation, Terzakis (2013) reports that the quality of the software increased due to better requirements definition and management even though the second and third generations of software were more complex. Based on the experiences from several industrial projects, Kujala (2008) reports that user involvement during the early stages of projects improves the effectiveness and quality of software products. Engaging with users for requirements elicitation requires special skills and methods such as interviews, brainstorming, ethnography, prototyping, futuristic workshops, focus groups, goal-based approaches and scenario-based techniques (Zowghi and Coulin 2005). All of these approaches involve different stakeholders of a system in general and end users in particular for eliciting a system's requirements. Researchers investigated the quality of the information received and understood by analysts and found that it is generally incomplete (Stacy and MacMillan 1995, Valusek and Fryback 1985). Browne and Rogich (2001, p. 223) compares different techniques used for requirement elicitation from

stakeholders: ‘prompting techniques’, ‘interrogatories technique’ and ‘semantic questioning scheme’ and finds prompting technique to be a better one.

2.2 Intelligence, Knowledge and Cognitive Processes

This section provides definitions for intelligence, knowledge and cognitive process from scholarly literature.

2.2.1 *Intelligence*

Intelligence is the ability to solve problems. Gardner listed seven intelligences (Gardner 1993, pp. 7-9 , Gardner 2003, Gardner and Hatch 1989):

- 1- Verbal and linguistic intelligence: ability to read, write and converse
- 2- Logical and mathematical intelligence: ability to use numbers and compute
- 3- Visual and spatial intelligence: ability to create and manipulate a mental model of a spatial world
- 4- Bodily and kinaesthetic intelligence: ability to dance and play various sports
- 5- Music intelligence: ability to understand and express oneself through rhythmic movements or composing music
- 6- Interpersonal intelligence: ability to communicate with other people and understand them
- 7- Intrapersonal intelligence: ability to understand and control ones’ emotions and thoughts

Persons with innate ability or giftedness have high talent in one or more domains; with little tutoring, they can understand the abstract concepts, ask deep questions, reflect on various interpretations of the problems and can transfer their knowledge from similar domains (Winner 2000). Schön (1983) introduced the terms ‘reflection-in-action’ and ‘reflection-on-action’; he describes reflection-in-action as ‘thinking on our feet’, the thinking and reflecting that happens in the midst of activity and, reflection-on-action as the thinking and reflecting that occurs after an event. Nguyen and Swatman (2003) found that ‘reflection-in-action’ and ‘reflection-on-action’ assisted in managing requirement engineering processes.

2.2.2 *Knowledge*

Knowledge which is ‘the substance of a given subject matter’ is determined by ‘scholars who have spent their lives studying and working in a field’ and arrived at ‘through a currently shared consensus within a discipline and is subject to change over time’ (Anderson and Krathwohl 2001, p. 13).

The Knowledge of a subject matter is grouped into four categories:

1. Factual knowledge: the knowledge that *'encompasses the basic elements that experts use in communicating about their academic discipline, understanding it, and organising it systematically'* (Anderson and Krathwohl 2001, p. 45).
2. Conceptual knowledge: the knowledge about *'how the different parts or bits of information are interconnected and interrelated in a more systematic manner, and how these parts function together'* (Anderson and Krathwohl 2001, p. 48).
3. Procedural knowledge: the *'knowledge of how to do something. The something might range from completing fairly routine exercises to solving novel problems'* (Anderson and Krathwohl 2001, p. 52).
4. Metacognitive knowledge: the knowledge *'about cognition in general as well as awareness of and knowledge about one's own cognition'* (Anderson and Krathwohl 2001, p. 55).

'Factual and conceptual knowledge represent "what" of knowledge' and 'procedural knowledge concerns how' (Anderson and Krathwohl 2001, p. 52).

2.2.3 *Cognitive Process*

The knowledge (section 2.2.2) and cognitive processes have been used to model educational objectives albeit with different names (e.g. Tyler (1959) used the terms content and behaviour instead of knowledge and cognitive process.). In setting the objectives of education, the statement contains a noun which 'describes the knowledge students are expected to acquire or construct' and a verb which 'describes the intended cognitive process' (Anderson and Krathwohl 2001, p. 12). The Cognitive Process Dimension is grouped into six categories (Krathwohl 2002):

1. Remember: recall or remember the knowledge
2. Understand: explain the knowledge
3. Apply: use the knowledge in a new way
4. Analyse: distinguish between different knowledges
5. Evaluate: justify or judge knowledge based on criteria and standards such as quality, efficiency, etc.
6. Create: putting the knowledge together in a new meaningful way.

The cognitive process, 'remember', is related to retention and cognitive processes, understand, apply, analyse, evaluate and create, relate to transfer. The lowest rung of the cognitive process ladder is 'remember' and highest rung is 'create'; each category is more complex compared to previous category. Problem solving (devising a solution that is unique to the individual), by building both the knowledge and the cognitive processes results in meaningful learning (Mayer 2002). Abstract reasoning and knowledge of a domain provides

a person with the ability to transfer their skills from one domain to other similar domains (Anvari et al. 2013). In a study of experts and novices, Hinds et al. (2001) demonstrated that experts can transfer knowledge from one domain to another at an abstract level. The performance of students in carrying out novel tasks will depend on their abilities and training in a similar domain, as well as their motivations (Maslow et al. 1987 pp. 22-31). Students exhibit different capabilities in learning new tasks or transferring learnt abilities from one domain to a similar domain (Lohman 2006, Winner 2000).

2.3 Spatial Ability

Spatial ability allows a person to see depth and be able to manipulate and rotate three-dimensional (3D) objects. Presmeg (1997) found visual–spatial scheme (pattern imagery) an important aspect of problem solving and abstracting knowledge. Sutton and Williams (2008) observed that spatial abilities refer to, in general, a collection of cognitive, perceptual, and visualisation skills such as the ability to visualize mental rotation of objects, the ability to understand how objects appear in different positions, and the skill to conceptualise how objects relate to each other in space. Many studies have reported that spatial visualisation can be a predictor of problem solving success (Koch 2006).

Spatial ability is essential to be successful in a number of domains such as Science, Technology, Engineering, Mathematics, architecture and programming (Mohler 2006). The importance of spatial ability in science and engineering has been studied by many researchers. Shea et al. (2001) in a longitudinal study of 563 students in the late 1970s using Scholastic Assessment Test and spatial ability tests found that those who scored better in a spatial ability test had selected careers in STEM. Similarly Webb et al. (2007) in studying 1060 students during the 1990's found that spatial ability provided greater variance in predicting individuals' preferences for STEM. Wai et al. (2009) drawing a random sample from the population of 400,000 students, who were longitudinally studied for 11 years, found that among those who chose careers in science, technology or mathematics scored high in spatial ability during their adolescence. Charyton et al. (2011) in a study of engineering students found that their score in a Creative Engineering Design Assessment, a test for measurement of creativity in engineering, is related to their performance in the Purdue Visualization of Rotations (PVR) (Bodner and Guay 1997). Ault and John (2010) surveyed the literature across the USA with the result that students doing four year engineering courses generally scored about 75% in the Spatial Rotation of Visualisation test. Students with higher spatial ability have been found to perform better in other fields. Anvari et al. (2013) analysed the data from an experiment that involved a group of students who had not done computer graphics before, after performing a spatial ability test of rotation, they were engaged in dual tasks: the main task was to generate a three-dimensional computer graphics and an interruption task, which was randomly generated, was to add two random two digit numbers.

The speed of response time to the interruption task and the accuracy of the response was an indicator of a lower cognitive load. The results showed that a student who had high spatial ability with low cognitive load performed well in the main task. This study suggests the significance of spatial ability and high abstract thinking in transferring knowledge and ability from one domain to another domain.

There are a number of tests to measure spatial ability such as the mental rotation test (MRT) (Vandenberg and Kuse 1978), the mental cutting test (MCT) (Quaiser-Pohl 2003) and the Purdue Visualization of Rotations (PVR) (Bodner and Guay 1997). The PVR is freely available and is adoptable to online system.

2.4 Creativity and Conceptual Design

Essential characteristics of creative products are novelty, value and surprising-ness (an impact of the unusualness and unexpectedness (Jackson and Messick 1965)) (Nguyen and Shanks 2009). Nguyen and Shanks (2009) devised a framework to understand creativity in requirements engineering. Plucker et al. (2004, p. 90) defined creativity as: *the interaction among aptitude, process, and environment by which an individual or group produces a perceptible product that is both novel and useful as defined within a social context*. Creativity is of two types: Historical creativity, H type creativity, where the work is new historically, Personal type creativity, P type creativity, where the work is new for the creator but it has already been produced before (Boden 2009, Howard et al. 2008).

Studies of the design process have divided creative design into separate, synonymously named, phases or segments (Akin and Lin 1995, Buurman 1997, Howard et al. 2008, Kryssanov et al. 2001): problem understanding, design and retrospection. The design phase is further divided into three sub-segments: conception, development and representation (Akin and Lin, 1995). Many researchers agree that the most important and influential phase of design is the conceptual design phase in which the behaviour of the system is formed (Christiaans and Almendra 2010, Gero and Kannengiesser 2004, Norman 1986, p. 57). Plucker et al. (2004, p 156) based on a number of peer reviewed journals defined creativity as “the interplay between ability and process by which an individual or group produces an outcome or product that is both novel and useful as defined within some social context”. Abilities are not fixed and, interest and persistence is important in achieving expertise (Lohman 2009). Relationships between personality, creativity and academic performance were studied by a number of researchers. Creative scientists were more likely to have personality traits of extraversion and openness to experience (Feist 1998, Furnham and Bachtiar 2008) and academics were more likely to be agreeable, conscientious and open to experience (Read et al. 2007). Silvia (2008) suggested that Plasticity (Extraversion and Imagination) is more strongly related to creativity than Stability (Agreeableness,

Conscientiousness and Emotional Stability). McCrae (1987) in a study of 268 men found that openness to experience and divergent thinking, a psychometric investigation of the creativity, were correlated; *'Creativity is particularly related to the personality domain of openness to experience'* (McCrae 1987, p. 1258). Poropat (2009) in a meta-analysis of students' measures of academic performance measured by grade point average found that secondary and tertiary students' performances were related to conscientiousness and intelligence. In a longitudinal study of engineering students, Field (2007) observed that students who excelled in design subjects did not necessarily do well in other academic subjects; excellence in design requires different abilities.

2.5 User Centred Design – a brief introduction

During the 1970s, computers were expensive, dedicated and specialised equipment. They were operated by trained professionals, who performed specialised tasks. The user would make one request from the system using a simple input device such as a keyboard, the system would provide a number of responses using a simple output device such as a mono chrome monitor, and the user would select one of the responses. During the 1980s and early 1990s, a single user would perform multiple tasks using complex input and output devices. As computing systems became networked and operated on multiple inputs, the system's response became complex, the computing equipment became more ubiquitous and users had less training in its use (May 2004). In these periods, a number of IT projects produced results that were very hard to use or did not provide the expected outcome; some were shelved; the reasons for the failures were poor requirements specification (Van Lamsweerde 2000). Numerous attempts were made to refine the technique of requirements elicitation and preparation of requirements specification (Hsia et al. 1993).

Norman (1986) introduced the concept of UCD as *'the purpose of the system is to serve the user...'* (Norman 1986 p. 61). Norman (2002) defined the concept of a good design as the one that offers affordances which produces an image in the mind of the user that matches the image that the designer had intended. Considerable research has been done by scholars and practitioners in identifying and involving users within system design (Ågerfalk 2001, Massanari 2010). Persona, an archetypical user, was introduced by Cooper (1999) as replacement for the term 'user'.

User-Centred Design methodologies, which consider the goals of the users as the primary requirement for developing software applications (Norman 1986), have been actively developed and promoted by the HCI community (Seffah and Metzker 2004) and are increasingly used in software engineering practices and processes (Aoyama 2007, Grimes et al. 2008). A good design has affordances which produces an image in the mind of the user that matches the image that the designer had intended (Norman 2002). Norman (1986), a

cognitive psychologist, proposed *an approximate theory of action*’ provided theoretical explanation for the interaction between the human and an interconnected multi-tasking computer system that have complex input and output devices. According to approximate theory of action there are three models representing the system:

1. Designer’s model of the system,
2. Physical model of the system as represented by the image of the system,
3. User’s conceptual model of the system formed by the appearance of the system to the user

According to the theory, the user has a goal which is psychological in nature and the system provides a state which is physical in nature. Norman named the separation between the user’s goal and the system state as the ‘gulf of execution’ which the user crosses through an execution bridge; and from the system to the user is the ‘gulf of evaluation’ which the user crosses by an evaluation bridge. Norman (1986) provides seven stages for the approximate theory of action to mediate between the system and the human:

1. Establishing the Goal,
2. Forming the Intention,
3. Specifying the Action Sequence,
4. Executing the Action,
5. Perceiving the System State,
6. Interpreting the State,
7. Evaluating the System State with respect to the Goals and Intentions (Norman 1986).

Norman (1986) from the above theory concluded that in order for systems to be more usable, the user’s conceptual model of the system should match the designer’s conceptual model through its representation. Hence he proposed design guidelines (Norman 1986, pp. 59-61):

- *‘Create a science of user-centered design;*
- *Take interface design seriously as an independent and important;*
- *Separate the design of the interface from the design of the system;*
- *Do user-centered system design: Start with the needs of the user’.*

User-Centred Design is founded on the philosophy that *‘the purpose of the system is to serve the user, not to use a specific technology, not to be an elegant piece of programming. The needs of the users should dominate the design of the interface, and the needs of the interface should dominate the design of the rest of the system’* (Norman 1986 p. 61). Thus the user can do the intended tasks and find pleasure in using the system (Norman 1986,

Norman and Draper 1986). UCD does not specify how a user representing a myriad of users should be involved in the project (Abrás et al. 2004, Ågerfalk 2001, Massanari 2010).

2.6 Persona and Scenarios

Cooper (2004 pp. 19-21) used the term *cognitive friction* to describe *the resistance encountered by a human intellect when it engages with a complex system of rules that change as the problem changes* which is unique to the information age and is caused by computer equipment. Among the examples that Cooper (2004) provides are the crash of American Airline Flight 965 on 20 December 1995 into a mountain in Buga, Colombia (Civil 1996, Cooper 2004 pp. 3-4) and USS Yorktown in September 1997 which ceased operation in middle of combat exercise (Cooper 2004 p. 13, McGraw and Viega 1999). He also lists a number of situations where users were frustrated with electronic equipment; such as a user venting his frustration upon a monitor (Wingfield 1998). The traditional engineering approach had failed to address the new issues that modern computer systems present. The *interaction design* of the software application is a new paradigm that require specialties which are different to *program design* (Cooper 2004 pp. 21-22, Norman 1986 pp. 59-61).

The concept of persona was introduced into software application by Cooper (1999) as a solution to designing software that is fit for its intended users. Cooper challenged the concept of *the user*; he deemed it to be too broad and vague, hence he introduced *persona* as an *archetypal user* (Cooper 2004 pp. 127-128). Personas are fictional characters that represent needs of typical users of a software application or product (Cooper 1999). Cooper (1999) put forward the idea that for application development to replace the term ‘user’, which is undefinable and has different representations for various stakeholders, with ‘persona’, which represent a target group of users who have some common characteristics and hence can be described (Cooper 1999). Since their introduction, personas have been used as a tool within UCD methodologies for design and communication with stakeholders regarding the scope and the final outcome of the software application (Cooper 2004, Goodwin 2009 p. 11, pp. 231-234).

Personas support the design of applications by focusing on target users and facilitating communication with stakeholders (Goodwin 2009, pp. 231-234, Miaskiewicz and Kozar 2011, Wikberg Nilsson et al. 2010). The use of personas in UCD is well established in the software industry (Miaskiewicz and Kozar 2011). Scenarios are the interactions that a persona has with the software application or product to achieve a goal (Cooper 2004 pp 179-181, Goodwin 2009 pp 308-312). Personas and scenarios are tools to design systems. The project team members involved in the development of a software application are often scattered around the globe. Hence the communication has to be precise and convey the same meaning across different cultural and language issues (Cooper 2004, pp 105-106). Chang et al. (2008) found

that the personas used by designers may take many forms: personas, mash-up personas, incomplete personas and unspoken personas. A number of researchers have found persona to be useful tool which assist design and creativity (Chen et al. 2011).

To encourage the use of personas for communication with the stakeholders, different researchers and practitioners have developed various methods. For example Guðjónsdóttir and Lindquist (2008) used posters and cardboard cut-outs to acquaint team members with personas. Long (2009) conducted a nine month study during which he tested the concept of persona with the students doing industrial design. He found persona to be a useful tool for design and communication and reported that designers showed a higher level of empathy towards personas with photos of real people compared with illustrated personas.

A number of researchers and practitioners have provided guidelines on how to recognise, author personas and use them in design and communication with stakeholders. Cooper (1999) provided basic guidelines on using text and photo of a person to author a persona (Cooper 2004, pp. 123-138). Goodwin (2009, pp 229-297) provided methodologies to author personas and scenarios based on market research on factual information such as demographics and interests along with the picture or illustration to author persona. Switzky (2012) developed personas by identifying use cases, whereas Schneidewind et al. (2012) identified personas from project scope definitions. There is no single known method for authoring persona. The knowledge to author persona is accumulating as practitioners and researchers try different techniques to author persona. Some of the techniques that scholars and practitioners devised are listed below.

- Market research - Goodwin (2009) advocated use of market research data in building personas (Goodwin 2009 pp. 229-297).
- Project Specification - Switzky (2012) reviewed the project specification and from the use cases developed personas.
- Project scope - Schneidewind et al. (2012) authored personas based on project scope.

2.6.1 *Criticism of Persona*

Researchers and practitioners have reported that there are issues with authoring and using persona. Chapman and Milham (2006) argued that personas may not be determined using real data but are more likely developed by teams that are in political conflict; some designers do not use personas in their design activity as they find personas abstract, impersonal, misleading and distracting (Matthews et al. 2012). Behrenbruch et al. (2012) found the persona to be inadequate for design of an application and included personality in the persona for design.

Personas can be misinterpreted due to personal and cultural settings. Figure 2.1 and Figure 2.2 are examples of persona description. Vietnamese UCD professionals in Vietnam understand 'Chi is a farmer' (Figure 2.1) and Australian UCD professionals in Australia understand 'Karl is a farmer' (Figure 2.2). Australian UCD professionals could easily misunderstand the persona 'Chi is a farmer' (Anvari and Tran 2013).

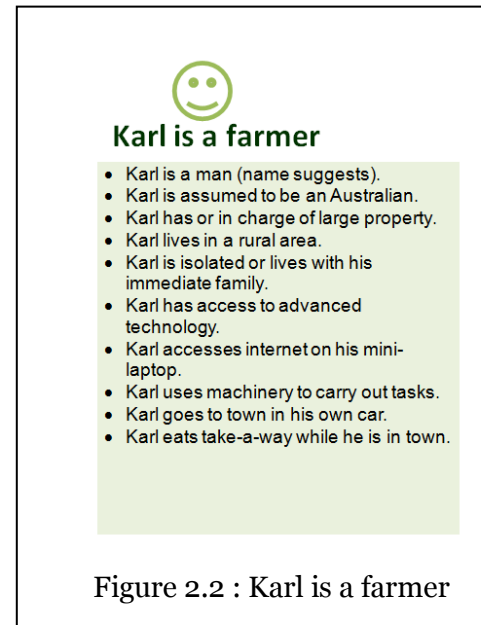
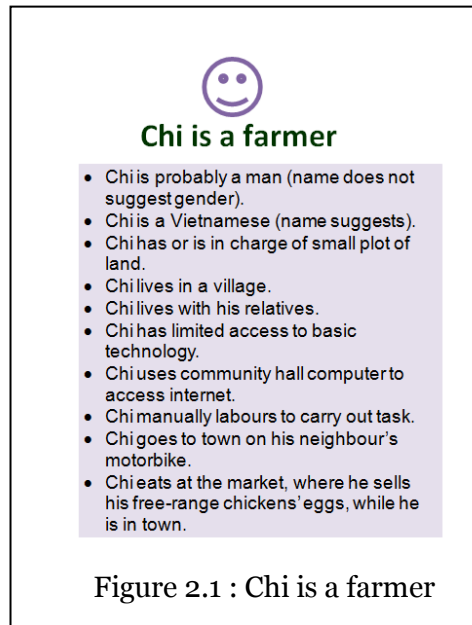
With the changing nature of HCI which results in closer contact between the user and devices, machines are more involved in the thinking and emotional lives of the users; human computer interactions take place on emotional and psychological levels. For example an EEG neuro-headset can be used to detect emotions (Horlings et al. 2008), classify working memory load (Grimes et al. 2008), provide neuro-feedback in behaviour modification (Johnston et al. 2011), create hands free input devices and virtual key boards (Scherer et al. 2004). HCI can occur through gesture recognition (Mitra and Acharya 2007) and facial expression (Bernays et al. 2012). Hence the designers need a precise understanding of end users to be able to design products that have good usability.

2.6.2 *Holistic Persona*

The close interactions between a system with its users require designers to be more involved in the thinking and emotional lives of a system's users (Miller et al. 2015). In the past the main users of personal computers were professionals from the developed world. In recent times computing equipment has become ubiquitous and has changed the way users learn, shop, bank, entertain, etc. Users can come from all walks of life and from all over the world. UCD professionals who have not experienced the conditions of some of the users (e.g. Motor Neuron patients or intellectually disabled users) would have difficulty building applications for these users without having well authored personas. To engineer an idea into software, UCD professionals require personas that are not only factually accurate but are emotionally resonant so that all team members can use and interpret personas similarly. Furthermore there is greater need for effective personas as HCI is changing rapidly and project team members may be scattered around the globe. Geographically dispersed and culturally divergent developers need well-authored personas to build applications.

Since the 1990's multi-user applications have been connected together and perform multiple tasks using technologically advanced complex input and output devices. Computer systems have permeated every aspect of human life; they are no longer used only for business purposes but are used in socially interactive situations, such as computer-supported cooperative work (May 2004, Rogers et al. 1994). Modern interconnected systems provides responses that are often not directly from the system but from another user who is connected to the system and the information could be filtered by the system, translated or modified. This is a new paradigm where involvement of a user is not only with a system but also with

other users (May 2004). Hence a holistic view of the user is necessary to be presented to the designers and stakeholders of a software application or product for more usable product design and development. Analysing the specific software requirements in five case studies from various Australian industries, Anvari and Tran (2013) proposed the notion of Holistic Persona, a persona with five dimensions: factual, personalities, intelligences, knowledge and cognitive processes, that seek to take into account individual differences in users and the impact of these differences on conceptual design of software to meet those users' needs.



This thesis focuses on persona with personality. Personality in general is presented in the next subsection. The following chapter presents Persona with personality in detail.

2.7 Personality

Multiple theories and models of human personality exist in the psychology literature (Maslow et al. 1987, Schultz and Schultz 2004) and each has its own use and application. The lexical hypothesis, as defined by Goldberg (1990) is: 'the most important individual differences in human transactions will come to be encoded as single terms in some or all of the world's languages' (Goldberg 1990, p. 1216). The Big-Five Factors (BFF) of personality, which is based on the lexical hypothesis, is widely used in research to measure personality (John and Srivastava 1999, Martínez et al. 2010, Nov et al. 2013a, Oliveira et al. 2013, Poropat 2009, Wilson et al. 2010). Researchers tend to use one of the three instruments, listed below, to measure the BFF of personality (John and Srivastava 1999):

1. Trait Descriptive Adjective (TDA) by Goldberg (Goldberg 1990, Goldberg 1992),
2. Big Factor Inventory (BFI) by John and Srivastava (1999) and
3. NEO Personality Inventory, Revised (NEO-PI-R) by Costa and McCrae (1992).

The three BFF models use similar terms to describe the five factors (Goldberg 1993, John and Srivastava 1999). For the studies presented in this thesis, the terms used by Goldberg's TDA, NEO-PI-R and BFI are considered to be similar (Goldberg 1993). The five factors of personality are (Goldberg 1990, Goldberg 1992, Goldberg 1993):

1. Extraversion
2. Agreeableness
3. Conscientiousness
4. Emotional Stability;

Costa and McCrae (1992) and, John and Srivastava (1999) refer to this factor negatively as Neuroticism.

5. Imagination or Intellect

In this thesis, the term 'Imagination' is used to refer to this factor.

Costa and McCrae (1992) refer to this factor as Openness to Experience and John and Srivastava (1999) refer to it as Openness/Intellect

Digman (1997) further refined the BFF to Alpha Factor (Agreeableness, Conscientiousness and Emotional Stability) and Beta Factor (Extraversion and Imagination). DeYoung et al. (2010) demonstrated that alpha factor (Stability) predicts conformity and Beta factor (Plasticity) predicts non-conformity. The two factors of Emotional Stability and Extraversion are considered to relate more strongly and more consistently with subjective well-being at a personal level (Larsen and Ketelaar 1989, Luhmann and Eid 2009, Watson and Clark 1992).

A body of literature demonstrate the user's personality affects her interaction with technology. A few examples are listed in the following paragraphs.

Svendsen et al. (2013), in a study of the relationship between personality and the findings of their technology acceptance model in a sample of 1004 Norwegians found behaviour intent, perceived usefulness and perceived ease of use varied depending on the personality of the users. Extraverts and emotionally stable people showed a positive relationship with behaviour intent; open to experience people showed a positive relationship with perceived ease of use but did not show any relationship with behaviour intent (Svendsen et al. 2013).

Landers and Lounsbury (2006) found that those who were introverted and had a lower score on conscientiousness and agreeableness used the Internet more often. Vazire and Gosling (2004) predicted the personality of the author of websites with reasonable accuracy. Oliveira et al. (2013) found that extraverts used their mobile phone more often and, extraverts and conscientious people were more satisfied with the level of service they received from their mobile phone service providers. Nov et al. (2013a) found that extraverted people

tend to be more responsive in a more popular website and emotionally stable people tend to be less influenced by a website's social anchoring.

Lane and Manner (2011) in a study of a sample of 312 participants reported that extraverts were more likely to own a smart phone and used it more often for texting messages. In the same study Lane and Manner (2011) found that agreeable personalities used the smart phone for voice communication. Devaraj et al. (2008) in a study of the technology acceptance and the personality traits reports that extraverts were more likely to use technology; extraverts were also more likely to act based on the opinions of those whom they consider as significant. A number of researchers have reported that extraverts prefer to use applications on their mobile phone (Butt and Phillips 2008, Chittaranjan et al. 2011, Oliveira et al. 2013). Correa et al. (2010) conducted a study of the personality, gender and social media use based on a sample of 959 adults in the United States (US) and concluded that extraverted personalities, especially young adults, and emotionally unstable men were regular users of social media.

Correa et al. (2010) speculated that emotionally unstable people require more time to think over their communication hence they prefer online communication. Halko and Kientz (2010) studied personality and persuasive technology among a sample of 240 participants (56% were 30 years old or younger) recruited mainly from US (53.1%) and India (35.9%). Halko and Kientz (2010) found that extraverts show negative correlation with persuasive strategies; openness to experience show positive correlation with authoritative strategies and conscientious people show positive correlation with persuasive strategies.

Moore and McElroy (2012) studied the relationship between personality and use of Facebook and regret about postings among a sample of 219 undergraduate students at a Midwestern university in the US. Moore and McElroy (2012) found that extraverts have a wider network of friends; emotionally unstable people spend more time on Facebook; emotionally stable and introverts use Facebook to keep in touch with their friends; emotionally stable, agreeable, conscious and introvert people expressed higher level of regret over inappropriate postings. Loiacono (2014) in a sample of 359 participants found that extraverts are more likely and agreeable and neurotic personalities are less likely to disclose personal information on the social networking site. Given the potential effect of a user's personality on their use of software, there is a growing body of literature supporting the incorporation of personality into applications' design. Behrenbruch et al. (2012) used persona with personality for development of a mobile application. McRorie et al. (2009) programmed a robot to use eye movements, gestures, and talking speed to show personality. Faily and Lyle (2013) suggested software tools to author personas and their use during software development. Svendsen et al. (2013) investigated technology acceptance and personality of users. Anvari and Tran (2013) proposed Holistic Persona, with personality being one of the dimensions, to better assist in design work.

2.7.1 *Instruments to Measure BFF*

In this thesis, as explained below, two instruments are used to assess BFF of personality:

1. The International Personality Item Pool (IPIP 2013) instrument (Goldberg 1993),
2. The Ten-Item Personality Inventory (TIPI) instrument (Gosling et al. 2003).

The IPIP instrument: The IPIP instrument is used to assess personality (Goldberg 1993). The instrument is made available at the International Personality Item Pool (IPIP 2013) in the form of bi-polar statements which a participant can rate the applicability of each statement on a 5 point Likert scale. The scales are added together after reverse scoring the negative questions (Goldberg 1993) to provide results for each factor of the BFF of personality in the range of 10-50. The resultant data which are interval-level data are converted to percentages and analysed using statistical packages.

The TIPI instrument: The TIPI is a short instrument to measure BFF, freely available and widely used (Gosling et al. 2003). TIPI is validated in a number of European languages and cultures: English (Gosling et al. 2003), German (Rammstedt and John 2007), Spanish (Romero et al. 2012) and Dutch (Hofmans et al. 2008).

2.8 Chapter Summary

This chapter presented a review of the related literature and the scholarly research in the field of software engineering related to development of software application for users. The chapter started by looking at software and requirements engineering, followed by cognitive processes, design, giftedness, spatial ability and its importance in STEM. It introduced HCI, UCD, personas and scenarios. It then discussed Holistic Persona, personality and the lexical hypothesis, as defined by Goldberg (1990) and the Big Five factor markers.

3 Overview of Research Methodology

This chapter presents an overview of the research methodology employed in this thesis. In particular, it examines the research questions, overall research approach, activities and data collection. Later chapters give more details on some of these areas, as follows:

Chapter 4: Materials including creation of Holistic Persona with Personality used in the experimental studies

Chapter 5: Procedure for Study I

Chapter 6: Rubrics for coding and analysis of the design artefacts

Chapter 8: Procedure for Studies II and III

In this chapter the research question (section 1.3) is analysed and divided into a number of sub questions (section 3.1). An outline of the study design, comprised of survey and design task activities, to provide answers for each of the research questions, is presented in section 3.4. A theoretical background to threats, validity of the design and an outline of the measures to overcome threats is provided in section 3.5. A summary of this chapter is provided in section 3.6.

3.1 Analysis of the Research Question

This thesis will answer the following research question:

Does the use of personas with different personalities result in different system or software requirements and conceptual designs tailored to that personality?

The above research question is broad and in order to answer it, it is necessary to refine it further.

The refined questions are:

1. Do participants consider that the Holistic Personas resemble real people? (Is there enough of a person there for people to believe this to be real?)
2. Do participants correctly identify the intended personality traits of Holistic Personas?
3. Do participants have a preference to design for a Holistic Persona due to its personality traits?

4. Do the participants tailor their designs according to the personality traits of Holistic Personas?

If the data obtained to the above questions are in the affirmative, the answer to the question below, seeks to assist the identification and training of talented UCD designers:

5. Can a spatial ability test and self-assessment of personality traits be used to identify talented aspiring designers who can produce a design within UCD methodologies that matches Holistic Persona's needs considering her personality?

'Talented designer' is defined as a designer who produces an in-depth design given a short period of time, without prior contemplation (Anvari and Richards 2016, Anvari et al. 2015). The rubric developed to assess the design artefacts (chapter 6) provides guidelines on identifying in-depth design. 'Aspiring UCD designer' is defined as a designer who completes the design activities.

Each of the above questions seeks to answer a different question category. Understanding the categories helps to design appropriate experiments to answer each question and ultimately the overarching research question.

1. The first question is an existential question; do participants, some of whom may be designers of an application and all of them are users of an application, consider the Holistic Persona to represent a real person.
2. The second question is a relationship question; it checks how closely participants identify the personality traits of Holistic Persona to the traits intended.
3. The third question is an existential question; it checks the preferences that participants have for a specific personality of a user in their design work.
4. The fourth question is a causal question; does Holistic Persona's Personality affect the design of the application?
5. The fifth question is knowledge or skill question; it attempts to discover innate design capabilities of a participant in use of persona with personality within UCD methodologies.

3.2 Research Design

To obtain answers to the research questions, the following data requirements and constraints were identified, leading to development of a survey questionnaire and design activity (Study I - chapter 5) or activities (Studies II and III - chapter 8).

- A participant's personality
- A participant's spatial ability

- A participant's perception of the personality traits of the Holistic Persona
- A participant's understanding of the Holistic Persona's requirements
- A participant's design artefact

In order to collect these data, three main items needed are:

1. Participants who are interested in design (potential UCD designers),
2. Holistic Persona with personality traits.
3. Rubric to assess the design artefacts.

To meet the requirement for item 1, participants recruited were needed to be from populations interested or involved with design. It is assumed that participants that took part in this study voluntarily were interested in design as they were not offered any rewards. To meet the requirement for item 2, eight Holistic Personas were authored with variations only in personality traits. As part of the study, the participants would evaluate the authored Holistic Personas' personalities to ensure that they are as intended (chapters 4, 7 and 9). To meet the requirement for item 3, a rubric was devised to assess the design artefacts (chapter 6).

In summary the objectives of this thesis is to conduct an in-depth study of the relationship between creativity in design, Holistic Persona's personality traits, designers' personality traits and spatial abilities.

3.3 Participants and Recruitment

The participants were recruited from accessible populations that were involved in the design of software. Some professionals and post graduate students took part in the study initially and they fulfilled both roles of testing the study procedures and supplying data for the studies. As there was an expectation of some interest in design and software, together with the Ethics requirement to provide some value to the participants, the studies involved an element of training (i.e. introduction to UCD see section 3.4.2). Access to suitable participants from the host institution, Macquarie University, was sought. Later, to improve the generalizability of the findings another institution outside Australia was identified as a source of participant recruitment.

The study was first introduced to second year Software Engineering students (Study I) (chapter 7) in a tutorial session in semester two, 2013, at Macquarie University. This was later extended to the students studying second year Game Design course, semester one, 2014, at Macquarie University (Study II) and postgraduate Software Engineering students, semester two, 2014, at IT University of Copenhagen (Study III) (chapter 9).

3.4 Design Activities, Questionnaires and Test Instruments

The study consisted of seven main design and data collection activities:

1. Demographics,
2. Test of participants' knowledge about UCD,
3. Self-assessment of personality,
4. Rating of Holistic Persona,
5. Design activity and design questionnaire,
6. Post design questionnaire,
7. Spatial ability test.

In the sections below an overview of each activity, which provides the activity goal and the research methodology used to achieve the goal, are provided. Chapters 6 and 8 discuss each of these items in detail in the context of the studies conducted and provide a summary of the questionnaires. Appendix A and Appendix B include references to questionnaires.

3.4.1 *Demographics*

Participants answered a demographic questionnaire that provided background information such as gender, age, educational background and experiences. The demographics questionnaire did not contain any personally identifiable data so that participants could answer the questions anonymously and honestly.

The procedure used to implement the questionnaire is covered in section 5.3 and section 8.3 and the listing of the implemented questionnaires are in Appendix J and Appendix L.

3.4.2 *Introduction to UCD*

At the onset of the study, it became clear that the majority of the expected participants who were students at the University had little exposure to UCD techniques and principles. A small tutorial with quizzes was written so that those who were new to the UCD methodologies got an introduction to persona, scenario and conceptual design. The introduction also acted as a refresher for those who had some exposure to these concepts before and would allow all participants to start from a similar level of knowledge.

The procedure used to implement the Introduction to UCD is covered in section 5.2 and section 8.4, and the detailed implementation is in Appendix D.

3.4.3 *Self-Assessment of Personality*

The BFF of personality is widely used to understand the structure of personality (Butt and Phillips 2008, Chittaranjan et al. 2011, Hu and Pu 2013, Nov et al. 2013g, Oliveira et al. 2013,

Poropat 2009, Wilson et al. 2010). The target population for this research work is a normal adult population who live in the Western culture; the BFF of personality will adequately describe the target population. A participant can provide her/his personality by answering a self-assessment personality traits questionnaire. This information helps to investigate the relationship between personality and other factors such as their preferences or performance. Two models of the BFF of personality were evaluated for this thesis:

- Trait Descriptive Adjective (TDA) by Goldberg (1993) and
- NEO Personality Inventory, Revised (NEO PI-R) by Costa and McCrae (1992).

Both models use similar terms to describe the five factors (Goldberg 1993). According to Goldberg (1993) the BFF are: (1) Extraversion, (2) Agreeableness, (3) Conscientiousness, (4) Emotional Stability and (5) Imagination or Intellect. For studies conducted for this thesis Goldberg's TDA (Goldberg 1993) was selected for a participant to provide a self-assessment of her/his personality traits for the following reasons:

- It is published in many languages which can be helpful if this study is translated to a different language for a different set of participants
- It is widely used by researchers
- The questionnaire is free
- It can be setup online

The procedure used to implement the questionnaire is covered in sections 5.4 and 8.5, the detailed implemented questionnaire is in Appendix E.

3.4.4 *Personality Traits of the Holistic Persona*

To ensure that the authored Holistic Personas' personality traits as viewed by participants were similar to the intended personality traits, the participants assessed the Holistic Personas' personality. The assessment provided data for statistical evaluation of Holistic Personas' personality. Hence deductions can be made about the mass perception of the personality of the authored Holistic Personas. The following tools were investigated to assess the Holistic Persona's personality:

- Trait Descriptive Adjective (TDA) by Goldberg (1993),
- NEO Personality Inventory, Revised (NEO PI-R) by Costa and McCrae (1992),
- Ten-Item Personality Inventory (TIPI) (Gosling et al. 2003),
- Five-Item Personality Inventory (FIPI) (Gosling et al. 2003).

Gosling et al. (2003) found that FIPI has weaker correlation with the BFF and hence is not used. Either of the two tools, TDA or NEO PI-R, is too detailed and takes a long time to

complete. Hence TIPI was selected for the participants to assess Holistic Personas' personalities for the following reasons:

- TIPI is a short version of TDA,
- TIPI is freely available and widely used (Gosling et al. 2003),
- TIPI is validated in English (Gosling et al. 2003), German (Rammstedt and John 2007), Spanish (Romero et al. 2012) and Dutch (Hofmans et al. 2008).

The participant can assess Holistic Personas' personalities using the TIPI questionnaire. The participant can also indicate her/his feelings towards the Holistic Persona. The procedure to implement this questionnaire is covered in sections 5.5 and 8.6.1 and the full listing of the questionnaires are placed in Appendix F and Appendix G.

3.4.5 *Design Activity*

Participants are given opportunity to engage in a design activity with a Holistic Persona during which they can design or recommend a software application or a product to assist the Holistic Persona.

The procedure to implement the design activities are covered in section 5.6 and section 8.6.2 and the full listing of the design activities are covered in Appendix H and Appendix K.

3.4.6 *Design Modification Activity and Design Questionnaire*

The design activity is followed by a design modification activity and design questionnaire that separately for each Holistic Persona enquires about the influence of the Holistic Persona on the participant's thinking during that design session. Reflection-on-action is the thinking and reflecting that occurs after an event (Schön 1983).

The procedure to implement this activity and the questionnaire is covered in section 5.7 and section 8.7 and the full listing of the activity and questionnaire are placed in Appendix H and Appendix K.

3.4.7 *Post Design Questionnaire*

The final part covering the design activity is a post design questionnaire that enquires about the participant's preference of any of the Holistic Personas and their overall thinking during the design.

The procedures to implement the questionnaire are covered in section 5.8 and section 8.8 and the full listing of the activity and questionnaire are placed in Appendix I and Appendix K.

3.4.8 *Spatial Ability*

Participants' spatial ability was determined using the Purdue Visualization of Rotation test (Appendix M). The permission to use this test is freely granted (Bodner and Guay 1997). There were 20 questions and each question was placed on a separate page. Each correct answer was given one mark. There was no penalty for a wrong answer. The time spent to answer each question was recorded. The total marks and the marks obtained during the first ten minutes were used for statistical evaluations.

The procedure to implement the test is covered in section 5.9 and section 8.9 and the full listing of the activity and questionnaire are placed in Appendix M.

3.4.9 *Other Considerations*

An online study would reduce administration effort in contrast with a paper-based study that would require a considerable amount of logistic and organisational arrangements. The duration of the study was restricted to no more than 75 minutes for study I and no more than 110 minutes for Studies II and III to allow student participants to complete the study in one sitting during two-hour tutorial sessions.

One of the main objectives of the study was: 'do the participants tailor their designs according to the personality traits of Holistic Personas?' Hence any specification or brief about the design objective would restrict the conceptual design and introduce bias in the mind of designers. The intention was to compare design activities for each of the Holistic Personas with each other or to assess each design using a design rubric (chapter 6). In addition, previous research supported the incorporation of personality into applications' design (Behrenbruch et al. 2012). The studies in this thesis do not compare performance in design for Holistic Personas with personality and without personality or design to specification hence there is no need for a control group where there is a 'no treatment condition, because a second (third, fourth, etc.) experimental group can serve as the comparison group instead of a control group' (Sproull 1995, p. 136).

3.5 **Study Validity**

Numerous scholars refer to the concept of validity not restricted to the assessment of a test but also extended to the appropriateness and usefulness of the results. The Standards for Educational and Psychological Testing (American Educational Research Association, American Psychological Association & National Council on Measurement in Education, 1999) refers to validity as: '*the degree to which evidence and theory support the interpretations of test scores entailed by proposed uses of tests*' (p. 9). Earlier, Messick (1995) expounded a unified concept of validity as an adequate and appropriate assessment of the tests and

provision of scores, which are empirical evidences for interpretations and actions, as well as the theoretical rationale which support the evaluative judgements. Wohlin et al. (2012) provide a similar definition for validity and lists four types of threats to validity:

- Construct validity highlights the processes that are used to arrive at the answers and theoretical rationales for observed consistencies in test responses.
- Internal validity or causal validity is to ensure that all other affects that can cause variation in the result are eliminated or controlled.
- External validity or generalizability validity is to ensure that the results arrived at are not limited to the sample that is tested but is generalizable.
- Conclusion validity ensures that the conclusions drawn are statistically significant.

(Messick 1995) refers to other aspects of validity:

- Structural aspect refers to validity of the test assessment representing the experiment construct and structure.
- Threats to construct validity are under representation, does not include all the relevant facets, and irrelevant variance, assessment is too broad.
- Consequential aspect that is to consider the implications of test interpretation and use.
- Content validity, linked with construct validity, refers to the issue of relevance and representativeness which sets the boundaries of the domain. This includes the knowledge, skills, attitudes, motive and other attributes that are to be revealed by the respondent.

In sum, test validity and threat mitigation requires compelling arguments that the available evidence justifies the test interpretation and use even though some pertinent evidence had to be forgone (Messick 1995, p 744); validity should be adequate for the purposes for which the test is used (Wohlin et al. 2012).

Based on the above discussion, the following are the processes that were used to mitigate threats to validity and maintain consistencies in answers.

3.5.1.1 Internal Validity

The internal threats included partial completion of the study, maturation effect, boredom, fatigue, and learning effect, where participants learn from the examples given during introduction to UCD. For each known threat measures were taken to mitigate the threat or reduce its effects. To mitigate learning effect, during introduction to UCD no mention of personalities of personas or users were made. The participants' answers were checked for soundness for each section of the study. Below is an outline of methodologies to detect data that is not sound.

- Holistic Persona assessment: If same rating is selected for all questions for one or more of the Holistic Personas or the time to complete the questionnaire is less than one standard deviation from the average time, disregarding the extreme values, then data is checked for soundness.
- Self-assessment of personality: The time to answer the personality self-assessment questions is measured but not displayed. A short answer time compared to average answer time can indicate either boredom or fatigue. The data is checked for soundness.
- Boredom or fatigue indication: If a participant indicates that s/he has been bored or fatigued during rating of the Holistic Persons due to short answer time or in any of the entries in any of activities of the study, the data is checked for soundness.
- Design assessment: For assessing design activities, if analytic scoring rubric is found to be too rigid, in addition to quantitative assessment, qualitative assessment is used.

3.5.1.2 Partial Completion of Study

A major threat to the study is partial completion of a study. As the study consists of a number of activities, each activity can be used to investigate a relevant research question provided that activity has been completed by a participant. Following are the guidelines used to assess and use each activity for statistical evaluations and discussions:

- Self-assessment of personality: The Self-assessment of personality data is used in statistics only if a participant completes all the questionnaires.
- Holistic Persona ratings: The Holistic Persona rating data is used in Holistic Persona statistics only if a participant completes ratings of all Holistic Personas.
- Design artefact: The design artefact is used in analysis or statistical evaluation depending on the content. If the participant has made a meaningful entry, the details of design are used for evaluations or discussions. If the design artefact does not contain a meaningful entry, it is used for statistical evaluations related to lack of response to design activity. The design artefact is discarded if the participant uses inappropriate language.
- Design questionnaire: The design questionnaire is used only if a participant answers all the questions.
- Post design questionnaire: The post design questionnaire is used only if a participant answers all the questions.
- Spatial Ability: The Spatial Ability data is used in any statistics only if a participant completes the first ten minutes of the test.

3.5.2 *External Validity*

An external threat that relates to generalisation of the study is when the sample size is limited and is from a selected population. The participants in the study are mainly students who are studying either undergraduate or postgraduate subjects at universities. As this limitation cannot be overcome hence generalisation of the study can be done only by inferences and observation of personality traits. However the design of the study is such that it can be undertaken by any participant who is interested in UCD design.

A limitation of the study is participants' ability to express and articulate their thinking and type them at the same time during conception phase of the design. A method to overcome this limitation is videotaping the participants while they conduct their design work and ask participants to think a loud. Some participants may think more creatively when they can record their thoughts using pen and paper. These methods proved to be logistically too difficult to administer and hence they were not considered in this thesis.

3.5.3 *Conclusion Validity*

To increase the precision of empirical research, the studies and selected methods to conduct the studies were designed in such a way to achieve data source triangulation (Runeson and Höst 2009). However this raises a potential threat to be mitigated concerning the combining of the data from different participants with different educational and cultural backgrounds. This is discussed in more detail in chapter 11.

3.6 **Chapter Summary**

This chapter discussed the methods that were used for the studies in this thesis. The participants were provided with authored Holistic Personas with varied personality traits. Data provided by participants included their design artefacts, answers to design and post design questionnaires, ratings of personality traits of the Holistic Personas, feelings about the Holistic Personas and perceptions of Holistic Personas' requirements and their method of meeting the Holistic Personas' requirements.

This chapter also identified the requirements, design and limitations of the study, perceived threats and measures to mitigate them. It covered the perceived limitation of the generalisability of the study. The design of the study is such that it can be undertaken by any sample from any population who are interested in UCD design.

The next chapter covers the details of Holistic Persona.

4 Persona with personality

This chapter begins with a description of persona with personality. It covers an overview of authoring Personas with four different personalities, which were used to conduct the studies presented in this thesis.

4.1 Introduction to Persona with Personality and Holistic Persona

Humans are complex with numerous traits and characteristics. The more human characteristics are included in the persona that represents the end users of the software application, the closer the persona matches the end users which she/he is to represent. From the case studies outlined in Anvari and Tran (2013) and the literature review, it was conjectured that a persona with the following five main attributes or dimensions, Holistic Persona, produce an image in the mind of the designer and stakeholder that is closer to the target audience (Anvari and Tran 2013):

1. **Factual Dimension:** details that are not covered in other dimensions such as demographics or hobbies and interests.
2. **Personality Dimension:** extraversion, agreeableness, conscientiousness, emotional stability and imagination (Goldberg 1990),
3. **Intelligent Dimension:** linguistic, logical-mathematical, spatial, musical, bodily-kinaesthetic, interpersonal and intrapersonal (Gardner 1993),
4. **Knowledge Dimension:** factual knowledge, conceptual knowledge, procedural knowledge and meta-cognitive knowledge (Anderson et al. 2001)
5. **Cognitive Process Dimension:** Learning processes: remember, understand, apply, analyse, evaluate, and create (Krathwohl 2002).

Holistic Persona augment the persona by utilising the techniques that have been evolved, well researched and widely used in industry to identify and author persona (Anvari and Tran 2014). This thesis examines only the personality dimension of the persona. The other four dimensions of the Holistic Personas are authored similarly for all Holistic Personas. Hence for ease of reading, in this thesis, the term Holistic Persona is used interchangeably with persona with personality.

The inclusion of personality in persona is put forward based on some of the following examples found in the literature. Landers and Lounsbury (2006) reported emotionally unstable women seek information online anonymously and Lagoe and Atkin (2015) reported neurotic people with health anxiety more incline to seek online health information.

Behrenbruch et al. (2012) used persona with personality to develop a mobile social networks application. Goldberg et al. (2011) used personas to resolve challenges in health care requirements elicitation and provided a framework to design e-health information system. In an experiment Chen et al. (2011) used empathic design and personas as replacement for end users participation in the design and found that the designers were more focused on the users' emotions. Other researchers who have investigated role of personality in software development testing and user acceptance are Svendsen et al, (2013), Aly and Tapus (2013) and Devaraj et al. (2008).

4.2 Authoring Holistic Persona for the Studies

A Holistic Persona is similar to an ontological framework; it is hierarchical in structure. At the root of the hierarchy is an abstract Holistic Persona with five dimensions: factual, personality, intelligence, knowledge and cognitive process. Each dimension represents a concept with a set of guidelines to author the concept within the Holistic Persona. Further the details are added to or removed from each dimension in each subsequent layer that inherits the attributes from the layer above itself. The Holistic Personas represent target users in various cultures, languages and lifestyle settings. Hence it is multi-layered and multi branched. The framework provides a repository for vocabulary with guidelines for using words and phrases to author the Holistic Persona (Anvari and Tran 2013).

In this thesis the personality dimension of the Holistic Persona is under investigation hence the main emphasis in the authoring of the Holistic Personas is placed on the personality dimension. The other dimensions will be investigated in future research.

During the authoring of the Holistic Personas it was known that the main participants for the first study would be students studying second year Software Engineering subject at Macquarie University. This fact was an important consideration in authoring the Holistic Personas for target users as will be explained below in section 4.2.1. The second study was extended to include students who were studying second year Game Design subject at Macquarie University and the third study includes postgraduate Software Engineering students from IT University of Copenhagen. The Holistic Personas used in all three studies were almost identical with minor variations as explained in the following sections.

4.2.1 Preliminary Analysis and Target Identification

In authoring Holistic Persona it is essential to identify the target users of the application. This will help to test the Holistic Persona with a sample of the population. For identifying target users of the Holistic Persona, the techniques developed for *traditional persona* are utilised. In the literature numerous methods have been employed to identify the target users. Some of them are as follows:

- Market research (Goodwin 2009, pp.229-297),
- Soliciting information from stakeholders and focus groups (Adlin and Pruitt 2010),
- Identifying use cases and hence using them as persona (Switzky 2012),
- Project scope definitions (Schneidewind et al. 2012).

For the studies reported in this thesis the intended users were young adult students living in a Western culture. Details of assessing the personality of the Holistic Personas will be covered in section 5.5 and section 8.6.1 of this thesis.

Different techniques have been used to present personas with alternative media and varying information contents:

- Cooper (1999) proposed the idea of personas described with text and photographs.
- Guðjónsdóttir and Lindquist (2008) used posters and cardboard cut-outs to acquaint team members with personas.
- Long (2009) reported that designers showed a higher level of empathy towards personas with photos of real people compared with illustrated personas.

The Holistic Personas were authored using text and a photograph which the author took a few years earlier at Salamanca Market in Hobart, Tasmania (under Australian, UK and US laws the author owns the copyright to the photo). As this thesis concentrates on the personality dimension of the Holistic Persona hence the three sets of four Holistic Personas were authored to resemble each other in the four dimensions of factual, intelligence, knowledge and cognitive process and differ only in two factors of the personality traits as shown in Table 4.2.

4.2.2 ***Factual Dimension***

The factual dimension gives the Holistic Persona an identity and adds to her credibility. The factual information also provides background information for personality, intelligence, knowledge and cognitive process. Factual information can be some of the following information:

- Demographics
 - Location and Age– to provide information about type of people who live in the area, local laws etc.,
 - Name, to provide personal element and familiarity consistent with the location of the participants,
- Photo or illustration that represents the Holistic Persona: Photo reveals ethnicity, cultural background,

- Hobbies: Some hobbies demonstrate intelligence: sport - kinaesthetic, gardening - botanical, reading - literacy, etc. (intelligences are discussed later in this chapter),
- Special needs such as wearing glasses, using walking stick or allergies.

The first three items were used for authoring the Factual dimension of the Holistic Personas. The personas in the three studies were identical except the familiar Australian names of the personas and places used in Studies I and II, were modified in Study III to provide familiar Danish names and places. Hence the Holistic Persona for Australian participants was an Australian who lives in Hobart, Australia's second oldest capital city. For Danish participants the Holistic Persona lives in Odense, Denmark's third biggest city which was known to exist since 988.

The Holistic Personas for the studies presented in this thesis have the factual information shown in Table 4.1.

Table 4.1 : Factual Information for the Holistic Personas

No	Type	Factual Item	Study	Value	Explanation
1	Demographic	Name	I	For rating: Jane, Jean, Jade, June, For design: Doris, Kate, Minty, Eliza,	The names are distinct and neutral. Since it is for rating and design activity, neutral names do not create any bias.
			II	For rating and design: Doris, Kate, Minty, Eliza	
			III	For rating and design: Helena, Katerina, Meta, Agneta	
2	Demographic	Place	I & II	Hobart	Historic and typically European-descendent-dominated city in Australia
			III	Odense	Historic and typically Danish city in Denmark
3	Demographic	Socio economic	All	Middle class	Match with majority of the sample population
4	Demographic	Occupation	All	student	Match with majority of the sample population
5	Photo	Identification	All	Photo	Same photo for all Holistic Personas, so as not to introduce any biased feeling due to differences in photos.
6	ethnic	Culture and ethnicity	All	European background	Match with majority of the sample population

4.2.3 *Personality Dimension*

For this thesis the BFF of personality (section 2.7) were used to author the personality dimension of the Holistic Personas as it has been used by researchers who have conducted computer-based applications studies and experiments among population who have Western

culture: Butt and Phillips (2008), Chittaranjan et al. (2011), Hu and Pu (2013), Martínez et al. (2010), Nov et al. (2013g), Oliveira et al. (2013), Phillips et al. (2006), Poropat (2009), Wilson et al. (2010). The five factors of personality are (Goldberg 1993):

1. Extraversion,
2. Agreeableness,
3. Conscientiousness,
4. Emotional Stability and
5. Imagination.

The Holistic Persona's personality is constructed by choosing adjectives from the following sources:

1. Table 1 of Ashton et al. (2004) which contains 1710 adjectives,
2. Table 1-4 of Goldberg (1990),
3. Table 1-3 of Goldberg (1992),
4. Trait-names (Allport and Odbert 1936) – provides classification of terms.

The following is part of a list of principles that Gosling et al. (2003) provided to select descriptors for the TIPI which is used as a guide for selecting descriptors while authoring a Holistic Persona.

1. Facets of the BFF to guide the selections of descriptors for breadth of coverage
2. Items that represented both poles of each dimension are identified
3. Minimize redundancy among the descriptors.

Some of the classes of adjectives that do not indicate personality traits (Allport and Odbert 1936, Ashton et al. 2004) are used only as factual information while authoring Holistic Persona: habits, needs, attitudes, awkward, physical appearance, moods, social roles, relationships, effects, etcetera.

In summary, for authoring the personality dimension of the Holistic Persona, initially, the target audience is assessed and the degree by which each personality factor is to be dominant is decided. Using the above tables as a guide, suitable adjectives with the appropriate loading factors are selected which is mixed with factual description to provide a human-like characteristics description of the Holistic Persona.

It was not feasible to conduct a study involving combinations of all five personality traits. Hence Emotional Stability and Extraversion were selected for these studies as they were considered to relate more strongly and more consistently with subjective well-being at a personal level (Larsen and Ketelaar 1989, Luhmann and Eid 2009, Watson and Clark 1992) thus it is anticipated that the participants would be able to distinguish the traits and they

would find the combinations plausible and be able to identify a software product that addressed the persona's wellbeing. The two chosen personality factors are from two separate 'refined' factors, beta factor, plasticity and, alpha factor, stability respectively (DeYoung et al. 2010, Digman 1997). Three sets of four Holistic Personas that were authored were very similar to each other in all dimensions of factual, intelligence, knowledge and cognitive process and, differed only in the personality traits. The two personality factors extraversion and emotional stability that were varied are shown in Table 4.2 (Table 4.1 provides factual information).

Table 4.2 : Holistic Personas and their personality traits

Holistic Persona	Modified Personality Traits	
	Extraversion	Emotional Stability
Doris, Jane, Helena	Extravert	Emotionally stable
Katie, Jean, Katerina	Extravert	Emotionally unstable
Minty, Jade, Meta	Introvert	Emotionally stable
Eliza, June, Agnetta	Introvert	Emotionally unstable

For authoring Holistic Persona, Doris/Jane/Helena, Table 4.3 was compiled. The table shows the adjectives used and the contribution that the adjective makes to the Holistic Persona's personality. Similar tables were authored for other Holistic Personas.

Table 4.3 : Selection of Terms for Doris/Helena

Adjective used	Term in literature	Trait-name	Category	Factor loading Com (Fac)	Reliability Alpha(F)	Reference
Goes out	outgoing	extraversion	Sociability	75(74)	0.77(0.27)	Goldberg (1990) Table 1 and 2
Meets people	Companionable	extraversion	Sociability	75(74)	0.77(0.27)	Goldberg (1990) Table 1 and 2
Home	stable	Emotional stability	poise	61(60)	0.83(0.18)	Goldberg (1990) Table 1 and 2
Helping	helpful	agreeableness	Altruism	56(55)	0.76(0.10)	Goldberg (1990) Table 1 and 2
Notes: Fac - Principal Factors						

4.2.4 *Intelligence, Knowledge and Cognitive Process Dimensions*

All Holistic Personas have intelligence, knowledge and cognitive processes dimensions. Intelligence is the ability to solve problems. Gardner listed seven intelligences: linguistic,

logical-mathematical, spatial, musical, bodily-kinaesthetic, interpersonal and intrapersonal (Gardner 1993, pp. 7-9). The knowledge dimension identified by Anderson et al. (2001) has four major categories: factual, conceptual, procedural and meta-cognitive knowledge (Krathwohl 2002). The cognitive process dimension or learning process has six major categories: remember, understand, apply, analyse, evaluate and create (Krathwohl 2002). The cognitive process along with the knowledge dimension would place the Holistic Persona at a certain level of knowledge and learning ability. This can be a current state or a desired state.

For the studies conducted in this thesis, the intelligence, knowledge and cognitive processes dimensions were similar for all Holistic Personas. For cognitive processes, the Holistic Personas have abilities for remembering, understanding, applying and analysing, which are the abilities required midway through an arts degree in University. For example, being midway through their university studies also assumes the Holistic Personas have linguistic and logical intelligences. They also have factual and conceptual knowledge and are gaining analytical and meta-cognitive knowledge through their university studies. The other intelligence specifically mentioned is musical intelligence. The Holistic Personas are not involved in physical activities such as sports or dancing and hence are limited in their bodily-kinaesthetic intelligence. As a result, they have weight problems and require help on handling them.

4.3 Chapter Summary

This chapter presented an overview of how the Holistic Personas have been authored. As this thesis is centred on the personality dimension of the Holistic Persona, details on authoring the Holistic Persona's personality dimension has been provided with an outline for authoring other dimensions.

5 Design of Study I

Chapter 3 analysed the objective of the study in detail and presented the general methodology for conduct of the study. As outlined in Section 3.4, the study consisted of a number of parts. This chapter presents the experimental design used to achieve the objectives of each part of Study I. In this chapter also the limitations of Study I and risks to its validity are highlighted and measures taken to mitigate the risks are outlined.

Section 5.1 covers the experimental design environment in which Study I was prepared and details of the ethics approval for the studies. The remaining sections present the detail of the procedure followed, including introduction to UCD, persona, scenario and conceptual design, consent, demographic questionnaire, participant's personality, Holistic Persona rating, design session activity, post design session questionnaire overall experiences and spatial ability test. The chapter concludes with a chapter summary.

5.1 Study I - Experimental Design, Implementation and Ethics Approval

To answer the research questions, a between subjects design with one factor (personality) was chosen to allow comparison between participants' performance in design, each participant were assigned one Holistic Persona with one of the four personality combination conditions (see Table 4.2). It was anticipated that at least 25 participants would be recruited for each condition (a total of 100 participants) from the 120 enrolled second year Software Engineering students. More details regarding the design is presented in the sections below that cover the procedure followed in Study I.

An online system was chosen for the conduct of the study for following reasons:

1. Data quality is higher with less errors or missed entries than is possible with paper-based handwritten surveys that need to be entered manually.
2. An online system requires less administration and manual effort to monitor.
3. For the above reasons, it is typically cheaper to conduct a study using an online system.
4. A study can be conducted by any participant at any location in the world as long as they have access to a web browser connected to internet.
5. The participant can participate in a study at any time.
6. As the content is not hand written, it is easier to read and analyse.
7. The content is stored online in a record format hence it is not necessary to encode the results. The results can be downloaded to a database for analysis.

8. The storage of the content is online and hence access to records is convenient.

As most participants are Computing students, it was anticipated that they would prefer an online system. Study I was developed using online survey software called Qualtrics (2015).

The ethics approval was obtained for conduct of the studies in this thesis from the Faculty of Science Human Research Ethics Sub-Committee, Macquarie University reference number: 5201300553 dated 14th of Aug 2013. The last minor amendment was approved on 19th of November, 2014. The ethics approved letters are included in Appendix N.

A pilot trial was conducted during which, one participant used a paper-based version of the online questionnaire and six participants used the online system. The pilot trials were conducted to test the usability of the online instrument and the procedure. As the result of the trial, the order of presentations of the activities was changed: the spatial ability test was presented as the last item as some participants may forget the answers to some of the questions in the post design questionnaire.

5.2 Introduction to User Centred Design

It was expected that few of the participants had any exposure to UCD tools and principles. To the best of available knowledge, UCD principles are not taught at Macquarie University where the majority of the participants in this study are in an undergraduate course in the Department of Computing. In order for the participants to start the study with a similar level of knowledge, the participants received a tutorial containing an introduction to UCD, use of persona in design of software applications or products and conceptual design. Each section of the tutorial was followed by a quiz to reinforce the participant's understanding of the UCD principals. To mitigate any learning effect that might affect the study, during the introduction to UCD no mention of personalities of personas or users were made. The answers to quizzes were given at the end of the introduction session. Appendix D contains a printout of the Introduction to UCD.

In study I, all students who attended the tutorial session undertook this introduction for educational purposes as part of the Software Engineering course. The answers to the quizzes for this introduction are not included in this thesis.

5.3 Consent and Demographic Questionnaire

After the introductory session, if the participants wished to participate in the study, they were required to give their consent. Hence only the results of the performance of the participants who gave consent to the study are included in any evaluation presented in this thesis. All participants who decided to take part in the Study I were presented with a consent letter (Appendix C). They were requested to read the consent form, and print it if they wished

before they gave consent. In the consent letter participants were advised about the nature of the study, its duration and the feed-back they would receive. Only those who gave their consent continued with the study. Please see Appendix C for the full text of the consent. Participants were expected to finish this activity in 10 minutes.

After consent, the participants answered demographic questionnaire (Table 5.1). The questionnaire enquired about their background information without asking them to identify themselves. Appendix J contains a copy of the questionnaire. Participants were expected to finish this activity in 5 minutes.

Table 5.1 : Summary of Demographic questionnaire

No	Question	Answer type	Reason for the question
1	gender	Single choice answer from: Male, Female, Other	Gender related differences in design performance or spatial ability test scores.
2	Year of birth	Free text – has to be a number in the range 1929-1995 (70 – 18 years old)	The participants age range as a sample population.
3	Main profession	Single choice answer from: an under-graduate student a post-graduate student an academic / a researcher a professional (Free text entry) none of the above (Free text entry)	Indicative of maturity and level of previous experience
4	General Design experiences	Multi choice answers from: studied design subjects design experience Interest in design	Indicative of interest and experience in design in general. If a person is not interested in design, s/he would not take part in this study.
6	Knowledge of English language	Whether they are native English speakers or not (single choice answer) and if they have spoken and written in English for (single choice answer) less than 1 year 1 - 3 year more than 3 years	Identify the participant's knowledge of English language and if they can understand the subtle points about personality.
7	Country where the participant spent her/his youth	Single choice from a drop down box showing all the countries	Identify what cultural background the participant has
8	Subjects studied	Multi choice answers from: Software engineering Arts and literature studies Fine arts and music Other Science Human science Business and economics Other	The educational background provides insight into the participant's design and spatial ability

5.4 Participant's Personality

In the methodology, section 3.4.3, the Big-Five factors of personality was chosen to describe the target population for this study. Goldberg's IPIP questionnaires (Goldberg 1993) was selected for participant's self-assessment of personality for this study.

(Goldberg 1993) IPIP was coded on Qualtrics (2015) as a set of 50 statements and the participant rated each statement as it applied to herself / himself on a 5-point scale ranging from 1 (Very Inaccurate) to 5 (Very Accurate). To prevent an overly cluttered looking page, the 50 statements were broken into five pages containing ten statements each page (Appendix E). The time spent on this item was recorded but not displayed.

Participants were expected to finish this activity in 10 minutes. The time spent was used to mitigate threats to validity (section 5.10). The full listing of the questionnaire is placed in Appendix E.

5.5 Holistic Persona Assessment

From the methodology section 3.4.4, Holistic Personas' personality is assessed based on questions adopted from the Ten-Item Personality Inventory (TIPI) (Gosling et al. 2003). Four Holistic Personas (Jane, Jean, Jade, June) were presented for assessment (Table 4.2). Appendix F contains the details of the four Holistic Personas and the questionnaires. The order in which the four Holistic Personas were presented to each participant was randomised to remove any bias due to presentation order. During Holistic Persona assessment, participants read a Holistic Persona and performed the following activities:

1. Participants rated their likings and preferences for each of the Holistic Personas on a 7-point scale ranging from 1 (disagree strongly) to 7 (agree strongly).
2. Participants evaluated each of the four Holistic Personas' personalities answering ten personality assessment questions on a 7-point scale ranging from 1 (disagree strongly) to 7 (agree strongly).
3. Participants rated whether the Holistic Persona is a real person on a 7-point scale ranging from 1 (disagree strongly) to 7 (agree strongly).

Participants were expected to finish this activity in 20 minutes. The time spent on this item was recorded but not displayed. The time spent was used to mitigate threats to validity (section 5.10). The full listing of the questionnaire for this study is placed in Appendix F.

Table 5.2 : Summary of Holistic Persona Assessment Questionnaire

No	Question	Reason for the question
1	I like the personality of [Holistic Persona].	These questions are indicative of how the personality of the Holistic Persona is liked.
2	I like to work for [Holistic Persona].	
3	I empathise with [Holistic Persona].	
4	I emotionally resonate with [Holistic Persona].	
5	I see [Holistic Persona] as conventional, uncreative.	Negative question for Imagination personality factor.
6	I see [Holistic Persona] as extraverted, enthusiastic.	Positive question for Extraversion personality factor.
7	I see [Holistic Persona] as critical, quarrelsome.	Negative question for Agreeableness personality factor.
8	I see [Holistic Persona] as dependable, self-disciplined.	Positive question for Conscientiousness personality factor.
9	I see [Holistic Persona] as anxious, easily upset.	Negative question for Emotional Stability personality factor.
10	I see [Holistic Persona] as open to new experiences, complex.	Positive question for Imagination personality factor.
11	I see [Holistic Persona] as reserved, quiet.	Negative question for Extraversion personality factor.
12	I see [Holistic Persona] as sympathetic, warm.	Positive question for Agreeableness personality factor.
13	I see [Holistic Persona] as disorganized, careless.	Negative question for Conscientiousness personality factor.
14	I see [Holistic Persona] as calm, emotionally stable.	Positive question for Emotional Stability personality factor.
15	I think [Holistic Persona] is a real person.	How realistically the Holistic Persona represents a real person.
Note: [Holistic Persona] is replaced by a name: Jane, Jean, Jade, June.		

5.6 Design Session Activity

For Study I, one design activity was required; participants were given a Holistic Persona randomly selected from four Holistic Personas (Doris, Katie, Minty and Eliza - Appendix G) that were authored to be similar to Holistic Personas (Jane, Jean, Jade and June - Appendix F) that the participants assessed their personality in the previous step (section 5.5), with the exception that the Holistic Persona assigned had a common health issue (overweight) and three other minor issues for which the participants were expected to provide a conceptual design that would help the Holistic Persona to overcome her issues (Appendix G). The conceptual design consisted of design of a new application or recommendation of a suitable existing application that addresses the Holistic Persona's needs. Participants also were expected to write a scenario in which the Holistic Persona uses the software application.

The scenario writing helps to assess the usability of the software application and demonstrates how the participant has considered the needs of the Holistic Persona's personality in her/his design. Participants were expected to finish this activity in 15 minutes.

5.7 Design Session Questionnaire

In Study I the design session questionnaire was combined with post design questionnaire. The participants answered a questionnaire about the effects of the Holistic persona on their

Table 5.3 : Design questionnaire for Study I

No	Question	Answer	Reason
1	My scenario writing / design activity was with Holistic Persona	One choice from: Doris, Katie, Minty, Eliza, Cannot remember. A free text entry was provided for those who wished to comment on their selection.	To check if the participant remembers the name of the Holistic Persona (the basic fact) that she was working with.
2	I was totally engaged with the Holistic Persona's personality while carrying out the scenario writing / design activity.	On a 5-point scale ranging from (1) disagree strongly to (7) agree strongly.	To find out the participant's perception of her level of engagement with the Holistic Persona's personality. The answer can be tested by checking the design artefact.
3	To meet the Holistic Persona's needs, I added features to the design which otherwise I would not have added.	Yes/No. If yes is selected, a text box is displayed for explanation.	To check the participant's feeling about the influence of the personality of the Holistic Persona on the participant's design. The answer can be tested by checking the design artefact.
4	I would like to do another scenario writing / design activity with the same Holistic Persona or a persona that has similar personality again.	Yes/No	Did the participant like the Holistic Persona to the extent that s/he wants to do another design session with her?
5	I was thinking of a real person that I know when I was conducting the design.	Yes/No	Did the Holistic Persona remind the participant about a real person that the participant knows during their design activity?
6	The person I was thinking had same personality as the Holistic Persona.	Yes/No	Whether the similarity of the personality traits were the reason for remembering the person.
7	For my future design activity, if I have to choose only one Holistic Persona I would choose	One choice from: Jane Jean Jade June, I cannot remember the name. A free text entry was provided for those who wished to comment on their selection. (if a participant did not want any of the Holistic Personas, she can select this option and provide an explanation)	To find their preference for a Holistic Persona for future design activity. The choice can be cross checked with their answers to the questions measuring their liking of Holistic Personas (Table 5.2 items 1-4).

design activity. As they have spent more time with the Holistic Persona, they have a greater understanding of the personality of the Holistic Persona compared to the earlier

questionnaire (section 5.5) when they just rated the Holistic Persona. Table 5.3 presents the design questionnaire for Study I and Appendix K contains the full listing of the questionnaire. Participants were expected to finish this activity in 3 minutes.

5.8 Post Design Session Questionnaire – overall experiences

Participants answered questions from a questionnaire about their feelings and thinking about the Holistic Personas and their overall experiences during their design session. Table 5.4 presents a summary of the post design questionnaire. Appendix K contains the full listing of the post design questionnaire for Study I. Participants were expected to finish this activity in 2 minutes.

Table 5.4 : Post design questionnaire for Study I

No	Question	Type of Answer	Reason
1	I found that the scenario writing / design activity was easy.	On a 5-point scale ranging from (1) disagree strongly to (5) agree strongly.	To assess if there is any relationship between ease of scenario writing, the participants liking the Holistic Persona and having design ability.
2	Reflecting back at Spatial Ability test, I have done similar test before.	Yes/No	To check the relationship between previous training in spatial ability and the score in spatial ability test.
3	The software application or product I selected for design session was one of my previous design work or I was familiar with it.	on a 5-point scale ranging from (1) disagree strongly to (5) agree strongly.	To assess if familiarity with the design would make design and scenario writing easier.

5.9 Spatial Ability Test

Participants conducted a 20-item Purdue Visualization of Rotation test (Bodner and Guay (1997), section 3.4.8 and Appendix M). The total marks and the marks obtained during the first ten minutes were used for statistical evaluations. The time spent for each question was also used to mitigate threats to validity (section 5.10). Participants were expected to finish this activity in 10 minutes.

5.10 Measures to Mitigate Threats to Validity

The threats to validity are mitigated differently. For self-assessment of personality and the Holistic Personas' personality assessment, the threats are boredom and saturation but for spatial ability, network error and the participant taking a break during the test is the threat to validity of the results.

For personality self-assessment and assessing the Holistic Persona the following procedure was used to detect the participants whose answers are not correct due to boredom. Each page is timed separately but the timer is not displayed. The timing was used as an indication to check boredom or fatigue. The mean and standard deviation for the time was calculated for all participants after ignoring the extreme values. The answer times that are shorter than mean answer time minus one standard deviation were considered as a short answer time. If the answer time was short or the participant makes an entry in any of the text boxes that she/he is bored, the participant's data was investigated further to find out if the participant has made her/his selections attentively. The answer was rejected based on the following criteria:

1. If a single selection is made to more than 10% of the questions about self-assessment of personality then it indicates that the participant is bored or unwilling to give correct answer.
2. If there is a set pattern in answers to more than 20% of the questions about ratings of Holistic Personas then it indicates that the participant is bored or unwilling to give correct answer.

The threat to the Spatial Ability test is mainly due to it being conducted online. This test used to be taken under supervision using a printed note book. In this thesis participants accomplished this test using online system (Appendix M). A weakness of online test is that the participants can take the test at any time or place – they cannot be seen. If a participant took longer time to answer a question than would normally be the case, it could be either due to network error or the participant may have taken a short break during the test. The error could substantially lower the test result if it occurred in the first ten minutes. If the difference between the total marks and the marks obtained during the first ten minutes were large, the timing to answer each question was checked. The mean and standard deviation of time taken to answer each question was calculated ignoring for the extreme values. If the answer time to any of the questions was larger than the mean plus one standard deviation, it may be caused by the system delay in loading the page or the participant had taken a small break; since her/his overall performance in spatial ability was good, hence the question that took a long time was ignored. This correction was justified as follows: Originally the test was done using paper and pen and under supervision, hence there was no delay in displaying the images and there was no unmeasured break taken during the test. Scoring a high total marks was indicative of good spatial ability, hence, in these studies, it was likely that the longer than average time taken to answer only one question was due to system error.

A 'cheat sheet' was prepared for the tutors who conducted the study during the tutorial session to resolve perceived online issues. None of the tutors reported that they used the cheat sheet hence it is not produced in this thesis.

5.11 Chapter Summary

In Study I, participants performed the activities listed below linearly and independently:

1. Introduction to UCD (Appendix D - for educational purposes only): the participant received a brief explanation about the UCD methodology and use of persona in design of software applications.
1. Consent agreement (Appendix C): The participants who wished to take part in the study gave their consent.
2. Demographics (Appendix J): Participants answered questions from a demographic survey questionnaire.
3. Self-assessment of personality (Appendix E): Participants answered questions from a personality test questionnaire.
4. Participants performed the ratings of four Holistic Personas (Jane, Jean, Jade and June – Appendix F) presented in random manner.
5. Participants performed one design session activity of about 15 minute duration (five minutes reading time and ten minutes conducting the design activity) with a Holistic Persona, Doris or Katie or Minty or Eliza (Appendix G) to design an application or recommend an existing application that suits the Holistic Persona.
6. Participants answered a design session questionnaire (Appendix K).
7. Participants answered a post design questionnaires about their design experience, perceptions of the Holistic Persona and features that were added in the design to help the assigned Holistic Persona (Appendix K).
8. Participants performed Purdue Visualization of Rotations Test (Appendix M).

In Study I, participants performed only one design session with one Holistic Persona hence the participants did not modify their design.

6 Design Rubric

This chapter covers the procedure followed to design a rubric to assess the design artefacts. The result of the literature search for the differences between rubrics used for long term projects (e.g. course work) and short term activities (such as tests or a quick design work) is presented in section 6.1. As the design activity assessed in this thesis is short term, the emphasis is placed on assessment rubrics for short term design work (section 6.2). The assessment tools are discussed with references to the notion of validity and reliability which was presented in section 3.5. Details of the designed rubric with examples are presented in section 6.3. The summary section 6.5 lists the requirements of the rubric for this thesis.

As part of the rubric design, and for appropriate assessment of the design work, in this thesis the motivating requirement for the design has been deduced, that is, the requirement that the designer used in creating the design (section 10.3.3). The motivating requirement can be used to gain an understanding of and insight into the designer's thinking at the time of conception of the design. Though the work started on the rubric during the planning stage, the rubric was completed after the end of the first study. Some minor modifications were done at the end of the third study. Due to these changes and the use of the design score in answering one of the research questions (section 7.6), all design activities were reassessed. However, there were no changes in any of the conclusions reached earlier.

6.1 Overview of a Rubric for Assessing Design Artefacts

In this section, rubric as an assessment tool of written work is defined (section 6.1.1) and two different styles of assessment are investigated: Biggs category system of grading and Blooms Taxonomy (section 6.1.2). The types of rubrics, qualitative and quantitative rubrics as well as rubrics for short term and long term activities are discussed in the section 6.2. The rubric devised for assessing the design artefacts in this thesis is presented in the section 6.3.

6.1.1 Definition of Rubric

Rubric, a descriptive scoring scheme, as an assessment tool assists in consistent subjective assessment of a written work (Brookhart 1999). In an assessment tool, the work is divided into categories and a score is allocated to each category by considering the description of the characteristics of the responses within each category (Brookhart 1999, Moskal 2000). The design of the assessment tool should be such that the results produced are valid, reliable, comparable and fair (Messick 1995).

6.1.2 ***Biggs Category System and Blooms Taxonomy for Grading***

Biggs (1992) proposed a category system of grading to address higher cognitive level outcomes. The work is graded into one of the five main categories and levels within each category denoting the work is barely adequate to exceptional (Biggs 1992). The categories and levels can then be translated to marks for statistical evaluation, which looks similar to marking along a single continuum, with the exception that using the categories and levels establishes a qualitative mind-set in the assessor. The stages in Structure of Observed Learning Outcomes (SOLO) taxonomy (Biggs and Collis 1982) are (Hattie et al. 1996, pp. 103-105):

1. Failure - *in a cognitive sense of poor learning,*
2. Prestructural - *The student engages in preliminary preparation, but the task itself is not attacked in an appropriate way.*
3. Unistructural - *One aspect of the task is picked up*
Multistructural - *several aspects of the task are picked up serially, but are not interrelated.*
4. Relational - *Several aspects are integrated into a coherent whole.*
5. Extended abstract - *Coherent whole is generalized to a higher level of abstraction.*

Biggs' category system is intended for a course duration that is long term as the system helps the student to improve her/his performance (Biggs and Collis 1982).

Blooms taxonomy revolves around the knowledge that a participant has and cognitive process to use the knowledge Anderson et al. (2001). The knowledge of a subject matter, as identified by Anderson et al. (2001) is the agreement between the scholars in the field. The knowledge of a field has four major categories: factual, conceptual, procedural and meta-cognitive (Krathwohl 2002). The cognitive process dimension or learning process has six major categories: remember, understand, apply, analyse, evaluate and create (Krathwohl 2002). Each category is divided into sub-categories (Krathwohl 2002). In a sentence that describes knowledge and cognitive process, the noun refers to the knowledge dimension. The verb that provides action for knowledge categorises the cognitive process.

Anderson et al. (2001, table 3.1) present a two dimensional table, the rows represent the knowledge dimension and columns are the cognitive processes dimension. Each objective is analysed by closely examining the verbs, or verb phrases, and nouns, or noun phrases. The objective is placed in appropriate cell that represent the category of knowledge sought and the cognitive process required to process the knowledge. With this table, the instructions given can be analysed and similarly placed in a cell of the table. In assessing the performance the student's artefact is analysed for the knowledge content and the cognitive processes used

and similarly placed in a cell of the table. Thus the table provides an alignment of the educational objectives, instructions given and the student's achievements. Anderson et al. (2001) provide six vignettes demonstrating the use of the taxonomy table in setting objective, teaching and assessing. However the revised Bloom's taxonomy can be used to assess performance in tests where the focus is on the evaluation of the produced artefacts.

6.1.3 *Analytic and Holistic Rubric*

Analytic and holistic rubrics use different approaches for the assessment of design work; in an analytic scoring rubric each criterion is scored on a different descriptive scale but in a holistic scoring rubric the scoring is allocated on a single descriptive scale considering all criteria (Brookhart 2004). Qualitative assessment tools are used for observation, interviews/focus groups and documents and quantitative assessment tools are used for surveys and questionnaires (Moazzen et al. 2013). An analytic rubric provides for an objective assessment of the design. It also prevents personal judgement affecting the assessments. It provides a standard for other experienced assessors to assess the markings independently.

6.1.4 *Assessment Tools for Design Scenario – a literature review*

The notion of validity of the assessment tool is closely interlinked with the tool representing the experiment construct and structure, and interpretation of the results (Messick 1995). Reliability refers to consistency of assessed scores. The kinds of reliability relevant to a rubric are inter-assessors reliability, when two assessors evaluate the work and give same or similar score to the work and intra-assessor reliability, when an assessor evaluates the work similarly at different times (Moskal and Leydens 2000).

Researchers often use assessment tools to monitor students' progress in design courses. For example, McMartin et al. (2000) developed a rubric consisting of seven criteria to measure undergraduate engineering design capability in a scenario based assignment, where the students were assessed based on how they would solve a realistic problem rather than providing a solution (McMartin et al. 2000, p. 113):

1. *Student Recognizes and Determines When a Problem Is Worth Solving*
2. *Student Defines (Frames) Problem Accurately*
3. *Student Articulates Social, Economic, and Technical Constraints of a Problem*
4. *Student Devises Process and Work Plan to Solve Problem*
5. *Student Identifies, Considers, and Weighs Options or Consequences of Plan and Design*
6. *Student Negotiates Various Design Approaches with a Multidisciplinary Group/Team*
7. *Student Leads or Follows When Appropriate to the Needs of the Group*

Each criterion was marked on a scale of 1 to 4 according to following guidelines (p. 117):

- *4 marks - Sophisticated: meets most or all criteria to an exceptional degree,*
- *3 marks - Adequate: meets some criteria to an adequate degree,*
- *2 marks - Limited: meets few criteria to a limited degree*
- *1 mark - Incompetent: fails to meet criteria.*

In the pilot study in which the rubric was tested, McMartin et al. (2000) found that different assessors rated the design activity consistently.

In designing a rubric for assessing the design produced by engineering students, Bailey and Szabo (2007) specified the design objectives that were going to be measured and listed key criteria of an assessment strategy to suit their requirements. Bailey and Szabo (2007) devised a rubric with 17 different levels to assess engineering design works which they found is too detailed and hence for future work decided to collapse some of the steps. Two of key criteria that Bailey and Szabo (2007) considered were: (1) the rubric assesses processes and (2) the rubric criteria are linked to different levels of Bloom's taxonomy (Anderson et al. 2001): remembering, understanding, applying, analysing, evaluating, and creating. Zowghi (2009) used Blooms taxonomy (Anderson et al. 2001) to assess Requirements Engineering students' gain in knowledge which most students achieved to *Comprehension* level or above.

The details of assessment tools for the design activity vary depending on the length of the design time. For a short design time, assessment tools generally concentrate on problem definition and conceptual design. For a longer design time such as course work, in addition to the requirements for a short design time, more criteria are involved, as the design activity is more complex, there is time for research, information gathering, documentation of conceptual and detailed design, and often collaboration with other designers. Inclusion of all these elements in the rubric makes the assessment tool more complex. Part of the rubric that Mckenna et al. (2007) used to evaluate design processes for a design course is as follows:

- Clear articulation of design problem
- Following appropriate research methodology
- Development of feasible design alternatives
- Solicitation of feedback from users, experts and peers
- Definition of specifications and requirements
- Meeting the established goals of the design

The rubric that Mckenna et al. (2007) used for assessing the design included scoring criteria related to the course objectives such as the use of appropriate design techniques,

tools, processes, qualitative analysis of alternatives, modelling, simulation, testing, demonstration of analytical refinement of the design, discussion of assumptions and sources of bias. Each criterion was evaluated on the scale of one, substandard performance, to ten, outstanding performance, including Nm, item not mentioned, and, n/a, item not appropriate for the stage of design. McKenna et al. (2007) present the result of one semester only and the mean and standard deviation for each criterion for the eight coders (five academics and three industry representatives) who assessed the students' design activity. The authors, also, used the rubric to identify the areas of strengths and weaknesses of the students' project work. This rubric is similar to McMartin et al. (2000)'s rubric mentioned earlier.

6.2 Factors Considered and Methodologies Used to Design the Rubric

Blooms Taxonomy is more relevant to this research as it can classify different levels of cognitive processes and knowledge and it is more applicable to assess works of short duration as it facilitates development of a marking scheme rather than Biggs which is a general assessment used for feedback to the students. Hence Blooms Taxonomy is used within this work for the design of the rubric. In this thesis the design activity has a short duration. Hence the assessment tools used are for a short design session such as McMartin et al. (2000)'s scenario writing. In developing a rubric, the issues that the participants faced were considered:

- the design task was not restricted to any kind of software application or product;
- the participants' knowledge was unknown;
- during the design activity, participants had limited resources to investigate the issues the Holistic Persona faced;
- the means to present the design was limited to written text only;
- the time allocated for the design task was short;
- the participants did not have any pre knowledge of the design task.

In addition, the following list of key criteria was considered for the design of a rubric for assessing the design produced by the participants.

1. Reliability: The rubric is reliable (inter-assessors and intra-assessor).
2. Process focused design: The rubric can evaluate a design that is process focused.
3. Bloom's taxonomy: The rubric distinguishes different levels of Bloom's taxonomy – in the design work the create level is clearly distinguishable.
4. Problem identification: The rubric can distinguish the design that has identified problem areas correctly and has provided a solution.
5. Factual information: The rubric can distinguish the design that has considered factual information and incorporated these into design work.

6. Needs on an individual level: The rubric can distinguish the design that has considered Holistic Persona's needs on an individual level.
7. Personality: The rubric can distinguish the design that has considered Holistic Persona's personality and has incorporated this understanding in the design.

The above key criteria are in line with the recommendation from previous researchers for the design of a rubric (Bailey and Szabo 2007).

The above criteria were used as a guide as the rubric was developed iteratively. Adopting a holistic approach in the first iteration, all the design works were studied and ranked noting the salient features of various designs and Holistic Persona's needs. In later iterations, emphasis was shifted from holistic approach to analytic approach and categories were devised and assessment objectives were set for each category. A number of detailed examples were provided so that inter-assessors and intra-assessor reliabilities can be maintained. Scholarly literatures were used as references to set standards for assessing the suitability of the design to the Holistic Persona's needs. The maximum score for the design activity is set at 15 marks. The number of marks allocated is based on the fact that the design duration is 15 minutes. As a general guide, in universities, the number of marks allocated for assessment of each examinable piece is equal to the number of minutes of exam duration for that piece.

Finally the analytic rubric (section 6.3) was devised and was used to assess each design artefact. The rubric was reviewed independently by an experienced designer Hien Minh Thi Tran and the author's supervisor, Professor Deborah Richards, and associate supervisor, Associate Professor Michael Hitchens. Adjustments were made to the rubric to resolve any discrepancies.

6.3 Details of Rubric for Design Activity

The design rubric consists of five parts for numeric scoring and two parts for qualitative assessment (Table 6.1):

1. Abstract Design (maximum 5 marks)
2. Design scenario (maximum 3 marks)
3. Factual information and reminder (maximum 2 marks)
4. Weight issues (maximum 2 marks)
5. Suitability to Holistic Persona (maximum 3 marks)
6. Personality Consideration (N – Not considered; C – Considered; I – In-depth)
7. In problem space (Y – Yes; N – No)

In Appendix O under separate headings each part of the rubric is expounded which consist of reference name, description, total marks assigned to each section and how the allocation of

mark is justified with examples for the marking. A summary of the rubric is presented in Table 6.1 for quick reference. Examples showing how rubric is used are placed in Appendix P.

One of the main issues that the Holistic Persona is facing is that she is overweight. Hence a separate part (part 4) is added to give credit to the design that addresses weight issue by concentrating on food, exercise or any way in which it can help Holistic Persona to reduce her weight. The Holistic Persona does not have any issues with other activities such as managing her musical interests or her studies; hence addressing other interests or aspects of her life in the design attracts credit for abstract design (part 1) only. If a participant indicates that her/his design is to help the Holistic Persona to deal with weight or forgetfulness issues either immediately or in the long term s/he gets credit for connectedness in suitability of the design to Holistic Persona (part 5). An example of connectedness would be to provide the Holistic Persona a confidence building tool with the intention that she can take part in sporting activity.

6.4 Rubric - Risks and Mitigation Measures

The risks identified and attempts to mitigate them are listed below:

- 1- Margin of error with the markings: From the rubric description, it was anticipated that the margin of error can be half a mark in each category. Hence the maximum margin of error can be two and a half marks which is 17% of the maximum mark. The margin of error is considered in discussion and conclusions reached using the rubric. Attempts were made to reduce this margin by:
 - a. Clarifying and revising the rubric further during marking process so as to improve inter assessment consistency.
 - b. Remarking all design artefacts a number of times to ensure intra assessment consistency.
- 2- Independent examination and testing of the Rubric: The rubric was examined and pilot tested by an experienced designer, Hien Minh Thi Tran. The pilot testing consisted of independently marking 10 design artefacts from the first study using the rubric. The markings were very close to the author's markings.

6.5 Summary of Design Rubric

This chapter provided the details of design rubric to assess design artefacts. The rubric consists of both qualitative and quantitative assessment. The quantitative assessment consists of five categories and maximum score is 15 marks. The qualitative assessments to

Table 6.1 : Summary of the UCD Rubric

Rubric No	Artefact	Descriptions	Marks or rank assigned
1	Abstract Design or Existing Application	<p>Abstract Design: A new generic application that would serve the persona</p> <p>Existing Application: Recommending an existing application or product e.g. Forum, Diary</p>	<p>5 marks in total</p> <p>1 mark – mention an application for use by the Holistic Persona.</p> <p>3 marks – providing details on how a standalone or an internet based application with a database such as dietary, forum or diary application works.</p> <p>1 mark – having unique features such as GPS to detect location and online connectedness with other systems and applications or data is automatically loaded by detecting location, motion, etc.</p> <p>1 mark Goal setting, reminder and advisor.</p>
2	Scenario	Holistic persona's interaction with the system	<p>3 marks in total</p> <p>1 mark – an interaction with the system for a basic activity which explains and clarifies some aspect of the design. This can be a query or to display of information.</p> <p>3 marks –an interaction with the system to carry out a significant task and the tasks that demonstrates that the conceptual design is working.</p>
3	Factual information	<p>Designer used Name and addressed these issues:</p> <p>Allergy</p> <p>Skin lotion</p> <p>Short sightedness</p>	<p>2 marks in total</p> <p>0.5 mark – refer to Holistic Persona by name</p> <p>0.5 mark – refer to her allergy</p> <p>0.5 mark – refer to her skin disorder</p> <p>0.5 mark – refer to her short-sightedness</p>
4	Addressing Weight Issue	Suggestions of food or exercise	<p>2 marks in total</p> <p>0.5 mark – acknowledging the problem by mentioning food or exercise.</p> <p>1 mark giving a simple feature e.g. an exercise reminder application</p> <p>2 marks – providing a comprehensive feature to address the weight issue. E.g. graph of BMI, food intake, calorie counter, exercise</p>
5	Suitable to the Holistic Persona	<p>These features help the suitability of the application to the Holistic Persona.</p> <p>Platform: PC / Mobile / Portable</p>	<p>3 marks in total</p> <p>1 mark for Ideas</p> <p>1 mark for Connections</p> <p>1 mark for Extensions</p> <p>Extension is taking account of the needs of Holistic Persona. For examples :</p> <p>Suggestive (Extravert)</p> <p>Informative (Emotionally Stable)</p> <p>Directive (Emotionally Unstable)</p> <p>e.g. an extravert needs a mobile application; providing encouragement or using peer pressure according to the personality</p>
6	Personality Consideration	Has designer considered the personality of the Holistic Persona in Design	<p>N – Not considered: Offered generic design or one design for all Holistic Personas or different designs for each of the Holistic Personas without explaining how it would suit each one.</p> <p>C – Considered: Offered explanation but is not adequate or cannot be supported</p> <p>I – In-depth: produced a design and/or offered explanations that are in line with literature</p>
7	In problem space	Is the design in problem space	<p>This is qualitative analysis</p> <p>Y- Yes: If any of the designs offered helps the Holistic Persona to overcome the stated problems of weight issues or remind her</p> <p>N – No: If the designs offered does not help the Holistic Persona but assist her purely in other areas such as her study or musical ability.</p>

categorise the design work in relation to the objectives of the thesis is: what requirement was the motivating requirement for the design (section 10.3.3). Examples showing how rubric is

used are placed in Appendix O. The rubric developed here is used in chapter 7 and chapter 10 for analysis of design work. The next chapter covers the Results of Study I.

7 Results of Study I

Study I was conducted following the procedure outlined in chapter 5. The second and third studies were conducted using a slightly modified procedure which will be described in chapter 8. There are a number of results that are common between the two studies and these are presented jointly in chapter 10. This chapter presents the statistics for, and the results that are applicable only to Study I.

7.1 Participants in the Study I

Study I was conducted in September 2013. The majority of participants for this research were recruited as part of the second year computing subject COMP 255 - Software Engineering taught within Computer Science Department, Faculty of Science, Macquarie University. Additionally, 11 adults, aged over 18 (Table 7.1 and Table 7.2), some of whom were students at Macquarie University or were professionals from Macquarie University or outside the university, participated in this study. Overall, 127 participants, aged between 18 and 67, took part in this study. Two participants were undergraduate students studying IT related courses and 113 participants were undergraduate students studying the second year Software Engineering subject who were invited to participate in this research during a tutorial session without receiving any course credit. Four participants were doing postgraduate studies and eight participants were not students. None of the participants received any financial benefit by participating in this study. Not all participants completed all activities in Study I. A number of participants stopped the study before completing the self-assessment of personality and their data were discarded. Data from 41 participants, sample population, are used in this thesis. They completed demographics, self-assessment of personality and at least one of the activities of Holistic Persona assessment, design artefact, design questionnaire, post design questionnaire and spatial ability (section 3.5.1.2). Table 7.1 provides statistics for participants whose data were used for analysis and discussions. Table 7.2 presents the demographics for the sample population (Table 7.1, No. 4).

The participants who completed the design session for a Holistic Persona are referred as aspiring UCD designers (Table 7.1 No. 6). The data from aspiring UCD designers are used for statistical evaluations of conceptual design.

In the sample population, for the question about gender, 78 % of the participants selected male, 17 % of the sample population selected female and 5 % of the sample population selected other. 93 % of the sample population spoke and wrote in English for more than three years; 7 % of the sample population wrote and spoke English for 1-3 years. 80 % of the

Table 7.1 : Participants in the Study I

No	Participants	Number of participants
1	Total number of participants who initiated in the study	127
2	did not give consent	12
3	Participants who stopped the study before finishing ratings of Holistic Personas or their data were misleading and discarded	74
4	Participated in the study - either fully or partially (sample population)	41
5	Completed assessment of Holistic Personas	38
6	Completed or attempted design session for Holistic Persona (aspiring UCD designers)	33
7	Completed post design questionnaire	32
8	Completed self-assessment of personality, design and spatial ability test	32

sample population had lived in Australia or New Zealand or UK or the USA during their youth. Most of the sample population finished the study, including the introductory session, within 70 minutes.

Table 7.2 : Demographics of participants in the study

No	Demographic	Participants %
1	Professional	17
2	Postgraduate	10
3	Undergraduate	73
4	Male	78
5	Female	17
6	Other	5
7	Native English speakers	73
8	Non-native English speakers who have spoken and written in English >3 years	20
9	Non-native English speakers who have spoken and written in English 1-3 years	7
10	Youth years spent in Australia, New Zealand, UK or USA	80
11	Undergraduate Students	73
Those who classified themselves as professional in Australia were: Financial Analyst, Artist, Hydraulic Engineer, Human Resources Manager, Chef and unknown (two).		

The participants who gave an email address received a copy of their results for the spatial ability and personality tests. All participants were thanked for their participation in the study.

7.2 Results of Study I

The results from study I are presented in the following sections covering the following topics:

1. Participants' assessment of Holistic Personas personality (section 7.3),

2. Participants' preferences for a Holistic Persona (section 7.4),
3. Effect of Holistic Persona on conceptual design (section 7.5).

7.3 Participants' Assessment of Holistic Personas' Personalities

This section of the thesis provides statistical result for the assessment of the personality of the Holistic Persona. Initially the objective of the analysis is presented followed by the results, discussion and conclusion for this objective. This section's methodology follows closely the publication Anvari et al. (2015)

7.3.1 Objective - Participants' Assessment of the Holistic Persona's Personality

The Holistic Persona should be assessed by a sample from the target population to ensure that the authored personality dimension is as intended. In study I the participants assessed four Holistic Personas. The objective of analysis in this section is:

Do the sample population recognise the personality dimension of a Holistic Persona as intended?

7.3.2 Analysis of Results and Discussion

For this analysis of the sample population, the number of participants who have

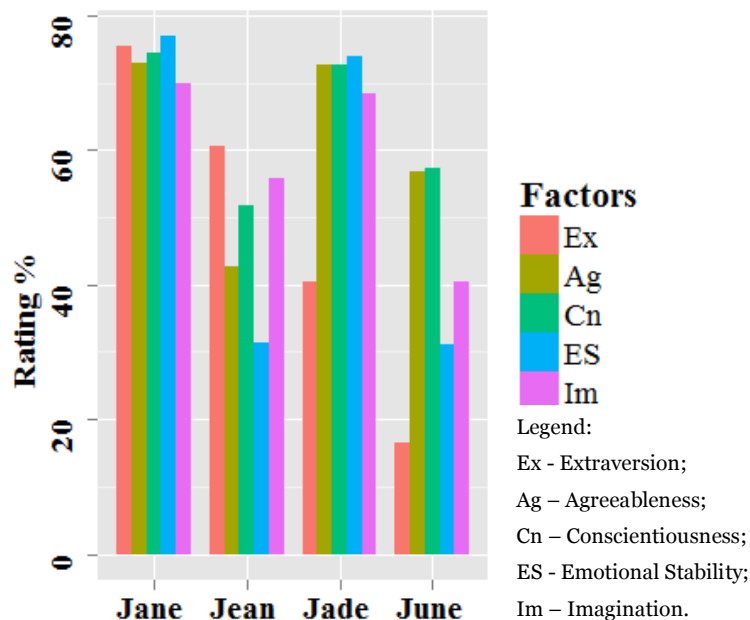


Figure 7.1 : Mean values of Holistic Personas' personality factors assessed by the sample population.
completed assessment of Holistic Personas is 38 (Table 7.1).

The bi-polar answers to the Holistic Persona's assessment questions on a 7 point Likert scale are added together after reverse scoring the negative questions (Gosling et al. 2003) and recoding to provide results in the range of 0-12. The resultant data is treated as interval-level data, converted to percentages and analysed using R statistical packages (Field et al. 2012). The mean values (in percentages) of the rating given to each persona by the sample population are presented in Table 7.3 and Figure 7.1.

Table 7.3 : Mean values of holistic personas' personality factors assessed by the sample population

Persona	Ex %	Ag %	Cn %	ES %	Im %	Holistic Persona represents a real person %
Jane	75 **	73 *	75 **	77 **	70 **	61 **
Jean	61	43+	52	31 *	56	58 **
Jade	40 *	73 *	73 *	74 **	68 **	72 **
June	16 **	57 *	57	31 +	41+	61 +
Note: ** p < .01 ; * p< 0.05; + p<0.1 Legend: Ex - extraversion; Ag – agreeableness; Cn – conscientiousness; ES - emotional stability; Im – imagination.						

Due to inter relationship between the five factors (Ehrhart et al. 2009), even though the other personality traits agreeableness, consciousness and imagination are authored similarly for the personas, the sample population rated these factors differently.

The dominant point to notice from Table 7.3, Table 7.4 and Figure 7.1 is that Jade has been rated similarly to Jane in all factors except extraversion. June is rated similarly to Jean in all factors except extraversion. Also Table 7.3 shows that Jane and Jade are rated high for emotionally stability (77% and 74%) and Jean and June are rated low for emotionally stability (both 31%). These results confirm the design of the personas, as listed in Table 4.2.

Table 7.4 : Average differences between the four Holistic Personas for each of the Five Factors of Personality

No	Holistic Personas differentiated		Ex %	Ag %	Cn %	ES %	Im %
1	Jane	Jean	14	30	23	46	14
2	Jane	Jade	35	0	2	3	2
3	Jane	June	59	16	18	46	29
4	Jean	Jade	21	-30	-21	-43	-12
5	Jean	June	45	-14	-5	0	15
6	Jade	June	24	16	16	43	27
Note: the bold items were the factors that were purposely manipulated in the Holistic Persona. Legend: Ex - extraversion; Ag – agreeableness; Cn – conscientiousness; ES - emotional stability; Im – imagination.							

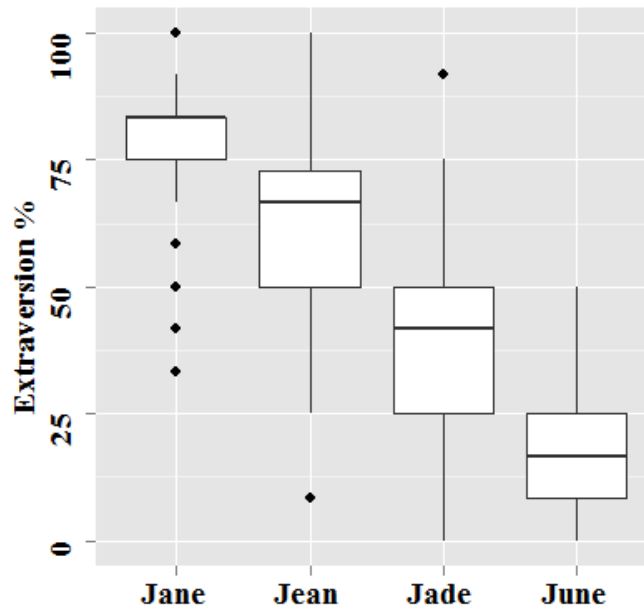


Figure 7.2 : Box plot of the sample population assessment of Holistic Personas' extraversion factor

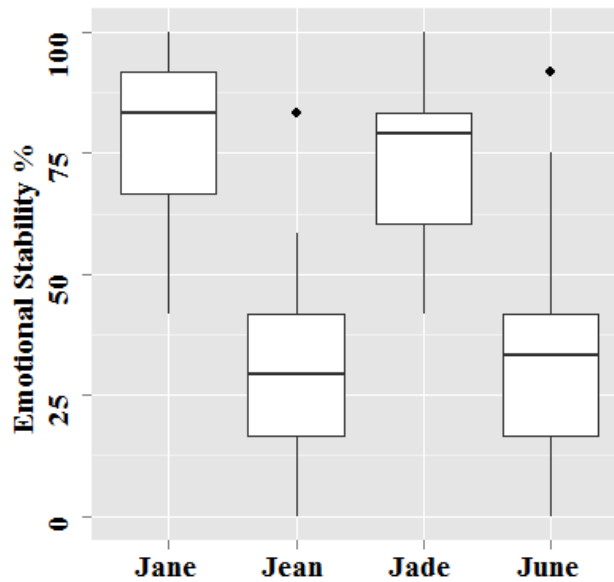


Figure 7.3 : Box plot of the sample population assessment of Holistic Personas' emotional stability factor

The box plot of participant assessment of the personality factors for two factors of extraversion and emotional stability are shown in Figure 7.2 and Figure 7.3. Figure 7.2 shows that the sample population rated Jane and Jean as extraverts whereas Jade and June are rated as introverts. Figure 7.3 shows that the sample population rated Jane and Jade as being high on emotional stability factor but Jean and June are rated as being low. Again, this conforms to the design of the personas.

Table 7.4 shows the average of the differences between the ratings the sample population gave to the personalities of each of the personas. Jane and Jade are rated similarly for all personality traits except extraversion where Jane is more extraverted than Jade (35% higher), as intended. Jean was intended to be only lower on emotional stability (46% lower) compared to Jane, but the participants rated her lower also for personality factors of extraversion (14% lower), agreeableness (30% lower), conscientiousness (23% lower) and imagination (14% lower) despite the fact that Jane and Jean's academic achievements, musical abilities, cognitive abilities and knowledge were kept constant. Similarly comparing Jane with June, June scored lower not only in the two factors of extraversion (59% lower) and emotional stability (46% lower) which were as intended but also scored lower in agreeableness (16% lower), conscientiousness (18% lower) and imagination (29% lower). As shown in Table 7.4 these differences don't affect the overall results.

The inter-factor correlation as given by Ehrhart et al. (2009) shows that emotional stability and extraversion affect the ratings of agreeableness, conscientiousness and imagination. Table 7.5 presents inter-correlation between each factor of emotional stability and extraversion, and the other three factors of agreeableness, conscientiousness and imagination that are found in the literature. This explains why some participants misidentified some personality traits.

Table 7.5 : Inter correlation between personality factors found in literature

Reference	Ex and Ag	Ex and Cn	Ex and Im	ES and Ag	ES and Cn	ES and Im
Ehrhart et al. (2009) table 1	0.05	0.04	0.15	0.27	0.18	0.22
Devaraj et al. (2008) table 1	0.21	0.28	0.20	0.15*	0.3*	0.13*
Moore and McElroy (2012) table 1	0.44	0.17	0.38	0.16	-0.02	0.18
Legend: Ex - extraversion; Ag – agreeableness; Cn – conscientiousness; ES - emotional stability; Im – imagination.						
* Devaraj et al. (2008) reports relationship between neuroticism and, agreeableness, Consciousness and openness as negative factors						

7.3.3 *Conclusion of Participants' Assessment of the Holistic Persona Personality*

From Table 7.4 and Table 7.5, variations in the results are as expected and are in line with the variations quoted in the literature. The participants in Study I considered that the Holistic Personas resemble a real person (Table 7.3, Jane 61%, Jean 58%, Jade 72%, June 61%). Results from Study I indicate that the participants who completed the rating of Holistic Persona section clearly saw the authored personas' personalities as intended.

7.4 Preferred Holistic Persona

The participant spent some time with each Holistic Persona while they were rating the persona and created a design for one Holistic Persona. Hence they may have formed a preference for a persona that they would like to work with. This section explores the question:

Which Holistic Persona is the preferred one?

7.4.1 *Analysis of Post Design Questionnaire Related to Preferred Holistic Persona*

After the design session, participants who continued with the study answered post design questionnaires. Since design and post design activities are independent of the persona rating activity, participants who provided valid data for these activities were included in the post design statistics. The number of participants that answered the post design questionnaire is 37 (Table 7.1, item No. 7); four participants choose not to answer the questionnaire and hence their data is not considered for these statistics.

7.4.2 *Conclusion of the Preferred Holistic Persona*

Table 7.6 shows that 45.9 % of the participants who answered the post design questionnaire prefer to design for a Holistic Persona that is emotionally stable; 18.9 % of

Table 7.6 : Choice of Holistic Persona for a future design activity

Holistic Persona	Percentage of participants select (%)
Jane	18.9
Jean	5.4
Jade	27.0
June	5.4
I cannot remember the name	43.2

them selected Jane and 27.0 % of them selected Jade. 43.2 % of the participants couldn't remember the name of their preferred Holistic Persona; some participants commented that they did not have any preferences. Hence the participants who made a selection for their

future design activity from among the four Holistic Personas had preferences based on personalities of the Holistic Personas and the majority of them indicated that for their future design activity they preferred a Holistic Persona who is emotionally stable.

7.5 Perceived Effect of Holistic Persona on Conceptual Design

Each participant spent time with a Holistic Persona during her/his design activity. The participant's awareness of the personality of the Holistic persona and the resultant effect that the personality had on their design was measured by design and post design questionnaires. This section presents the details of the questionnaire and the statistical calculations of their answers.

7.5.1 Design Questionnaires and Analysis

From design notes, 25 participants (73.5 % of the aspiring UCD designers) demonstrated that they were aware of the personality dimension of the Holistic Persona. The following statements were made in the post design survey questionnaire related to Holistic Persona assigned during the design activity. The aspiring UCD designers' responses are presented in Table 7.7.

1. The personality of the Holistic Persona positively influenced the scenario writing / design activity.
2. I would like to do another scenario writing / design activity with the same Holistic Persona or a persona that has similar personality again.
3. To meet the Holistic Persona's needs, I added features to the design which otherwise I would not have added.

Table 7.7 : Participants' perception of Holistic Persona

No	Statements about Holistic Persona	Participants' Responses (%)		
		<i>Agree</i>	<i>Neutral</i>	<i>Disagree</i>
1	Her personality positively influenced design activity	57	22	22
2	Would like to do another session with her	22		78
3	Extra Features Added	57		43

Analysis of answers to the above questions (Table 7.7) indicate that the participants were aware of the personality dimension of the Holistic Persona: 79 % of them reported that the holistic persona's personality influenced their design activity (57 % positively and 22 % negatively); 78 % of them reported that they would like to design for a Holistic Persona with a different personality than the one they were given.

From design notes it is evident that 19 participants (57 % of the aspiring UCD designers) took the personality of the Holistic Persona into consideration and provided conceptual designs that are tailored to the personality of the Holistic Persona. Table 7.8 shows a sample of quotes from undergraduate students while they were engaged in the conceptual design task. Participant Id 1029's thinking regarding extraversion and mobile phone usage is similar with Oliveira et al. (2013)'s findings that extraverts used their mobile phone more often. Participant Id 1023's comments are in line with Hamburger and Ben-Artzi (2000) and Landers and Lounsbury (2006)'s findings; emotionally unstable women seek information online anonymously. In Table 7.7 question 3, 57% answered positively that they have added features to the design which otherwise they would not have added.

Table 7.8 : Design comments about personality of the persona

Participant Id	Holistic Persona assigned	Dominant personalities	Design comments
1029	Doris	Extravert / Emotionally stable	<i>"...The virtual diary allows for entries based on various user designed topics or sub topics, weather that be health food ideas or new music that they enjoyed, or information relating to her social activities. The reminder application will utilize multiple parts of a phones system (assuming that such a social girl would have a relatively advanced phone). ..."</i>
1024	Katie	Extravert / Emotionally unstable	<i>"... I think this person need some kind of personal coach that will just ping or notify her of various reminders and set goals for her to do each day and she can fill these out like a survey and the coach will say some words of encouragement ..."</i>
1036	Minty	Introvert / Emotionally stable	<i>"Minty could possibly benefit from an app that recommended local social events. This would encourage Minty to socialize more with the people she is already comfortable around and continue to engage her social skills in new, yet familiar environments. ...".</i>
1031	Eliza	Introvert / Emotionally unstable	<i>"i feel like she would not be willing to listen if I recommended a health and fitness program ... possibly go and see a counsellor to help work through her self-doubt. software is not what this girl needs. She needs human contact..."</i>
1023	Eliza	Introvert / Emotionally unstable	<i>"An anonymous, public forum of message board where discussion is encouraged. -This would allow Eliza to find groups of people with similar interests, issues, and ideas to discuss and socialize with reduced pressure from her introverted personality (since the application is online and anonymous). -When she would otherwise be under too much social anxiety or has been previously rejected in face-to-face conversations, an online forum would allow group discussion and input from other users who are much more likely to empathize. This can also boost self-esteem from the support other users are likely to provide...."</i>

7.5.2 *Conclusion of Effect of Holistic Persona on Conceptual Design*

Based on the above analysis it can be deduced that the participants felt that the Holistic Persona's personality affected the participants' conceptual design of the software application.

7.6 **Relationship between Personality Traits, Spatial Ability and Design Ability**

Based on the studies of Anvari et al. (2013), Charyton et al. (2011), Feist (1998), Field (2007), Furnham and Bachtiar (2008), Poropat (2009), Shea et al. (2001) both personality traits and spatial ability are important in cognitively demanding tasks such as creativity and design within the software engineering field. Hence this section addresses the research question:

Can a spatial ability test and self-assessment of personality traits be used to identify talented aspiring designers who can produce a design within UCD methodologies that matches Holistic Persona's needs considering her personality?

To answer this research question the data from self-assessment of personality trait, design task and spatial ability test were used. The evaluation done below follow closely the paper Anvari and Richards (2015) - awarded best student paper (Appendix Q) - with the difference that in that paper to maintain homogeneity and identify the population from which the sample was drawn, the results from the undergraduate students at Macquarie University were used but in this section the results from all participants were used. Some of the additional participants are postgraduate students and professionals (Table 7.2). From Table 7.1 item 6, data from 33 participants were complete and used for this part of the study. Their scores for conceptual design, spatial ability and personalities were analysed and the results are presented here.

7.6.1 *Relationship between Performance in Design and Personality Trait*

Table 7.9 presents the breakdown of the sample populations according to their performance in design based on the rubric (chapter 6). The sample population was divided

Table 7.9 : Performance in design

No	Performance in design (%)	Participant (%)
1	85 -100	31
2	75 - 84	15
3	65 - 74	6
4	50 - 64	24
5	Less than 50	24

into groups based on their scores in imagination personality factor and spatial ability (section 7.6.2). In section 7.6.4, the groups are compared with one another based on the influence that the abilities have on their performance in design (Table 7.12). The influence is described

using effect size, the Pearson's correlation coefficient, r , computed from the t -test (Field et al. 2012). Field et al. (2012) describe effect size as small when $r = 0.1$, medium when $r = 0.3$ and large when $r = 0.5$. Table 7.11 shows partial correlation (r) of the five factors of personality with the participant's performance in design. Our sample population indicates that there is a medium sized relationship between imagination personality factor and performance in design and it is significant ($r=0.37$, $p=0.049$) having a shared variability of 14%.

7.6.2 Dividing Performance into Four Quadrants

Since in our sample population, imagination personality factor is the only personality factor correlated with design performance, our further analysis concerning performance in design is restricted to the imagination personality factor and spatial ability. Figure 7.4 shows a scatter plot of the participants' performance in the spatial ability test at 10 minutes versus their imagination personality factor; the points are labelled with their performance in design. Using the area of the plot covered by this group as a guide, Figure 7.4 is divided into four

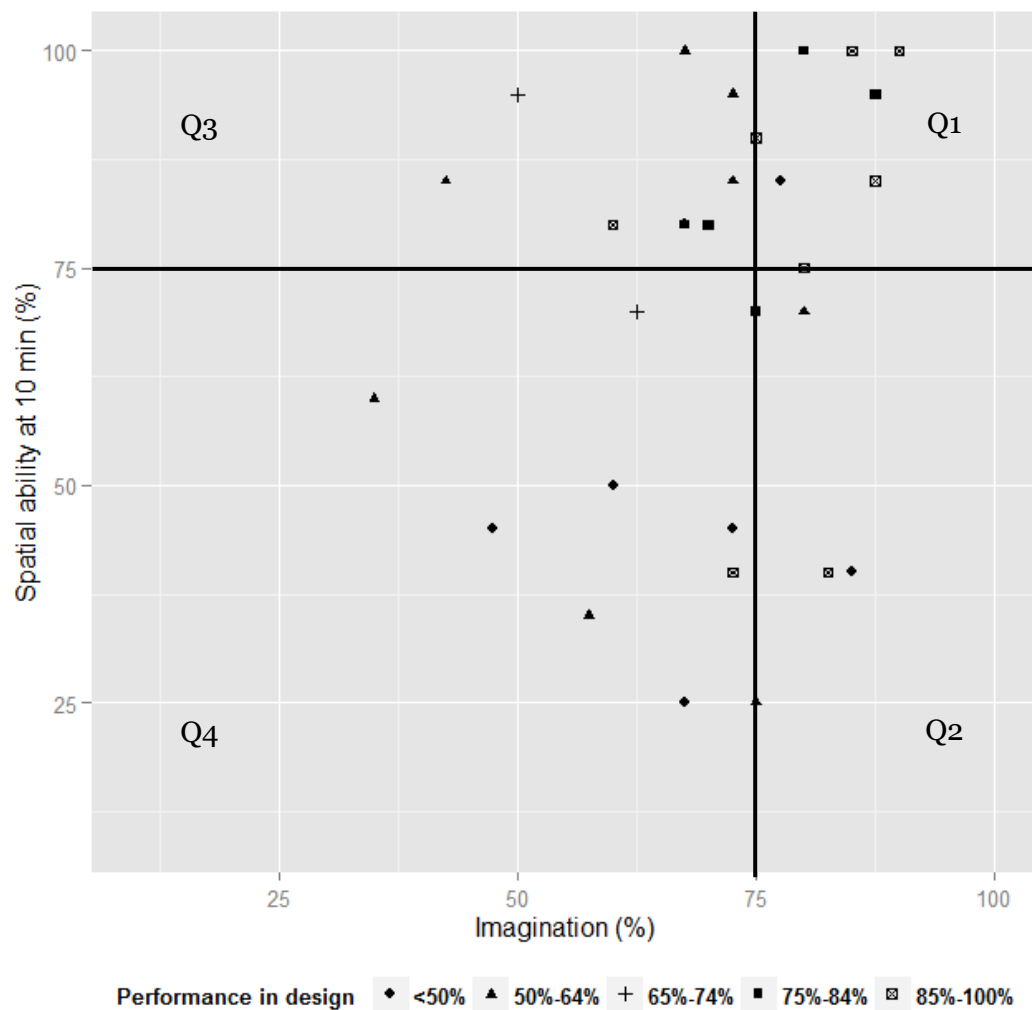


Figure 7.4 : Participants' performance in design

quadrants. The first quadrant (Q1) is bounded by those participants who scored 75% or greater in spatial ability (Ault and John 2010) and the imagination personality factor; in most Australian universities 75% or greater is used to award the grade of Distinction. Table 7.10 shows that 27% participants (with different levels of performance in design) are in Q1. Figure 7.4 shows that most participants in Q1 (top right hand corner) have also performed well in design.

Table 7.10 : Quadrant population

No	Quadrant	Participant (%)
1	Quadrant 1 (Q1)	27
2	Quadrant 2 (Q2)	15
3	Quadrant 3 (Q3)	31
4	Quadrant 4 (Q4)	27

Table 7.11 : Partial correlation of the performance in design with personality factors study

BFF	pcor (r)	r ²	t-value *	p (> t)	Effect size
Ext	-0.01	0.00	-0.07	0.95	nil
Agr	0.07	0.00	0.36	0.72	nil
Cn	-0.16	0.02	-0.86	0.40	nil
ES	0.09	0.01	-0.47	0.64	nil
Img	0.37	0.14	2.1	0.049	medium
Legend: Ext - extraversion; Agr – agreeableness; Cn – conscientiousness; ES - emotional stability; Img – imagination; df – degrees of freedom; pcor – partial correlation; p - probability. *(df=27)					

The second quadrant (Q2) is bounded by those participants whose score in spatial ability is less than 75% but their score in the imagination personality factor is equal to or above 75%. Table 7.10 shows that 15% of participants are in Q2. The third quadrant (Q3) represents those Participants whose score in spatial ability is equal to or above 75% but their score in the imagination personality factor is below 75%. Table 7.10 shows that 31% of participants are in Q3. The fourth quadrant (Q4) is bounded by those participants whose scores in spatial ability and the imagination personality factor are below 75%. Table 7.10 shows that 27% of participants are in Q4. Figure 7.4 shows that most participants in the first quadrant scored highly for their performance in design with the mean value of 84.1 (Table 7.12).

7.6.3 Five Scenarios to Study Results in Four Quadrants

The participants' data were analysed using five scenarios (Table 7.12). In each scenario the performance in design was studied for two groups. The five scenarios are listed below:

1. Effect of high imagination and spatial ability: performance of the group whose score in both imagination personality factor and spatial ability are high (Q1) compared with the rest of the sample population (Q2, Q3 & Q4);
2. Effect of imagination: difference in performance in design for the group of participants whose score in the imagination personality factor is high (Q1 & Q2) versus other participants (Q3 & Q4);
3. Effect of spatial ability - high imagination: difference in performance in design for the group of participants who scored high in both imagination personality trait and spatial ability (Q1) versus the participants who only scored high in imagination personality trait (Q2);
4. Effect of spatial ability: difference in performance in design for the group of participants whose score in spatial ability is high (Q1 & Q3) versus group of other participants (Q2 & Q4);
5. Effect of imagination - high spatial ability: difference in performance in design for the group of participants who scored high in both spatial ability and imagination personality factor (Q1) versus the participants who only scored high in spatial ability (Q3).

7.6.4 *Comparison of the Results in Four Quadrants*

Table 7.12 shows Mean (m), Standard Error (SE) and Median for each group of participants. The two groups in each scenario are compared using Welch two sample single tail t-test and the effect size (r) between the two samples are described using the Pearson's correlation coefficient, r computed from the t-test (Field et al. 2012). The null hypothesis (H₀) is that all groups are drawn from the same population, hence the difference in means of the different groups is zero, the alternate hypothesis (H₁) is that the difference in mean is greater than zero.

Figure 7.5 shows five box plots of participants' performance in UCD conceptual design for each of the five scenarios listed in Table 7.12:

- Scenario 1 shows that the participants who scored high in both spatial ability and imagination personality factor performed significantly higher in design (m=84.1, SE=6.3) compared with the other participants' performance in design (m=59.1, SE=4.3). The Welch two sample single tail t-test indicates that the difference in the means of the two samples is significant at 5% (t=-3.3, df=16, p<0.05) and the Pearson's correlation coefficient shows the effect size is large.

Table 7.12 : Analysis of participants' performance in design under five scenarios

Scenario No	Scenario	Quadrants (Q)	Mean (m) %	SE %	Median %	Welch two sample single tail t-test				Effect Size (r)
						t-test	df	p	Reject Ho at 5% confidence	
1	Effect of high imagination and high spatial ability	Q1 (SImg=>75% & SpAb=>75%)	84.1	6.3	90.0	-3.3	16	0.002	True	0.6 Large
		Q2, Q3 & Q4	59.1	4.3	58.5					
2	Effect of imagination	SImg =>75% Q1 & Q2	76.5	5.8	85.0	-2.4	28	0.011	True	0.4 Median
		SImg < 75% Q3 & Q4	58.1	4.9	57.0					
3	Effect of spatial ability – high imagination SImg=>75%	Q1 (SpAb=>75%)	84.1	6.3	90.0	1.84	7	0.053	False	0.6 Large
		Q2 (SpAb<75%)	62.8	9.7	60.0					
4	Effect of spatial ability	SpAb=>75% Q1 & Q3	74.2	4.8	80.0	-2.61	28	0.007	True	0.4 Median
		SpAb< 75% Q2 & Q4	54.6	5.7	57.0					
5	Effect of imagination – high spatial ability SpAb=>75%	Q1 (SImg=>75%)	84.1	6.3	90.0	2.13	17	0.024	True	0.5 Large
		Q3 (SImg<75%)	65.3	6.2	68.0					
Note: Ho - Hypothesis - True difference in mean is zero H1 - Alternate Hypothesis - True difference in mean is greater than zero Legend: Q – quadrant; df – degrees of freedom; p – probability; SE – standard error; SImg – score in imagination personality factor; SpAb – score in spatial ability.										

- Scenario 2 (Table 7.12 and Figure 7.5) shows that the participants who scored high in the imagination personality factor performed significantly better in design (m=76.5, SE=5.8) compared with the other participants' performance (m=58.1, SE=4.9), (t=-2.6, df=21, p<0.01).
- Scenario 3 (Table 7.12) shows that the participants who scored high in both imagination personality factor and spatial ability (m=84.1, SE=6.3) did not perform significantly better than the participants who only scored high in imagination personality factor (m=62.8, SE=9.7). The Welch two sample single tail t-test indicates that the difference in the means of the two samples is not significant (t=1.84, df=7, p>0.05) and the Pearson's correlation coefficient shows the effect size is nil. As the sample in Q2 is small, hence no inferences are made in regard to the effect of spatial ability and UCD design when the designers have high imagination.
- Scenario 4 (Table 7.12) also that participants who scored high in the spatial ability test performed significantly better than those whose spatial ability score was not high (t=-2.61, df=28, p<0.05).

- Scenario 5 (Table 7.12), shows that the participants who scored high in imagination personality factor and spatial ability performed significantly better in design ($m=84.1$, $SE=6.3$) compared with the participants who scored high in spatial ability but scored low in imagination personality factor ($m=65.3$, $SE=6.2$) ($t=2.13$, $df=17$, $p<0.05$).

From Table 7.11, imagination personality factor is related to performance in design ($r=0.37$, $p=0.049$) and, Table 7.12 shows the combined effect of imagination personality factor and spatial ability significantly influence performance in design ($t=-2.4$, $df=28$, $p<0.05$). In the sample population, the correlation between performance in design and other personality factors such as agreeableness, extraversion and emotional stability is inconclusive.

7.6.5 *Conclusion of Relationship between Personality Traits, Spatial Ability and Design Ability*

For the design activity, the participants were required to read the description of the Holistic Persona (Appendix G), understand her requirements and prepare a design work within fifteen minutes. The results indicate that participants, who score above 75% in the imagination personality factor and spatial ability test, can think of design features that suit the Holistic Persona within a short period of time; they are identified as talented aspiring UCD designers. They can ‘think on their feet’ (Schön 1983).

This part of the study highlights the importance of the imagination personality trait and spatial ability in performing well in UCD design. Section 11.6 covers detailed discussion of this topic.

7.7 **System Deficiencies and Improvements**

Analysis of data from Study I revealed the following deficiencies in the setup of the study:

1. The completed design artefacts contained unequal numbers of the design artefact for the four Holistic Personas
2. The number of participants who either partially or fully completed the study was not as large as expected. From Table 7.1 the number of participants who started the study was 127 but only 41 participants (32%) either partially or fully completed the study. As a result between subject studies would not reveal statistically significant data. The participants who completed the design activity were dedicated students who most likely did not mind spending additional time if the study was slightly longer.
3. The following question needed to be revised:
 - a. Question about ‘have you had previous training in spatial ability’ should not be a simple yes or no answer. Some participants may only have had exposure to

the test and have no prior training but others may have undertaken training in spatial ability. Hence a sliding scale, strongly disagree to strongly agree, would better reveal the previous training information.

The above question is more suited to be part of the demographics

- b. Demographic question on 'Design interest', an extra option: none of the above was added.
- c. Participant's design experience is not known. As some participants have previous design experience hence a question on this would provide an understanding into their performance (section 8.1.1).
- d. Design question 'To meet the Holistic Persona's needs, I added features to the design which otherwise I would not have added' should be a five point scale to measure the participants perception of the influence of the Holistic Persona's personality on their design (section 8.7 and Table 8.2).

7.8 Chapter Summary

In this chapter, results specific to the Study I were presented:

- 1. Holistic Persona's Personality: Participants clearly saw the authored personas' personalities as intended.
- 2. Preferred personality: The participants who answered post design questionnaire
 - a. 45.9 % prefer to design for a Holistic Persona that is emotionally stable,
 - b. 10.8% prefer to design for the emotionally unstable personas,
 - c. 43.2% cannot remember the name of their preferred personas
- 3. Perceived effect of Holistic Persona's personality on conceptual design: the participants felt that the Holistic Persona's personality affected their conceptual design of the application.
- 4. Identification of aspiring designers in UCD: Personality Traits and a Spatial Ability Test were used to Identify Talented Aspiring Designers in User-Centred Design Methodologies

In this chapter a few improvements were also highlighted and were incorporated into the Qualtrics system for Studies II and III. The next chapter covers procedure followed for the conduct of Studies II and III including the details of changes made to the study. Chapter 10 covers the sections of Study I that can be combined with Studies II and III. The results from all studies will be discussed in chapter 11.

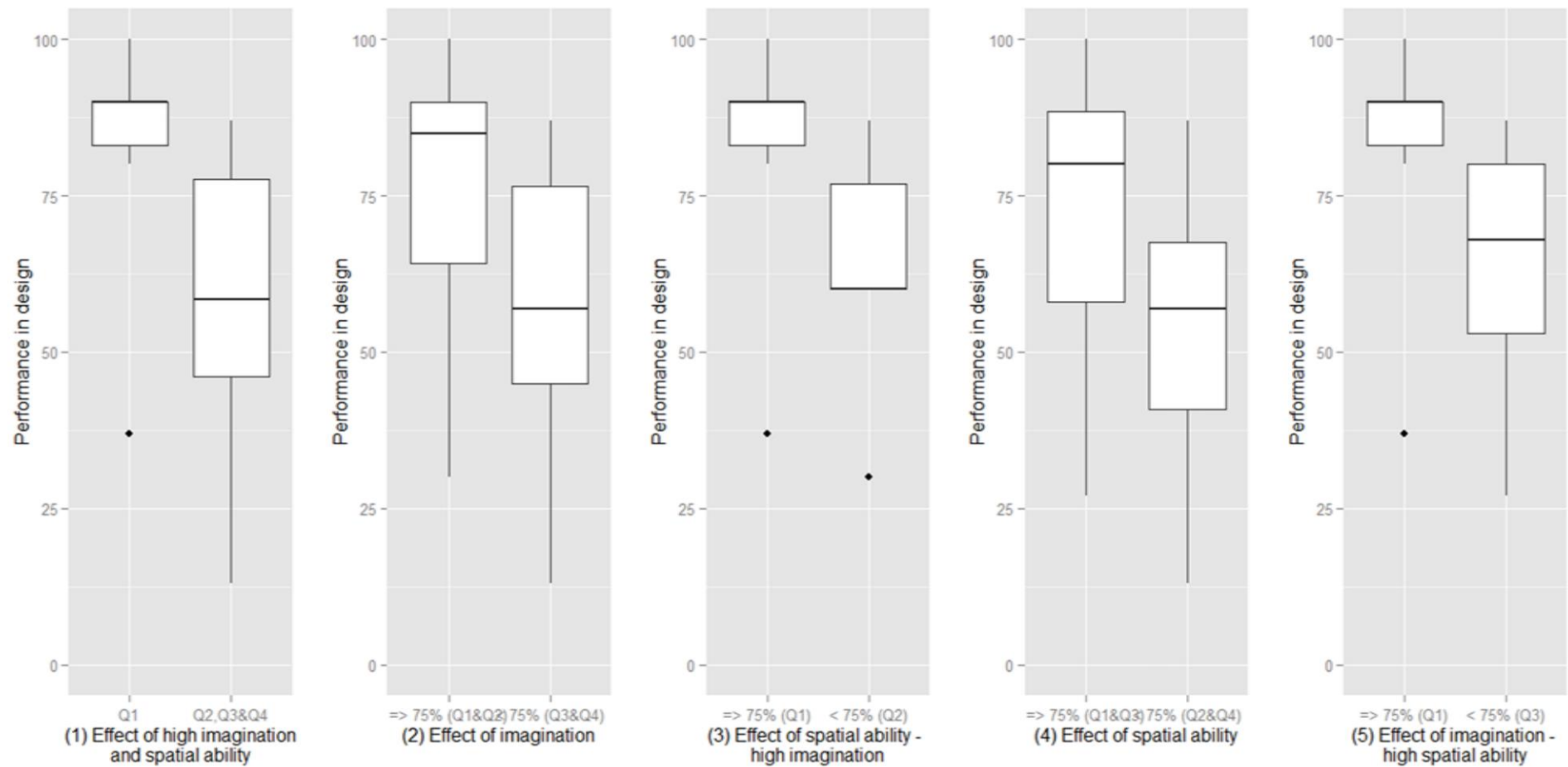


Figure 7.5: Box plots of the participants' performance in design for five scenarios

8 Design of Studies II and III

The between subjects design used in Study I relied on obtaining a sufficient number of participants to complete all parts of the study to allow for variations between individuals that might affect results. As noted previously, out of 127 who started the study only 41 participants (32%) completed the study which did not provide sufficient data to draw conclusions. A within-subjects design involving participants completing a design for all four personas with a between-subjects factor (personality order) would require fewer participants, produce more designs and also allow for comparison of multiple designs by one participant, reducing the effect of individual differences. It was also desirable to address other limitations of Study I. Hence the Study I procedure was modified for subsequent studies, as detailed in the following sections. Please see Appendix B for complete details of the second and third studies.

8.1 Modifications to Design of the Study

The methodology for studies II and III was modified as follows compared to study I: Holistic Persona rating and the design activity were modified; each participant was presented with the four Holistic Personas in random order and the participant first assessed each of the Holistic Persona presented and then performed a design activity. It was anticipated that as the participants produced four designs, one for each of the four Holistic Persona (that have same needs but different personalities), they would become aware of the importance of the users' personality and the effect personality has on the usability of the software application.

The revised procedure was expected to take about 110 minutes. The research was conducted via an online system Qualtrics (2015). Following is a summary of the changes made to the study details in the second and third studies:

8.1.1 Demographic Questionnaire Modifications

As reported in chapter 7, during analysis of data from Study I some deficiencies in demographic questionnaire were observed. Following is the modifications to the questionnaire with rationale for each change.

In studies II and III two extra questions were added to the demographics:

1. I have experience and/or training in (choose all that applies): User-centred design, Screen / interface design, interactive design, industrial design, other types of design (with a text box), none of the above

Rationale: This question sought to clarify the specific area of design that the participant has experience or training in.

2. I have been trained in Spatial Ability – answer is a 5-point scale: (1) Strongly disagree, (2) Moderately disagree, (3) Neither agree nor disagree, (4) Moderately agree, (5) Strongly agree.

Rationale: This question sought to clarify the amount of Spatial Ability training a participant has received.

The following three questions were modified:

1. My main profession is – (this question was 'I am') a text box added for a participant who is professional to state her/his profession. An option 'none of the above' with a text box is added.

Rationale: To obtain more detailed information about the knowledge the participant gained through their professional experience.

2. I am studying or have studied – two new subjects are added: 'Game design' and 'Engineering'. Text boxes are added to 'Science' and 'Engineering' selections for more details explanations.

Rationale: to obtain more detailed knowledge about the participant's educational background

3. Demographic question on design interest - I have (choose all that applies) - option 'none of the above' was added.

Rationale: Gives participants who have not studied design subjects or do not have design experience or interest in design an appropriate option to choose.

8.1.2 ***Post Design Questionnaire Modification***

The following questions are modified:

1. For my future design activity, if I have to choose only one Holistic Persona I would choose – The names of Holistic Personas are changed to Doris, Katie, Minty and Eliza for Study II and Helena, Katerina, Meta and Agneta for Study III.

Rationale: The names of Holistic Personas are changed to the names that the participants assessed in each study.

2. Considering personalities of Holistic Personas, I added features to designs which otherwise I would not have added.
3. Comments on the features added due to Holistic Personas' personalities.

Rationale: The questions 2 and 3 above were modified to clarify the purpose of the questions.

The following question was added:

- While I was conceiving solutions, foremost thoughts on my mind were: (Participants can write in free text whatever they thought during their design session).

The following question is removed from this section and moved to demographics:

- I was trained in spatial ability: (Participants can answer yes or no).

Other questions are changed to plural as there are four design activities in this study.

8.1.3 *Consent Form Modification*

The consent form is modified to include the names of associate and adjunct supervisors, changes in procedure and timing.

8.1.4 *Other Modifications*

The introduction to UCD was placed after the information and consent page so that the result of quizzes can be used for analysis in this thesis.

During analysis of data from study I it became obvious that the facility to navigate to previous pages could affect the timing of the activities, hence it was disabled.

8.2 **Consent**

In Study II, the participant was given the consent form (Appendix C) to read and if the participant gave consent she/he proceed with the study. The participant could print the form or save it as pdf (Appendix C). This activity was expected to take five minutes.

In Study III, the participant was asked whether she/he would give consent to use her/his data for the purpose of conducting research. The data from participants who gave their consent were used in this thesis.

8.3 **Demographic Questionnaire**

The participants provided their personal information such as how long they have been speaking English, in which country they spent their youth, background knowledge such level of education, subjects studied and experiences and interests in design.

Participants were required to answer all questions. This questionnaire was expected to take three minutes to answer. Table 8.1 presents a summary of the demographic questionnaire. The full printout of the questionnaire is provided in Appendix L.

Table 8.1 : Demographics Questionnaire - Summary

No	Question	Answer type	Reason for the question
1	gender	Single choice answer from: Male, Female, Other	Gender related differences
2	Year of birth	Free text – has to be a number in the range 1929-1995 (70 – 18 years old)	Participants have to be adults
3	Main profession	Single choice answer from: an under-graduate student a post-graduate student an academic / a researcher a professional (Free text entry) none of the above (Free text entry)	Indicative of maturity and experience
4	General Design experiences	Multi choice answers from: studied design subjects design experience Interest in design none of the above	Indicative of interest and experience in design in general
5	Specific types of design training or experience	Multi choice answers from: user-centered design screen / interface design interactive design industrial design other types of design (Free text entry) none of the above	Experience or training in the specific types of design
6	Knowledge of English language	For those who English is not their first language, if they have written and spoken in English for (single choice answer) less than 1 year 1 - 3 year more than 3 years	identify the knowledge of English language and if they can understand the subtle points about personality
7	Country where the participant spent her/his youth	Single choice from a drop down box showing all the countries	Identify what cultural background the participant has
8	Subjects studied	Multi choice answers from: Game Design Software engineering Arts and literature studies Fine arts and music Other Human science Business and economics Science (Free text entry) Engineering (Free text entry) Other (Free text entry)	To know the relevant educational background design and spatial ability
9	Previously Trained on spatial ability	On a 7-point scale ranging from 1 (disagree strongly) to 7 (agree strongly)	For those skilled in spatial ability, the skill is a native ability or learnt ability

8.4 Introduction to UCD

Introduction to UCD which provides an introduction to UCD methodology, persona and conceptual design, is same as the activity in Study I and is used in Studies II and III (section 5.2 and Appendix D). However this activity was moved after the participant has given her/his consent. This activity was expected to take about seven minutes.

8.5 Participants' Personality

Participants provided a self-assessment of their personality traits using IPIP (2013) questionnaires (Goldberg 1993). This activity remained unchanged for all studies (section 5.4 and Appendix E).

8.6 Holistic Persona Rating and Design Activities

In Studies II and III, for each of the four Holistic Personas, participants initially rated the Holistic Persona and then conducted a design activity for her. Details of the procedures for rating and design activities are listed below. The ratings and design activities for all four Holistic Personas were expected to take about 60 minutes.

8.6.1 *Holistic Persona Rating*

The procedure for rating a Holistic Persona and the list of questionnaires were the same in all studies. In Studies II and III, a participant rated a Holistic Persona then conducted a design work for her. The Holistic Personas are listed in Appendix G. The order in which the four Holistic Personas were presented to each participant was randomised to remove any bias due to presentation order.

The time spent on this item and the following design activity was recorded as a single unit for each Holistic Persona but was not displayed. The time spent was an indicator that the participant had genuinely answered questions and conducted the design activity.

8.6.2 *Design Activity*

The participant designed a new or recommended a suitable existing software application, service or product that sought to address the Holistic Persona's needs. The participant was also required to write a scenario in which the Holistic Persona uses the software application. The scenario writing helps to assess the usability of the software application and demonstrates how the participant has provided measures to suit the needs of the Holistic Persona considering her personality.

8.7 Design Modification Activity and Design Activity Questionnaire

The design modification activity and design activity questionnaire were presented together on one web page for each Holistic Persona (Appendix H). These activities follow rating the four Holistic Personas and the design activities.

In the design modification activity, for each Holistic Persona, the participant was presented with their design artefact. She/he is given an opportunity to make any extra comments about or modify their design artefact. During designs for the four Holistic Personas, the participant may detect unmet needs and hence this activity provided an opportunity to make additional comments. This activity was optional as a participant may not think it is necessary to add any design comments.

On the same page where the participant entered the design modification for each Holistic Persona the Design activity questionnaire was presented.

For reference purposes, a description of Holistic Persona was added at the end of the page. The participant was informed about the content of the page in the description of the activity in the introductory page to the activity.

For the design questionnaire, the participant answered questions about the effects of Holistic Persona on their design and their feeling towards the Holistic Persona. As by then they have spent more time with the Holistic Persona compared to rating of the Holistic Persona, they have a better understanding of the personalities of the Holistic Personas compared to earlier questionnaire, rating of the Holistic Persona.

Answering all the questions in the design activity questionnaire was compulsory. Table 8.2 presents a summary of the design activity questionnaire and the rationale for the questions.

The above activities were expected to take 12 minutes to complete.

8.8 Post Design Questionnaire

This questionnaire was conducted after the participant performed all the design activities. Participants reported their feelings and thoughts about the Holistic Personas and their overall experiences during the design sessions.

Answering all the questions in the post design questionnaire was compulsory. Table 8.3 presents a summary of the post design questionnaire and the rationale for the questions.

The post design questionnaire activity was expected to take three minutes to complete.

8.9 Spatial Ability Test:

The Participant did a *Purdue visualization of rotation test* to assess her/his spatial ability. This activity is the same as the activity in Study I and was expected to take 10 minutes (Section 5.9 and Appendix M).

Table 8.2 : Design Activity Questionnaire - Summary

No	Question	Answer	Reason
1	I was totally engaged with [Holistic Persona]'s personality while I was designing for [Holistic Persona]	on a 7-point scale ranging from disagree strongly to agree strongly	To find out the participant's perception of her level of engagement with the Holistic Persona's personality. The answer can be tested by checking the design artefact.
2	The personality of [Holistic Persona] positively influenced my design for [Holistic Persona].	on a 7-point scale ranging from disagree strongly to agree strongly	Does the designer find Holistic Persona's personality influence her/his design?
3	I was thinking of a real person that I know when I was designing for [Holistic Persona].	Yes/No	Does the Holistic Persona trigger memories of a real person? The earlier question shows their preference. This question to reveal if the liking and influence on design was due to resemblance with a real person that they know.
4	I was thinking of a person who had same personality as [Holistic Persona] when I was designing for [Holistic Persona].	on a 7-point scale ranging from disagree strongly to agree strongly	Have they imagined interacting with a person while they are designing? If they design to specification the answer expected would be neither agree nor disagree.
5	I would like to do another scenario writing / design activity with [Holistic Persona] or a Holistic Persona that has similar personality to [Holistic Persona].	on a 7-point scale ranging from disagree strongly to agree strongly	Does the participant like the personality of the Holistic Persona that they want to engage with the Holistic Persona again?

8.10 Study Environment

The study was developed using an online system Qualtrics (2015) which allows a participant to participate in the study without having the restriction of equipment, place or time.

Table 8.3 : Post Design Activity Questionnaire - Summary

No	Question	Answer	Reason
1	I found that the design activities/ scenario writings were easy	on a 5-point scale ranging from (1) disagree strongly to (5) agree strongly	To find relationship between ease of writing scenario liking Holistic Persona and having design ability
2	Considering personalities of Holistic Personas, I added features to designs which otherwise I would not have added	Yes/No If the participant selected yes for their answer, participant were asked to enter in a text box the details of the features they have added.	The participant perception about the feature they have added to their design which was influenced by the Holistic Persona's personality. Newness: This statement is similar with the statement in the first system.
3	For my future design activity, if I have to choose only one Holistic Persona I would choose.	A selection from Doris, Katie, Minty Eliza I cannot remember the name. The participant can enter in a text box comments on her/his choice of Holistic Persona for their future design.	This question is to find which of the Holistic Personas' personality made an enduring effect on the participant.
4	At least one of the software applications or products I selected for design sessions was one that I was familiar with it.	Yes/No	To assess the effect of the participant's previous design experience for a similar system
5	While I was conceiving solutions, foremost thoughts on my mind were:	The participant can enter in a text box comments on her/his thinking during the design activities.	To find out the designer's foremost thought at the moment of conceiving a solution and the factors that influenced her/his thinking. Was the thinking influenced by personality or other features of the Holistic Persona or there were other personalities foremost in their thought.

8.11 Chapter Summary

This chapter presented the methodology for the second and third study and highlighted items that are different in the two studies compared with Study I.

In summary, the participants performed the activities below:

1. **Consent:** For Study II, the participants were presented with a consent form. For the third study, the participants were presented with consent statement (Appendix C). Those who wished to take part in the study gave their consent.

2. **Demographic questionnaire:** Participants answered questions from a demographic survey questionnaire (Table 8.1 and Appendix B).
3. **Introduction to UCD:** Participants received a brief introduction to UCD methodology and use of persona in design of software applications or products (Appendix D).
4. **Personality self-assessment:** Participants answered questions from a personality test questionnaire (Appendix E).
5. **Assessing the Holistic Persona, design sessions and post design questionnaire:**

The four Holistic Personas, Doris, Katie, Minty and Eliza (Appendix G), were presented to each participant in a randomised order. Participants performed the following activities for each Holistic Persona:

 - a. They assessed Holistic Persona's personality and their own feelings towards the Holistic Persona.
 - b. They designed a software application or product for her.
6. **Design modification activity and design activity questionnaire:** Participants were given their design for each of the four Holistic Personas:
 - a. **Design modification activity** - Participants could make changes to their design if they wished to do so.
 - b. **Design session questionnaire** - Participants answered design session questionnaire.

The participants were presented with a description of the Holistic Persona for their reference. The order in which the Holistic Personas were presented: Doris, Katie, Minty and Eliza for Study II and Helena, Katerina, Meta and Agneta for Study III (Appendix H).
7. **Post design questionnaire:** Participants answered post design questionnaire about their experiences during the design session (Appendix I).
8. **Purdue Visualization of Rotations Test:** participants conducted a 20-item Purdue Visualization of Rotation test (Appendix M).

The expected period for studies II and III was 110 minutes. Thus participants performed four design sessions with all four Holistic Personas. In the following chapter the results from Studies II and III are presented, followed by presentation of the discussion of the results and the conclusions specific to the studies.

9 Results from Studies II and III

This chapter presents the results obtained and statistical analysis of the results specific to the Studies II and III. Due to differences in the study methodology between study I and Studies II and III, results specific to the second and third studies are presented in the following sections. In section 9.3 it will be demonstrated that the data from Studies II and III for attributes of interest are homogenous. Hence the combined data set in these two studies is used in all statistical analysis.

This chapter covers the demographics (sections 9.1 and section 9.2), test of homogeneity of data (section 9.3), participants' assessment of Holistic Personas' personalities (section 9.4), participants' preferred Holistic Persona (section 9.5), participants' perception of effect of Holistic Persona on their conceptual design (section 9.6). The content of this chapter is similar to the paper, Anvari et al. (2015). In this chapter some additional data which became available later was considered. Hence the resultant analysed data were changed slightly but all the conclusions drawn in the paper are unchanged.

9.1 Participants

The participants in studies two and three (Table 9.1 and Table 9.2) were from Australia and Denmark respectively. The participants in Study II were students who were studying the second year subject COMP 260 – Game Design session taught within Computer Science Department, Faculty of Science, Macquarie University. The participants in Study III were Danish postgraduate students studying Software Architecture course offered at IT University of Copenhagen. The students were invited to participate in this research during a tutorial session without receiving any course credit. None of the participants received any financial benefit by participating in the study.

Table 9.1 shows that the majority of participants completed all activities. While assessing the rating of Holistic Persona, it was observed that two participants had shown signs of boredom while rating the Holistic Personas hence their rating of Holistic Persona is not included in statistical studies related to assessment of the Holistic Personas. They provided the same rating for two or more Holistic Personas.

9.2 Demographics

Table 9.1 item 4 shows the sample population, that is, the participants who participated in the study either fully or partially. The demographics are based on the sample population.

Table 9.1 : Number of Participants in Second and Third Studies

N o	Participants	Number of participants		Total
	Study	II	III	II & III
1	Total number of participants who initiated in the study	36	31	67
2	did not give consent	0	4	4
3	Participants who stopped the study before finishing ratings of Holistic Personas or their data were misleading or used inappropriate language. Their data was discarded	11	2	13
4	Participated in the study - either fully or partially (sample population)	25	25	50
5	Completed ratings of Holistic Personas	24	24	48
6	Completed or attempted design session for Holistic Persona (aspiring UCD designers)	25	25	50
7	completed post design questionnaire	24	23	47
8	Completed self-assessment of personality, design and spatial ability test	25	25	50

Table 9.2 : Demographics for Second and Third Studies *

Participants	Country		Total	Percent
	Australia %	Denmark %	Australia and Denmark %	Australia and Denmark %
Study	II	III	II & III	II & III
Professional ^	0	9	9	18
Postgraduate	1	16	17	34
Undergraduate	24	0	24	48
Male	23	22	45	90
Female	2	3	5	10
Other	0	0	0	0
English is first language	20	1	21	42
Spoken and written in English >3 years	3	24	27	54
Spoken and written in English for 1- 3 years	2	0	2	4
Youth years spent in a western country +	22	16	38	76
Sub total	25	25		
Total	50		50	100
Did not give consent or discontinued the study	11	6	17	34
Note: * Demographics is based on sample population (item 4 in Table 9.1) ^ Those who classified themselves as professional in Denmark were postgraduate students; their professions were: Skilled IT, Senior Developer, Developer (three), Front-end Developer, System Developer, Programmer and IT Architect. + Australia, New Zealand, UK, USA, Denmark				

In the sample population, for the question about gender, 90 % of the participants selected male, 10 % of the sample population selected female and none of the sample population selected other. In the sample population there were 43% native speakers, 54 % spoke and wrote in English for more than three years and 4% of the population spoke and wrote in English for 1-3 years. 76 % of the sample population had lived in Australia or New Zealand or UK or USA or Denmark during their youth. The data for those who had spoken and written English for three years or less was examined carefully as it was important that the participants could demonstrate a reasonable level of competence in understanding the required concepts. No significant problem was detected in the language used for the study. Most of the sample population finished the study, including the introductory session, within 70 minutes.

The participants who gave an email address received a copy of their results for the spatial ability and personality tests. All participants were thanked for their participation in the study.

9.3 Homogeneity of Data

The data from studies II and III were analysed to ensure that the persona assessments were homogeneous even though the two groups of participants come from different countries, Australia and Denmark, with different cultures. In this section the results related to personalities of the Holistic Personas and participants' belief that the person is a real person is investigated. I conducted Welch Two Sample t-test, using R statistical packages (Field et al. 2012), comparing the data from two groups for the four personas for the three factors, two personality traits of extraversion and emotional stability and the question, believing the persona is a real person were conducted (Table 9.3). The result demonstrates that at 95% confidence level the true difference between the means of the two groups is zero for all four personas for the three factors. Hence the data supplied by the two groups can be considered to be homogenous.

In this chapter and chapter 10, the name Doris refers to both Doris and Helena. Similarly the name Katie refers to Katie and Katerina, Minty refers to Minty and Meta and Eliza refers to Eliza and Agneta.

9.4 Participants' Assessment of Holistic Personas' Personalities

This section provides statistical results for assessment of the personality traits of the Holistic Persona. Initially the objective of analysis is presented followed by the results, discussions and the conclusion. The Holistic Persona's personality is assessed by the participants to ensure that the authored personalities are as intended.

Table 9.3 : Welch Two Sample t-test for Second and Third Studies

Holistic Persona	Attribute	t-test	df	Pr(>t)	Ho
Doris/Helena	Ext	-0.56	42.9	0.58	True
	ES	-0.24	40.0	0.81	True
	Real Person	0.31	40.6	0.76	True
Katie/Katerina	Ext	0.56	44.6	0.58	True
	ES	0.89	45.9	0.38	True
	Real Person	-0.54	41.9	0.59	True
Minty/Meta	Ext	1.00	45.6	0.32	True
	ES	0.32	46.0	0.75	True
	Real Person	-0.35	43.4	0.72	True
Eliza/Agneta	Ext	1.67	44.1	0.10	True
	ES	-0.40	44.8	0.69	True
	Real Person	0.75	45	0.46	True
Legend: Ext - extraversion; ES - emotional stability; df – degrees of freedom. Ho – Null Hypothesis (True difference between the means is zero at 95% confidence)					

9.4.1 *Objective of Analysis*

The Holistic Persona should be assessed by a sample from the target population to ensure that the authored personality dimension is as intended. The objective of analysis is:

Does the sample population recognise the personality dimension of a Holistic Persona as intended?

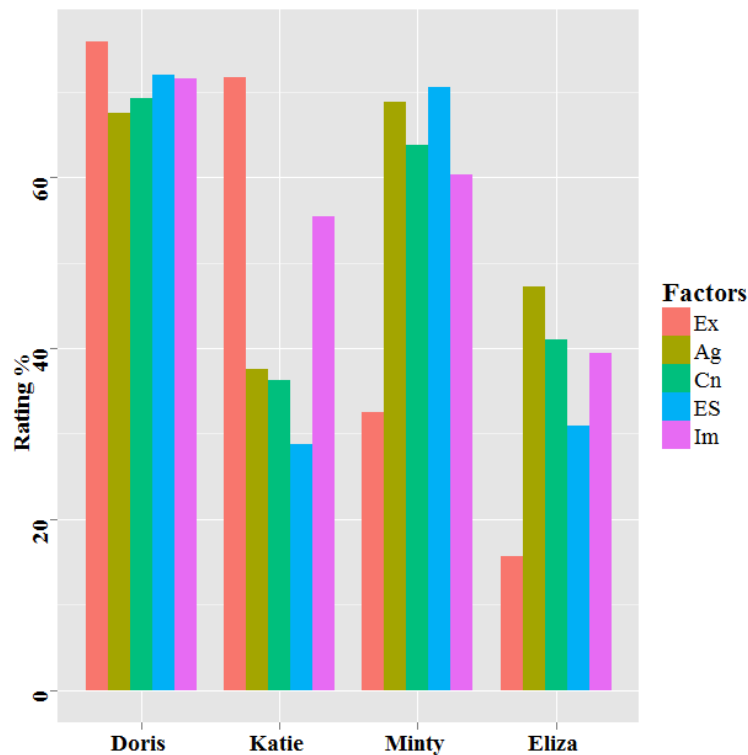
9.4.2 *Analysis of Results and Discussion*

For this analysis the sample population, the number of participants who have completed ratings of Holistic Personas is 48 (Table 9.1). The bi-polar answers to the persona's assessment questions on a 7-point likert scale were added together after reverse scoring the negative questions (Gosling et al. 2003) and recoding to provide results in the range of 0-12. The resultant data is treated as interval-level data, converted to percentages and analysed using the R statistical packages (Field et al. 2012). The mean values (in percentages) of the rating given to each persona by the sample population are presented in Table 9.4 and Figure 9.1. Due to inter relationship between the five factors (Table 7.5), even though the other personality traits agreeableness, consciousness and imagination are authored similarly, the participants rated these factors differently.

Table 9.4 : Mean values of personas' personality factors

Persona	Ex %	Ag %	Cn %	ES %	Im %	Persona represents a real person %
Doris	76 **	68	69 ^^	72 **	72 *	57 **
Katie	72 *	38 *	36 ^^	29 **	55	61 **
Minty	32 *	69 ^	64	70 ^	60 ^	61 **
Eliza	16 **	47 *	41 ^	31 *	39	54 **
Note: ** $p < .01$; * $p < 0.05$; ^^ $p < 0.10$; ^ $p < 0.15$ Legend: Ex - extraversion; Ag – agreeableness; Cn – conscientiousness; ES - emotional stability; Im – imagination.						

The dominant point to notice from Table 9.4 and Figure 9.1 is that Minty has been rated similarly to Doris in all factors except extraversion. Eliza is rated similarly to Katie in all factors except extraversion. Also Table 9.4 shows that Doris and Minty are rated 72% and 70% respectively for emotional stability and Katie and Eliza are rated 29% and 31% respectively for emotional stability. These results confirm the intended personality traits of the personas as listed in Table 4.2 and also reflect the equivalent results from study I.



Legend: Ex - extraversion; Ag – agreeableness; Cn – conscientiousness; ES - emotional stability; Im – imagination.

Figure 9.1 : Mean values of personas' personality factors rated by the sample population.

The box plot of the participants' ratings of the personality factors for two factors of extraversion and emotional stability are shown in Figure 9.2 and Figure 9.3. Figure 9.2 shows that the participants rated Doris and Katie as extraverts whereas Minty and Eliza are rated as introverts. Figure 9.3 shows that the participants rated Doris and Minty as being high on emotional stability factor but Katie and Eliza are rated as being low. Again, this reinforces the intended personal traits of the personas were correctly identified by the participants.

Table 9.5 shows the average of the differences between the ratings the participants gave to the personalities of each of the personas. Doris and Minty were rated similarly for all personality traits except extraversion where Doris is more extraverted than Minty (44% higher), as intended. Katie was intended to be only lower on emotional stability (43% lower) compared to Doris, but the participants rated her lower also for personality factors of extraversion (4% lower), agreeableness (30% lower), conscientiousness (33% lower) and imagination (17% lower) despite the fact that Doris and Katie's academic achievements, musical abilities, cognitive abilities and knowledge were kept constant. Similarly comparing Doris with Eliza, Eliza scored lower not only in the two factors of extraversion (60% lower) and emotional stability (41% lower) which were as intended but also scored lower in agreeableness (21% lower), conscientiousness (28% lower) and imagination (33% lower).

The inter-factor correlations, as given by Ehrhart et al. (2009), show that emotional stability and extraversion affect the ratings of agreeableness, conscientiousness and imagination. Table 9.5 presents inter-correlations between each factor of emotional stability and extraversion, and the other three factors of agreeableness, conscientiousness and imagination that are found in the literature.

Table 9.5 : Average differences between the four personas for each of the five factors of personality

No	Personas differentiated		Ex %	Ag %	Cn %	ES %	Im %
1	Doris	Katie	4	30	33	43	17
2	Doris	Minty	44	-1	5	2	12
3	Doris	Eliza	60	21	28	41	33
4	Katie	Minty	40	-31	-28	-41	-5
5	Katie	Eliza	56	-9	-5	-2	16
6	Minty	Eliza	16	22	23	39	21

Note: the bold items were the factors that were purposely manipulated in the persona.

Legend: Ex - extraversion; Ag - agreeableness; Cn - conscientiousness; ES - emotional stability; Im - imagination.

9.4.3 Conclusion - Holistic Persona's Personality as Assessed by Participants

From Table 9.4 and Table 9.5 variations in our results are as expected and are in line with

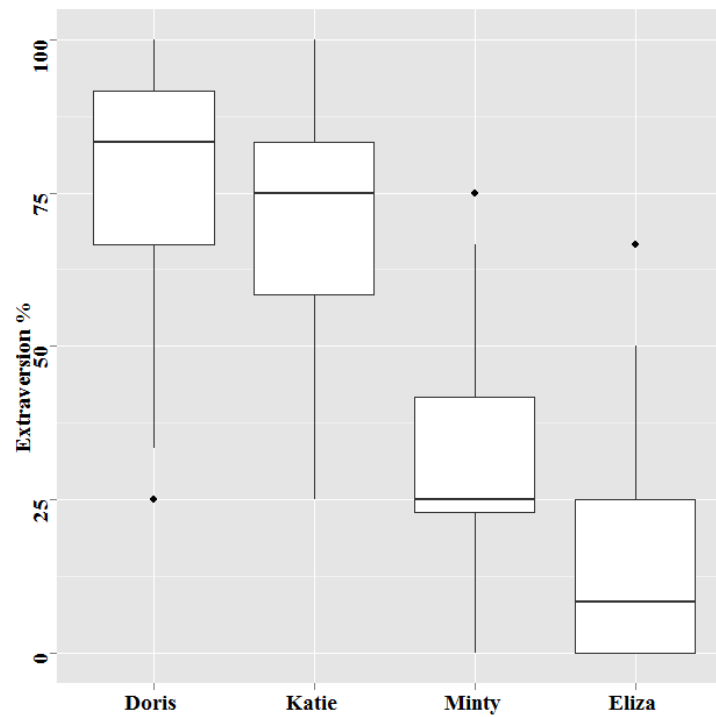


Figure 9.2 : Participants Rating personas' personality - Extraversion

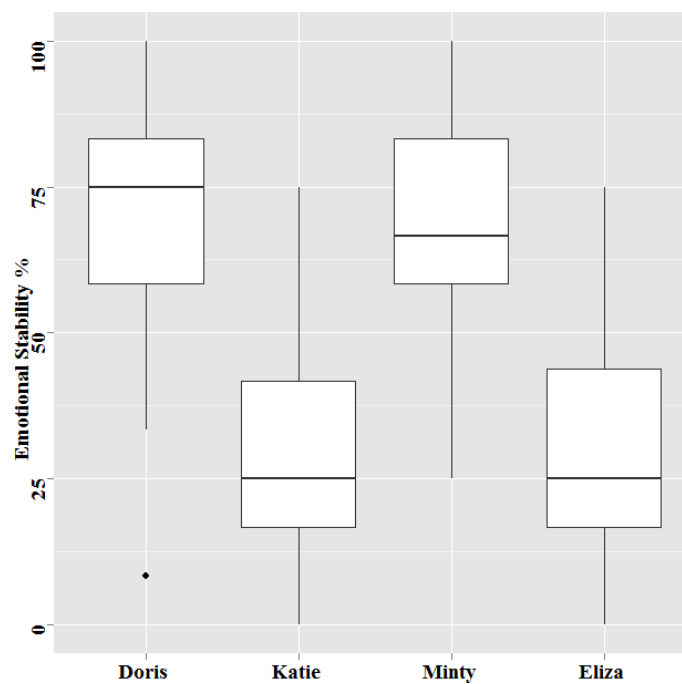


Figure 9.3 : Participants ratings personas' personality - Emotional stability

the variations quoted in the literature. The participants considered that the personas resemble a real person (Table 9.4, Doris 57%, Katie 61%, Minty 61%, Eliza 54%).

The empirical results of Study II and Study III indicate that participants correctly identified the authored personas' personalities as intended.

9.5 Participants' Preferred Holistic Persona

In this section the participants' preferred Holistic Persona is presented. The participants spent some time with each Holistic Persona while they were rating the persona and designing an application for the Holistic Persona. Hence they may have formed a preference for a persona that they would like to work with.

This section explores the following research question:

How to identify the Holistic Persona that has likeable personality traits as perceived by the participant?

This question is part of research question 4 in the section above:

Is a participant more creative (produces a design that scores high, 75% or higher or is more in-depth, in comparison with other participants) when working with a Holistic Persona that has likeable personality traits as perceived by the participant?

9.5.1 Analysis of Post Design Questionnaire Related to Preferred Holistic Persona

After the design session, participants who continued with the study answered post design questionnaires. Since design and post design activities are independent of the persona rating activity, participants who provided valid data for these activities were included in the post design statistics. Table 9.1 indicates that 47 participants provided valid answers to the design and post design questionnaires.

In one question participants were asked to select either one of the four personas for their future design activity or indicate they did not remember the persona's name. They were given an opportunity to comment on their choice. From answers given to these questions, their explanations for their selection and their design notes, Table 9.6 is compiled which shows that 73% of these participants preferred to design for a persona that is emotionally stable, 32% of them selected Doris/Helena and 41% of them selected Minty/Meta. Only 12% of the participants preferred to design for the emotionally unstable personas (Katie/Katerina and Eliza/Agnetta). The rest selected the option that they could not remember the names of their preferred personas (15%); from the notes, 4% indicated that they did not have a preference,

2% indicated that they preferred to design for a new persona and 9% did not give any explanation for their selection.

Table 9.6 : Preferred persona for a future design activity.

Persona		Percentage of participants select (%)
Doris	Helena	32
Katie	Katerina	6
Minty	Meta	41
Eliza	Agneta	6
Did not remember the name		15

9.5.2 Conclusion - Preferred Holistic Persona

From Table 9.6 it is evident that for their future design activity the participants who made a selection from among the four Holistic Personas had preferences based on personalities of the Holistic Personas and the majority of them indicated that for their future design activity they preferred a Holistic Persona who is emotionally stable.

9.6 Participants' Perception of Effect of Holistic Persona on Conceptual Design

To assess the participants' awareness of the personalities of personas, the following statements were made during the design modification activity for each Holistic Persona and participants were asked to rate each of these statements on a 7-point scale ranging from 1 (disagree strongly) to 7 (agree strongly):

1. I was totally engaged with [the Holistic Persona]'s personality while I was designing for [the Holistic Persona],
2. The personality of [the Holistic Persona] positively influenced my design for [the Holistic Persona].

The participants' responses for the preferred Holistic Persona during the post design questionnaire (Table 9.6) are presented in Table 9.7.

Analysis of answers to the above questions (Table 9.7) indicates that 68% of the participants felt that they were totally engaged with the personality of their chosen Holistic Persona and 75% of the participants reported that the personality of the Holistic Persona positively influenced their design.

9.6.1 Conclusion of Effect of Holistic Persona on Conceptual Design

The above statistics indicate that the participants were aware of the personality of the persona during their design activity and hence they believed that they tailored their design according to the personality traits of a persona.

Table 9.7 : Effect of personality traits of the preferred persona during the design session

N o	Statements about persona	Participants' Responses (%)				
		<i>Strongly Agree</i>	<i>Moderately Agree</i>	<i>Neither Agree nor Disagree</i>	<i>Moderately Disagree</i>	<i>Strongly Disagree</i>
1	I was totally engaged with her personality while I was designing for her	30	38	23	7	2
2	Her personality positively influenced my design	33	42	15	5	5

9.7 Chapter Summary

This chapter covered the procedure followed during the studies II and III. A subset of the results of the studies was presented in this chapter.

The results of the studies demonstrate that the participants in the study can identify personality traits of the personas and personas with personality traits affect designers at the conceptual design phase. Design notes and answers to the post design survey questionnaire indicate that 80% of the participants tailored their conceptual designs according to personalities of the personas. Personality affects the way users interact with the software applications or products (Behrenbruch et al. 2012, McRorie et al. 2009, Nov et al. 2013a, Oliveira et al. 2013, Svendsen et al. 2013, Vazire and Gosling 2004), so it is expected that the target users would find the software applications tailored to their personality to be more user friendly. Since the participants in these studies were able to correctly recognize the personalities of the persona hence they can develop designs tailored to the Holistic Persona's personality.

The next chapter discusses the results of all three studies.

10 Results from Studies I, II and III

This section covers the combined results from all three studies. It covers all the sections that are common or can be considered common to all studies. Following a summary of the combined demographics for all studies, combined results are presented.

10.1 Participants for all Studies

Demographics for results that use all studies are presented in Table 10.1. In this chapter the data from participants' personality traits and design ability, design and post design questionnaire and spatial ability test are used as the questions in study I are the same as questions in studies II and III.

Table 10.1 : Number of participants in studies I, II and III

No	Participants	Number of participants			Total
	Study	I	II	III	I, II & III
	Country	Australia	Australia	Denmark	
1	Completed or attempted design session for Holistic Persona (aspiring UCD designers)	33	25	25	83
2	completed post design questionnaire	32	24	23	79
3	Completed self-assessment of personality, design and spatial ability test	32	25	25	82

10.2 Overall Assessment for Multiple Design

In studies II and III the participants were offered four Holistic Personas to assess their personalities and prepare a design for each one of them. Analysis of the designs revealed a number of design variations or patterns. The design variations observed are as follows:

- 1- A different design is offered for each Holistic Persona.
- 2- Designs deal with other issues that the participant thought important for the Holistic Persona mainly centring on musical activities.
- 3- One generic design is offered for all Holistic Personas with little or no variation.
- 4- The initial design is progressively changed to suit the new Holistic Persona.
- 5- One or more of the designs are in problem space.

For each participant, also an overall assessment was made which provides a summary of the design activities for all four Holistic Personas. The design rubric presented in Chapter 6

was used for the design assessment. In assessing the design, scenario, factual information, weight issue and suitability of design to Holistic Persona, considerations were given to all the designs presented. All the applications listed were treated as one design work and the highest rating was selected in each category for overall design assessment. If any of the design for the Holistic Persona was assessed as in-depth or considered the personality of the Holistic Persona, the overall qualitative assessment of the personality consideration in design was marked as either 'in-depth' or 'considered' respectively.

Variations one and two are assessed as outlined above. In variation three, the design, scenario, factual, weight issue marks were assessed to be the same for all designs and the overall design. However the suitability of the design for a particular Holistic Persona can vary depending on the suitability of the generic design to one or more of the Holistic Personas. This was taken into consideration for each design and for overall assessment.

In variation four, all factors vary, especially suitability to Holistic Persona. This type of design work is generally considered 'in-depth' as the designer attempts to produce a design that is suitable to each of the Holistic Personas.

In variation five, if any of the designs for any of the Holistic Personas was in the problem space, in the overall assessment, the design was considered to be in the problem space.

10.3 Effect of Holistic Persona's Personality on System Requirements

The studies of Anvari and Tran (2013), Behrenbruch et al. (2012), Faily and Lyle (2013) and Svendsen et al. (2013), identified the potential value of considering personality during the requirements and early (i.e., conceptual) design stages. To understand the role that personality can play, this section explores answers to the research question:

Does the use of personas with different personalities result in different system or software requirements and conceptual designs tailored to that personality?

10.3.1 Review of Research Methodology and Results Used

Three empirical studies were conducted involving four personas (Table 4.2) that were identical except for their personality and the familiar Australian names of the Holistic Personas and places used in Studies I and II, were modified in Study III to provide familiar Danish names and places. In these controlled experiments the testable hypothesis that resultant systems or software requirements were tailored to the personality of a Holistic Persona by manipulating the independent variables, the personalities of the Holistic Personas were investigated; in other words the investigations were to uncover the existence of a cause-effect relationship (Easterbrook et al. 2008).

Combining data from studies I, II and III due to variations in procedure and background of participants increases the threats to validity of the study. A statistical analysis of data covered in section 10.3.17 indicates that the data from the three studies can be analysed in combination for this research question.

10.3.2 *Design Statistics*

The participants in Studies I, II and III produced 33, 91 and 94 design artefacts, respectively, after discarding the incomplete designs and one design with inappropriate content (Table 10.2). The total of 218 design artefacts (Table 10.2) were distributed nearly evenly for all four Holistic Personas with Minty having 58 design artefacts, the highest number, and Katie having 50 design artefacts, the lowest number.

Table 10.2 : Design statistics ^

Description	Study	Doris	Katie	Minty	Eliza	Totals
No of design activity	All	60	60	61	60	241
Completed design activity	I	7	6	10	7	30#
	II	23	22	23	21	89#
	III	23	20	25	23	91#
Appraised the Holistic Persona *	I	0	1	0	2	3#
	II	0	0	0	2	2#
	III	1	1	0	1	3#
Attempted the design activity	All	54~	50~	58~	56~	218
Did not attempt a design activity +	All	6	10	3	4	23
Notes: ^ Numbers of designs for each Holistic Persona. A participant's design for each of the Holistic Personas was considered as a single design. * Appraised the Holistic Persona: The participant attempted the design activity, appraised the Holistic Persona and indicated her/his reason for not designing or recommending any software application or product. + Did not attempt a design activity: The participants assessed Holistic Persona's personality, answered post design questionnaire and continued with the study but did not make a meaningful entry in the design field for that Holistic Persona only. ~ These statistics were used for all percentage evaluations of the requirements for each Holistic Persona for all the studies in the tables below. # Completed and appraised totals were added for each study and used for all percentage evaluations of the requirements for each study in the tables below.						

10.3.3 *Requirements Motivating the Design*

Analysis of design artefacts for assessment using the rubric (chapter 6) revealed the motivating requirements that were the impetus for the design works. For each design the motivating requirements facilitated preparation of a system requirements list as the designer would have envisioned. Table 10.3 shows the list of condensed requirements, after requirements that were similar to each other have been abstracted to higher level.

Table 10.3 : High level list of Requirements motivating the design

No	Application Requirements
1	Food/Exercise
2	Scheduler/Reminder
3	Combined Food/Exercise and Scheduler/Reminder
4	Social Event With Friends
5	Social Event Alone
6	Peer Reliance
7	Peer Competition
8	Social Encourager
9	Confidence Builder
10	Relaxation
11	Music (learning app)
12	Music (other than learning app)
13	Intellectual, Investigator
14	Group apps - connected with others' app
15	Cultural Differences
Note: requirements listed in rows are mutually inclusive; a design artefact can have multiple requirements.	

Analysis of design artefacts showed that a number of design requirements are mutually inclusive. A designer can propose a design idea to fulfil two or more requirements. For example the designer who recommends a public forum indicates the reasons: assist the Holistic Persona in building her confidence and to encourage her to socialise; hence one design fulfils two requirements. Further the requirements identified by a participant for the same design can be varied. For example, a weight loss application is recommended by a participant to meet the Holistic Persona's requirement to manage her weight but another participant states the requirement for weight loss application is for the Holistic Persona to build her confidence.

The following sections show the classification of the design impetus requirement details that have been condensed and abstracted into higher level requirements. In each section beginning with a high level summary, the details of the design ideas put forward by the participants are listed.

10.3.4 *Statistics for the Identified Requirements*

The results of analysis of design artefacts from the three empirical studies for the four Holistic Personas show that, the participants listed 15 high level requirements (Table 10.3). Table 10.4 presents a summary statistics for the top-level requirements for each of the Holistic Personas. In order to avoid uneven distributions of designs, the percentages have been calculated based on the total number of designs for each of the Holistic Persona. Figure 10.1 shows this summary graphically for each Holistic Persona.

A number of high-level requirements were comprised of several low level mutually exclusive requirements. The following subsections and Table 10.5 - Table 10.10, provide the numbers of the breakdown of Table 10.4 for items 1, 2, 8, 9, 12 and 14. In the low level tables (Table 10.5 - Table 10.10), a design (one design per Holistic Persona) contributes to only one item of the low level table, however a design may contribute to multiple low level tables. Hence, the rows in a low level table are additive showing the number of designs for each persona that contributed to the higher-level requirements (of items) in Table 10.4.

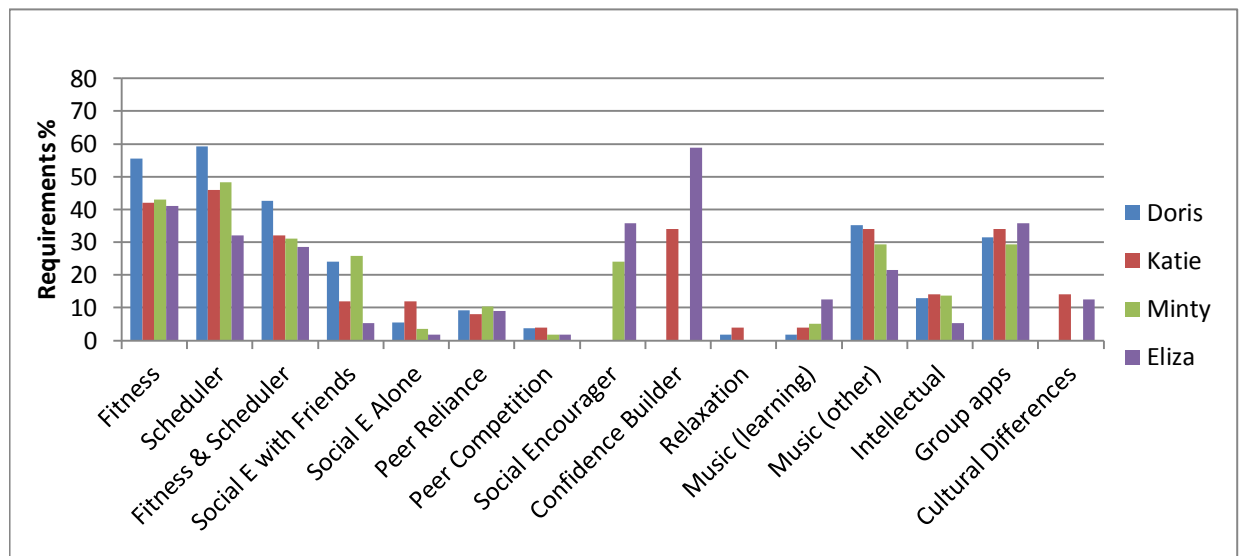


Figure 10.1 : Participants' view of Application Requirements

10.3.5 *Fitness - Weight Issue*

One of the main requirements for the design of an application is to address the Holistic Persona's weight issue. All design artefacts that met the weight issue centred on either food or exercise or both food and exercise. Following are the design ideas to overcome the weight problem:

1. Diet or observation of food intake: monitoring calorie intake
2. Exercise: monitoring calorie burn out
3. Fitness (both diet and exercise): applications to assist the Holistic Persona in measuring the calorie intake and the amount of exercise to achieve the targeted goal in weight reduction
4. Use of a coach or trainer to guide the food intake and calorie burn out
5. Willingness and mental attitude: comments about willingness or mental attitude to reduce weight

Table 10.5 provides statistics for requirements that the participants elucidated for their design to meet the food and exercise requirement.

Table 10.4 : Summary of application requirements*

No	Application Requirements	Doris %~	Katie %~	Minty %~	Eliza %~
1	Fitness	56	42	43	41
2	Scheduler	59	46	48	32
3	Combined Fitness & Scheduler	43	32	31	29
4	Social Event With Friends	24	12	26	5
5	Social Event Alone	6	12	3	2
6	Peer Reliance	9	8	10	9
7	Peer Competition	4	4	2	2
8	Social Encourager	0	0	24	36
9	Confidence Builder	0	34	0	59
10	Relaxation	2	4	0	0
11	Music (learning app)	2	4	5	13
12	Music (other than learning app)	35	34	29	21
13	Intellectual, Investigator	13	14	14	5
14	Group apps - connected with others app	32	34	29	36
15	Cultural Differences (Issue with Holistic Persona's personality)^	0	14	0	13
Notes: * A design often meets multiple requirements. ~ Percentages are based on the total number of designs for each of the Holistic Persona (Table 10.2). ^ Cultural Differences: Australian participants found Eliza's personality a hindrance to their design work where as participants from Denmark found Katie's personality a hindrance.					

Table 10.5 : Summary requirements – food/exercise

Application Requirements	Doris %	Katie %	Minty %	Eliza %
Food and Diet (monitoring calorie in-take)	13	12	15	7
Exercise (monitoring calorie burn out)	11	10	9	9
Fitness (both food and exercise)	30	16	19	23
Coach	0	2	0	2
Willingness and mental attitude	2	2	0	0
Total	56	42	43	41

10.3.6 *Memory Management - Reminder and Scheduler*

Another main requirement that the design of an application or service is to address, is the Holistic Persona's needs to be reminded about applying sun cream lotion, take reading glasses and telling the waiter about her allergy. Some participants used the reminder also to include diet or exercise as well as items that the Holistic Person needs to be reminded of. The need for a reminder is addressed by one or more of the following:

1. Reminder: without specifying implementation details
2. Time based reminder: a reminder that is triggered at a predetermined times e.g. pre-programmed meal times.

3. Event based reminder: a reminder by location detection such as a restaurant or motion detection, e.g. the Holistic Persona is about to leave her home.
4. Advisory reminder: a reminder that the Holistic Persona can use to advise her items she should be taking or doing to achieve her goals.
5. Reminder with features: The participants listed features such as sensors to detect proximity, scan diary entries for scheduled meetings, check weather information, etc.
6. Friends: ask her friends to remind her e.g. at a restaurant with friends the friends who are pre warned about the Holistic Persona's allergy can remind her to check the food ingredients
7. Coach: a coach that reminds the Holistic Persona to remember what to do and eat.

Table 10.6 lists requirements that the participants elucidated for their design to meet the scheduler requirement, which includes reminders.

Table 10.6 : Summary requirements - scheduler

Application Requirements	Doris %	Katie %	Minty %	Eliza %
Reminder (details not specified)	17	16	16	12
Time based reminder	9	8	9	5
Event based reminder	7	4	5	4
Advisory reminder	13	12	12	7
Reminder with features (sensors, scan diary entry, weather info)	11	4	3	4
Friend	2	0	3	0
Coach	0	2	0	0
Total	59	46	48	32

10.3.7 *Social Encourager*

Socialization was a requirement in 36% and 24%, respectively, of designs for Eliza and Minty (Table 10.4, item 8). This requirement is addressed by one or more of the following design ideas:

1. Recommendation of a forum or a networking based on an item of interest or a chat software
2. Meeting organizer : application to organise meetings between friends or strangers using some common characteristics.
3. Fitness app with intention of socializing
4. Music app with intention of creating social network
5. Coach: recommended a coach for socialization and
6. Psychologist: recommended a psychologist for socialization

7. No recommendations: mentioned Holistic Persona's needs for socialisation but did not made any suggestion due to extreme personality traits of the Holistic Persona Eliza/Agneta

Table 10.7 shows conceptual designs that the participants provided to meet social encouragement requirements.

Table 10.7 : Requirements - social encourager

Application Requirements	Doris%	Katie %	Minty %	Eliza %
Forum / networking / chat for socialization	0	0	15	14
Meeting organizer	0	0	9	7
Fitness app	0	0	0	2
Music app	0	0	0	4
Recognized need for socialization / recommended coach for social training	0	0	0	9
Total	0	0	24	36

10.3.8 *Confidence Builder*

Lack of confidence was identified by 59% and 34% of the design work for Eliza and Katie respectively (Table 10.4, item 9). The design idea is to acknowledge Holistic Persona's inner experience and increase her motivation and confidence (Ryan and Deci 2000). Following are the design ideas which the participants suggested as result of the perceived requirement to build Holistic Persona's confidence:

1. Schedule / planning / reminder app - for building Holistic Persona's confidence
2. Forum and social communication – for building Holistic Persona's confidence
3. Music apps for building confidence
4. Fitness app with incentive
5. Coach / Inspirational apps
6. No recommendation: lack of confidence was acknowledged without offering any design idea.

Table 10.8 shows conceptual designs that the participants provided to meet confidence building requirements.

Table 10.8 : Requirements – confidence builder

Application Requirements	Doris%	Katie %	Minty %	Eliza%
Schedule / planning / reminder app	0	8	0	4
Forum & social communication – for building confidence	0	4	0	18
Music apps for building confidence	0	2	0	12
Fitness app with incentive	0	6	0	9
Acknowledged lack of confidence / recommended coach for confidence building / offered inspirational apps	0	14	0	16
Total	0	34	0	59

10.3.9 *Social Activities*

The designs that provided for search and purchase of tickets for social activities like concerts were motivated by two main categories of requirements:

1. The Holistic Persona would attend the function in the company of her friends or invite her friends to take part (Table 10.4, item 4),
2. The Holistic Persona would attend the function alone (without inviting her friends) (Table 10.4, item 5).

10.3.10 *Peer Reliance and Peer Competition*

Peer reliance refers to the requirement of relying on peers for reminders (Table 10.4, Item 6). Peer competition is the requirement to motivate the Holistic Persona to undertake or accomplish an activity (Table 10.4, item 7). Both requirements closely follow Social Learning theory which calls for group interaction and peer feedback (Johnson and Aragon 2003).

10.3.11 *Music*

Some participants' design work centred on music or used music as an objective to achieve other goals. This resembles the Behavioural Learning Theory which calls for positive reinforcement and repetition (Hunt et al. 1979). The participants incorporated music in their design work differently. Two main categories of design centred on music were identified:

1. Need to learn music such as play guitar (Table 10.4, item 11)
2. Music (other than learning app) (Table 10.4, item 12)

Design ideas that are categorised as music (other) are:

1. Calendar of musical events
2. Music Forum
3. Application to record and share music

4. Application to record and/or play music
5. Organise and file music collections

The statistics for requirements listed for music (other than learning app) are in Table 10.9.

Table 10.9. Requirements – Music (other than learning app)

Application Requirements	Doris %	Katie %	Minty %	Eliza %
Calendar of musical events	17	18	10	4
Music Forum	11	4	5	5
Application to record and share music	4	4	2	5
Application to record and/or play music	3	8	10	5
Filing and organizing music collections	0	0	2	2
Total for the requirements – Music (other)	35	34	29	21

10.3.12 *Intellectual, Investigator and Planner*

Some participants incorporated intellectual or investigative ideas in their design or considered the Holistic Persona as having tendency to make long term plans (Table 10.4, item 13).

10.3.13 *Group applications*

In their design, a number of participants considered applications that have connections with other users and hence are part of a group/social network, group applications.

Group applications were designed either to operate in networks that are connected as client server or to web sites and portals in order to collect information such as weather or ticket prices or to connect to other users' applications. Group applications are often a requirement to satisfy the need for social improvement. The type of group application and the frequency it was proposed are shown in Table 10.10.

Table 10.10. Requirements – group applications

Application Requirements	Doris %	Katie %	Minty %	Eliza %
Private communication with friends	15	10	9	9
Specialized forum (require registration)	9	14	15	11
Public Forum (can be anonymous)	8	10	5	16
Total	32	34	29	36

10.3.14 *Cultural Differences in Identifying Requirements*

Due to the cohorts coming from two different cultural backgrounds (i.e., Australian and Danish), some cultural differences were identified in the way that Australian and Danish

participants expressed their responses to and (dis)like of the personality traits of Eliza/Agneta and Katie/Katerina. Some Australian participants found it difficult to design a product for Eliza. But the Danish participants found Katie/Katerina as a personality that they found difficult to design for (Table 10.4, item 15). Furthermore there are cultural differences in participants' choices of application architectures that will be discussed in section 10.3.18.

10.3.15 *Core Requirement Motivating a Design Artefact*

A design artefact generally fulfils a number of requirements. However one requirement can be considered as a core or central requirement. Many of the design artefacts provided evidence that some requirements were considered to be more significant for the design. Some requirements listed in Table 10.3 are supportive of other requirements and hence they are not considered in Table 10.11 which lists the core requirements for all designs. The items from Table 10.3 that are excluded for the list of core requirements are: item 13 - Cultural Differences, item 14 - Relaxation, item 15 - Group apps and item 16 - Single user apps. In Table 10.3, item 10, relaxation is identified as a requirement but none of the participants considered it as a core requirement in their design artefacts (Table 10.11, item 10).

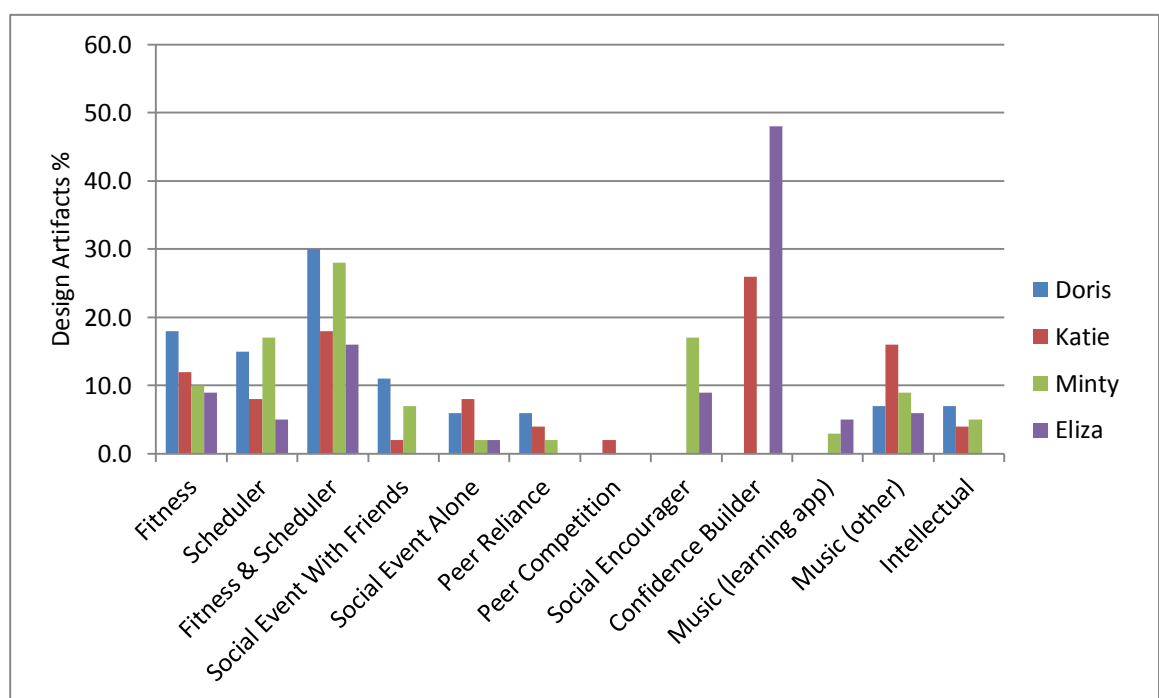


Figure 10.2 : Participants' view of Applications' Core Requirements

Table 10.11 and Figure 10.2 show the core requirements for all Holistic Personas. For this table, in cases where the participants attempted the design activity but did not provide a design or recommendation for an application (Table 10.2), from the comments and answers

to questionnaires the requirement that the participant thought the Holistic Persona needed most was entered as the core requirement.

Table 10.11 : Core requirements *

No	Application Core Requirements	Doris %~	Katie %~	Minty %~	Eliza %~
1	Fitness	18	12	10	9
2	Scheduler	15	8	17	5
3	Combined Fitness & Scheduler	30	18	28	16
4	Social Event With Friends	11	2	7	0
5	Social Event Alone	6	8	2	2
6	Peer Reliance	6	4	2	0
7	Peer Competition	0	2	0	0
8	Social Encourager	0	0	17	9
9	Confidence Builder	0	26	0	48
10	Relaxation	0	0	0	0
11	Music (learning app)	0	0	3	5
12	Music (other than learning app)	7	16	9	6
13	Intellectual, Investigator	7	4	5	0
	Total	100	100	100	100
* A design meets single application core requirements. ~ Percentages are based on the total number of designs for each of the Holistic Persona (Table 10.2).					

10.3.16 *Statistical Evaluations*

The data from each requirement for each Holistic Persona (Table 10.4) has been standardized using the requirement's mean and variance for correlational studies. Some items from Table 10.4 are excluded from correlational studies as statistics listed in these items are repeated in other items:

- item 3 - Combined Fitness & Scheduler (statistics listed in item 3 are repeated in items 1 and 2)
- item 14 - Group apps (statistics in item 14 is repeated in other items, e.g., forums or peer reliance)
- item 15 - Cultural Differences (statistics listed in Item 15 indicates the comments the participants made about the Holistic Persona's personality, it is not a requirement to include in correlational studies; any requirement listed in design artefacts are included in other items of the table).

The correlation of the requirements between any two pairs of the Holistic Personas (Table 10.12) is indicative of the differences in requirements due to the personality of the personas.

Pearson's product-moment correlation revealed statistically significant findings in the correlation of the requirements between Doris, extravert and emotionally stable, and Eliza, introvert and emotionally unstable, ($r=-0.83$, $p<0.01$) and Katie, extravert and emotionally unstable, and Minty, introvert and emotionally stable, ($r=-0.72$, $p<0.01$). Other notable statistics, which are not statistically significant, are the small positive correlation between the requirements for Doris and Katie (both are extravert) and Doris and Minty who are both emotionally stable. The correlations demonstrate that personality traits have a high modifier effect on design requirements.

Table 10.12. Correlation of requirements between holistic personas

Holistic Personas	r	t-value	df	p (> t)
Doris & Katie	0.09	0.28	10	0.787
Doris & Minty	0.04	0.12	10	0.905
Doris & Eliza	-0.83	-4.71	10	0.001**
Katie & Minty	-0.72	-3.24	10	0.009**
Katie & Eliza	-0.39	-1.36	10	0.205
Minty & Eliza	-0.11	-0.36	10	0.727
Notes: r – Pearson's product-moment correlation, double sided with confidence level at 0.95; t-value – t-statistics; df – degrees of freedom; ** significant as $p < 0.01$				

10.3.17 Threat to Homogeneity of Data

Data source triangulation increases the precision of empirical research (Runeson and Höst 2009), however this raises a potential threat to be mitigated concerning the combination of the data from Study I, where four Holistic Personas were presented and rated and only one design activity was performed with a randomly assigned Holistic Persona, with studies II and III, where each of the four Holistic Personas was presented in random order and was rated and a design activity was performed for her. Table 10.13 shows that the percentage of designs (based on the total number of designs per study) for each of the requirements identified in section 10.3.3 are similar in all studies. Statistical evaluations of the normalized data (normalized using mean and variance of each requirement discarding the following data as they are repeated: Fitness and schedule, group design and cultural differences) for three studies have been presented in Table 10.14 and Table 10.15. Table 10.14 presents the Pearson's product-moment correlation, and Table 10.15 presents two-way mixed ANOVA with 2 and 33 degrees of freedom for the three studies. As shown in Table 10.14, there is a medium degree of correlation between data obtained from Study I and Study II, and Study I and Study III. Table 10.15 shows that there is no difference in requirements elicitation between the three studies. Hence, the analysis indicates that the data from the studies can be combined for further statistical evaluation.

Table 10.13 : Summary of application requirements for each study*

N o	Application Requirements	Study I % #	Study II % #	Study III % #
1	Fitness	54	41	48
2	Scheduler	73	48	35
3	Combined Fitness & Scheduler ^	42	35	29
4	Social Event With Friends	18	16	17
5	Social Event Alone	3	7	5
6	Peer Reliance	21	7	7
7	Peer Competition	0	1	5
8	Social Encourager	21	13	16
9	Confidence Builder	21	0	26
10	Relaxation	0	3	0
11	Music (learning app)	0	4	10
12	Music (other than learning app)	15	29	36
13	Intellectual, Investigator	9	8	16
14	Group apps - connected with others app ^	15	27	44
15	Cultural Differences (Issue with Holistic Persona's personality) ^	12	3	7
Notes: * A design often meets multiple requirements. # Percentages are based on the total number of designs for each study (Table 10.4). ^ These items were discarded for homogeneity of data studies as they are repeated in other items.				

Table 10.14 : Correlation of requirements between studies

Studies	r	t-value	df	p (> t)
S1 & S2	-0.66	-2.80	10	0.019**
S1 & S3	-0.65	-2.74	10	0.021**
Notes: S1 – Study I, S2 – Study II, S3 – Study III, df - degrees of freedom r – Pearson's product-moment correlation, ** significant as $p < 0.05$				

Table 10.15 : Statistical evaluations of studies

Ho	F value	df #	Pr(>F)	Accept/Reject Ho
There is no difference in requirements elicitation between Studies I, II and III	1.33	2, 33	0.28	Accept *
Notes: * Accept the null hypothesis Ho # df –degrees of freedom				

10.3.18 Answering the Research Question

Three empirical studies report on the potential of using Holistic Personas (personas with personality traits) for requirements elicitation and conceptual design. The results demonstrate the variation in system requirements and hence the design due to designers perceived need/s of the end user.

The majority of the participants offered at least one design that was centred on food or a scheduler for Doris/Helena (Table 4, items 1, 2 and 3). Thus, the participants were aware of

the needs of the Holistic Persona for weight reduction or memory issues. However the participants identified 12 high level requirements including fitness and memory. Some of the requirements can be described as creative requirements (P type creativity) as they are unusual and unexpected (Nguyen and Shanks 2009).

Major issues that the Holistic Personas face are weight concerns and their inability to remember to take their glasses, apply sun cream lotion when the day is sunny and to warn a waiter about their allergy. In most designs, these issues were addressed separately. However the majority of the participants did not see these issues to be of equal importance for all Holistic Personas; 56% of the participants saw reducing weight and 59% saw a scheduler or a reminder as a requirement for Doris but only 41% and 32% respectively saw the same requirement for Eliza. Some of the participants detected the introvert and emotionally unstable nature of Eliza and did not provide a weight reduction design. Some participants did not place a high priority on a weight reduction requirement for Minty (43% for Food/exercise) for a different reason as a participant stated that Minty feels good about herself so she does not want to lose weight as much as Katie. However, 48% of the designs (Table 10.4) provided for a scheduler/reminder, which indicates that Minty needs a reminder according to the participants.

Socialization is a requirement that the participants identified for Eliza and Minty (Table 10.7). Lack of socialization for Eliza was dealt with combined with confidence building measures in the proposed designs. For Minty, the requirement was translated into a conceptual design by recommending forums and match making applications. Some participants saw lack of confidence as an important requirement that needs to be addressed initially to assist Eliza and Katie. To fulfil this requirement, the participants either suggested a forum, personal coach or enhancement of their musical abilities. The personality traits of Eliza and Katie led a number of participants to design applications for building their confidence. None of the participants made any suggestion for a confidence building design for Doris or Minty. A comparison of Table 10.7 and Table 10.8 reveals that confidence building features were suggested more than social building features.

Group and single user applications were the architectures that the participants considered in their design to meet the requirements of the Holistic Personas. Group applications were often a requirement to satisfy the need for group improvement whereas single user applications were mainly to meet personal needs of the Holistic Personas (e.g. a reminder or calorie counter). Table 10.10 shows the various types of group application and the proposed frequencies are in similar proportions for all Holistic Personas, however the underlying reasons are different. For Doris, the group connected applications are mainly used for peer connection as she has a number of friends and relies on her friends for support or remains in contact with her friends. But for Eliza, the majority of the connected applications are socially

interactive forums where she can join anonymously. A number of participants identified requirements for Eliza to help her to build confidence and socialise anonymously or the need for Minty to use forums and socialise; suggestions suitable for introverts. Hence introducing personality to persona can help to better represent the target users of the application or service. For example the requirement for Doris is in line with Moore and McElroy (2012) finding that extraverts have a wider network of friends. The requirement for Eliza is in line with Landers and Lounsbury (2006)'s findings: emotionally unstable women seek information online anonymously and Lagoe and Atkin (2015)'s report: neurotic people with health anxiety are more incline to seek online health information.

These studies also highlight the differences in how people in different cultures view extremes of personalities. The results present the differences in how Australian and Danish people view Eliza/Agneta and Katie/ Katerina (section 10.3.14). Cultural differences may affect the design activity as users and designers in different countries have different expectations and may identify requirements differently (Anvari and Tran 2013). These studies contribute to that understanding. Another cultural difference identifiable from Table 10.13 item 14 is group applications, the applications that are connected with other applications. The higher percentage of participants who identified this architecture to meet the Holistic Persona's requirement was in study III (44%) compared to studies I (15%) and II (27%). This suggests that Danish participants place more emphasis on social connectedness. From the World Happiness Report, Denmark has a 'very high level of social trust not matched almost anywhere else in the world' (Helliwell et al. 2015, p. 160).

In sum, the studies confirm that the use of personas with different personalities result in different system or software requirements and conceptual designs that are tailored to personality of the personas.

10.3.19 *Conclusion for Effect of Holistic Persona's Personality on System Requirements*

This chapter has demonstrated that software engineers can elicit system requirements using Persona with personality traits and produce conceptual designs based on those requirements. From the design artefacts it is evident that the software engineers' views of system requirements can be affected by the personality traits of a persona. For example, for an introverted and emotionally unstable personality, a software engineer would give the requirements for a confidence builder and socializer a higher priority compared with an extravert and emotionally stable personality. Furthermore, this thesis has demonstrated that Personas with personality traits can enable software engineers to elicit personality specific requirements. Thus, it can be concluded that the use of personas with different personalities does result in different system or software requirements and conceptual designs tailored to that personality. As an interesting outcome of conducting these studies in two different

countries, some cultural differences were found in terms of what requirements were identified and the participants' preferences to design for certain types of personalities.

II Discussion of the Results

This chapter presents a discussion of the results. Initially a list of research questions is provided, followed by a summary of the activities performed in the studies. For each of the research question, the discussion provides the meaning of the results for persona design, requirements, UCD, SEs, etc. and comparison with other findings in the literature, contribution to, revision and confirmation of, theories and practices in the field.

11.1 Review of the Research Question

This thesis sought to answer the following research question:

Does the use of personas with different personalities result in different system or software requirements and conceptual designs tailored to that personality?

The above research question was refined further into following questions:

1. Do participants consider that the Holistic Personas resemble real people? (Is there enough of a person there for people to believe this to be real?)
2. Do participants correctly identify the intended personality traits of Holistic Personas?
3. Do participants have a preference to design for a Holistic Persona due to its personality traits?
4. Do the participants tailor their designs according to the personality traits of Holistic Personas?
5. Can a spatial ability test and self-assessment of personality traits be used to identify talented aspiring designers who can produce a design within UCD methodologies that matches Holistic Persona's needs considering her personality?

In summary the objectives of this thesis was to conduct a study of the relationship between creativity in design, Holistic Persona's personality traits, designers' personality traits and spatial abilities.

11.2 Summary of the Studies

Each of the research questions sought to answer a different question category.

1. The first question is an existential question; do participants, some of whom may be designers of an application and all of them are users of an application, consider the Holistic Persona to represent a real person.

2. The second question is a relationship question; it checks how closely participants identify the personality traits of Holistic Persona to the traits intended.
3. The third question is an existential question; it checks the preferences that participants have for a specific personality of a user in their design work.
4. The fourth question is a causal question; does Holistic Persona's Personality affect the design of the application?
5. The fifth question is knowledge or skill question; it attempts to discover innate design capabilities of a participant in use of persona with personality within UCD methodologies.

Three empirical studies were conducted to answer the research questions concerning the influence of the Holistic Persona on the designer and the relation between the designer's and persona's personality traits.

The studies were conducted with three different participant cohorts, Software Engineering Semester 2 2013, tutors and adult participants (chapter 5 and chapter 7) and Game Design Semester 1 2014 students and tutors at Macquarie University and postgraduate Software Engineering Semester 2 2014 students from IT University of Copenhagen (chapters 8 and 9).

The data were collected by getting the participants to perform the following tasks:

1. Fill demographics questionnaire.
2. Complete a self-assessment of personality traits.
3. Receive a brief introduction to UCD methodologies for educational purposes, which included an example of a persona, a conceptual design and a scenario.
4. Then the participants carried out:
 - 4.1. assessment of each of the four personas, and
 - 4.2. design activities with Holistic Personas (only one design activity with one Holistic Persona in study I and four design activities with each of the four Holistic Personas in studies II and III).
5. The design activities were followed by:
 - 5.1. redesign activities (studies II and III) and
 - 5.2. answering design questionnaire
6. Answer post design questionnaires about their overall design experiences,
7. Perform a spatial ability test.

In these experiments the testable hypothesis that resultant systems or software requirements were tailored to the personality of a Holistic Persona by manipulating the independent variables, the personalities of the Holistic Personas was investigated; it was an investigation of the existence of a cause-effect relationship (Easterbrook et al. 2008). The

results for study I was presented in chapter 7 and results from studies II and III were presented in chapter 9.

The rest of this chapter covers the discussion of the results for each of the research question from the three studies.

11.3 Personality of Holistic Personas

Two sets of four Holistic Personas were authored in which two personality factors, extraversion and emotional stability, were varied. The personality dimension of the Holistic Persona was tested by having participants assess the Holistic Personas.

In Study I, the results for research questions 1 and 2 (section 11.1 and section 3.1) were evaluated in section 7.3. In regards to the question 1, the results (section 7.3.2, Table 7.3) demonstrated that the participants in Study I responded positively; the Holistic Persona represents a real person (Table 7.3, Jane 61%, Jean 58%, Jade 72%, June 61%). In regards to the question 2, the results (section 7.3.2, Table 7.3, Table 7.4, Figure 7.1, Figure 7.2 and Figure 7.3) demonstrate that the participants recognised correctly the personalities of the Holistic Personas as were authored (Table 4.2). Table 7.3 and Table 7.4 demonstrate that even though the Holistic Personas were authored to be similar in all other personality factors and other four dimensions of factual, knowledge, intelligence and cognitive processes (Anvari and Tran 2013), the participants rating influenced other personality factors. Table 7.5 shows the inter relationship between personality factors found in literature. It became obvious that any change in Holistic Persona varies perception of her personality.

In study I, the Holistic Personas that were authored for assessment were slightly different to the Holistic Personas authored for design work (Appendix F and Appendix G). The Holistic Persona for assessment did not have memory issues and no mention of her weight problem was made. However in assessing the participants response it became obvious that memory issues reflected on the personality of the Holistic Persona. Hence in studies II and III the same Holistic Personas (Appendix G) were used for assessment and design activities.

The participants in studies II and III were from Australia and Denmark respectively. Before analysis of data the homogeneity of data (section 9.3) was investigated to ensure that the data from the two populations can be mixed together and the conclusions are valid. The data from both populations proved to be homogeneous (Table 9.3) for the items that are investigated in this thesis.

In study II and III, the results for research questions 1 and 2 were presented in section 9.3. In regards to question 1, the results (section 9.4.2, Table 9.4) demonstrated that the participants responded positively to the question: 'Holistic Persona represents a real person'

(Doris 57 %, Katie 61%, Minty 61% and Eliza 54%). In regards to question 2, the results (section 9.4.2, Table 9.4, Table 9.5, Figure 9.1, Figure 9.2 and Figure 9.3) demonstrate that the participants recognised correctly the personalities of the Holistic Personas (Appendix G) as were authored (Table 4.2). Table 9.4 and Table 9.5 demonstrate that even though the Holistic Personas were authored to be similar in all other personality factors and other four dimensions of factual, knowledge, intelligence and cognitive processes (Anvari and Tran 2013), the participants rating influenced other personality factors. Table 7.5 shows the inter relationship between personality factors found in the literature. From Table 9.4 and Table 9.5 variations in the results are as expected and are in line with the variations quoted in the literature (Table 7.5). The results for all three questions for studies II and III are similar to the results obtained for study I. In this thesis, the results for the study I and studies II and III were evaluated and presented separately.

Threats to assessment of Holistic Persona and measures to mitigate the threats were (section 3.5) boredom or fatigue which resulted in selection of same answer for all questions for one or more of the Holistic Personas. The main mechanism to detect this threat was by checking answer times; if it was short (less than one standard deviation from the average time disregarding the extreme values) then data was checked for soundness. Section 7.1 and section 9.1 provides the number of participants whose data were excluded.

Results from Study I, II and III indicate that the participants who completed the rating of Holistic Persona section clearly saw the authored personas' personalities as intended. The findings in the literature review (Devaraj et al. 2008, Ehrhart et al. 2009, Moore and McElroy 2012) concern studies with real people whereas Holistic Personas are authored for this thesis using framework outlined in section 4.2.

11.4 Spatial Ability Test

Participants performed Purdue Visualization of Rotations (PVR) (Bodner and Guay 1997) test for measure of their spatial ability. The results is used for research question 5 (section 11.1): Can a spatial ability test and self-assessment of personality traits be used to identify talented aspiring designers who can produce a design within UCD methodologies that matches Holistic Persona's needs considering her personality?

The threat to the Spatial Ability test was mainly due to it being conducted online (Appendix M). During the trial of Study I, a participant noted that during spatial ability test one of the images took a long time to load and another participant took a break during the test. In the studies conducted for this thesis, even though most participants completed the studies (and the test) during their tutorial sessions the invitees in all studies were allowed to do the study later if they had not participated in the classroom study; hence they could not be seen. In section 5.10 a measure was setup to mitigate this threat. While analysing the results,

it was noted that only one participant took longer than average time to answer one question but the participant's overall spatial ability mark was high, hence the question was ignored.

A 'cheat sheet' was prepared for the tutors who conducted the study during the tutorial session to resolve perceived online issues. None of the tutors reported that they used the cheat sheet hence it is not produced in this thesis.

11.5 Preferred Holistic Persona for Future Design Activity

The post design survey questionnaire revealed each participant's feelings and thinking towards each of the personas and their effect on the design.

Do participants have a preference to design for a Holistic Persona due to her personality traits?

In Study I, the results for the above research question was analysed in section 7.4. Table 7.6 shows that 27% of the sample population preferred Jade - emotionally stable and introverted, 19% of the sample population preferred Jane - emotionally stable and extraverted; 11% of the sample population preferred Jean or June - emotionally unstable.

Similarly in Studies II and III, the results for the above research question was analysed in section 9.5. Table 9.6 shows that 41% of the sample population preferred Minty or Meta - emotionally stable and introverted; 32% of the sample population preferred Doris or Helena - emotionally stable and extraverted; 12% of the sample population preferred to design for Katie or Katerina, and Eliza or Agneta - emotionally unstable.

In study I, 43% of the sample population and in studies II and III 15% of the sample population selected the option: they cannot remember the name. The percentage of the sample population who made a selection from one of the Holistic Personas for their future design activities were 57% in Study I and 85% in Studies II and III. As the participants were not given an option which would allow them to select none of the Holistic Personas, hence the data may be subject to desirability bias (Nederhof 1985). The option that would have allowed a participant to choose none of the Holistic Personas was not provided as this question was aimed to identify the participants' preferred personality for a Holistic Persona for their future design activity from among the four Holistic Personas which were presented in a random order. The participants' preferences can be cross checked with the information available in the design artefacts. A preliminary analysis indicates that the preferences were close to their choices. It is expected that social desirability is not a problem in these studies as the four Holistic Personas were authored to be similar except for their personality traits and the order of the presentations were random. The details and ratios of preferences for each of the Holistic Personas are not subject of study for this thesis. However the results show that the participants who made a selection for their future design activity from among the four

Holistic Personas had preferences based on personalities of the Holistic Personas and majority of the participants preferred a Holistic Persona who is emotionally stable for their future design activity.

In study I, the percentage of the sample population who selected the option that they cannot remember the Holistic Persona's name was three times higher than in studies II and III. In study I the participants rated the four Holistic Personas, performed one design activity with one of the Holistic Personas and then answered the post design questionnaire. In studies II and III the participants rated each of the Holistic Personas and performed a design activity with the Holistic Persona followed by the post design questionnaire. Hence the amount of time each participant spent with each of the Holistic Personas in the study I was less compared with studies II and III. Also in study I there was a larger delay between rating the Holistic Personas and answering the post design questionnaire. The above factors could be the reasons that in study I, a larger percentage of the participants did not remember the names of their preferred Holistic Persona based on her personality.

In summary, from the studies presented in this thesis, the sample populations indicated that they had preferences for one of the Holistic Personas based on her personality for their future design activity. This finding contributes to the body of knowledge about personality, conceptual design and designer preferences.

11.6 Performance in Design and Spatial Ability Test and Self-assessment of Personality Traits

In section 7.6 analysis of participants' performance in design, their score in spatial ability test and imagination personality trait was presented. In the following sections the issues surrounding the results are highlighted and in section 11.6.3 the performance in design activity is discussed.

11.6.1 *Variability in Study Parameters*

There are a number of variables in the study: four Holistic Personas that represent real people but have different personalities - participants verified that they representing real people with differences in personalities (section 7.3, Table 7.3, section 11.3 (Anvari and Richards 2015) and Anvari et al. (2015)); participants with different backgrounds – undergraduate students, postgraduate students, professionals with non-design background (section 7.1, Table 7.2, section 9.2 and Table 9.2); known individual preferences for the Holistic Personas - participants have shown their liking for a Holistic Persona (section 7.4, Table 7.6, section 9.5 and Table 9.6); undefined problem setting – participants were asked to provide a conceptual design to assist the Holistic Persona who had in addition to weight and

memory problem, represented a human (Table 7.3, Table 9.6 and Appendix G) with other personality issues.

11.6.2 *Spontaneous Design Activity*

The participants were given the Holistic Persona and were asked to design or recommend a software application or product (Appendix G). It was unlikely that the design activity was premeditated. The only premeditation could be due to the knowledge received by previous participants. This was considered unlikely as there were seven activities in the study and each one of them were equally important. None of the participants received any handouts or materials that they could preserve other than their consent form (if they choose to print it or save it).

In Study I, the memory issues and weight problem were introduced only for the Holistic Personas used for design activities so that the designs are not premeditated as there was a period of 20 minutes between rating of the Holistic Personas and the design activity. However, as discussed in section 11.3, due to the inter relationship between personality factors, any change in Holistic Persona changes the perception of her personality (Devaraj et al. 2008, Ehrhart et al. 2009, Moore and McElroy 2012). It was essential that the personalities of the Holistic personas that the participants were given for design activity be assessed. Hence in Studies II and III, the same Holistic Persona was used for both assessment of the Holistic Persona and design activity.

In studies II and III, the design activities was performed immediately after the assessment of the Holistic Personas, hence it can be considered the design activities in these studies were spontaneous and not premeditated.

11.6.3 *Performance in Design*

For the design activity, the participants were required to read the description of the Holistic Persona (Appendix G), understand her requirements and prepare a design work within fifteen minutes. The range of design artefacts including the levels of details and quality were varied. A quantitative analysis of results was considered for final assessment, as it would not be prone to subjectivity and variability. The rubric devised (chapter 6) was used to assess the design artefacts.

Initially the relationship between personality traits and performance in design (section 7.6.1) was investigated. Table 7.11 shows that in the sample of participants only the personality factor imagination is correlated with performance in design with medium effect size (Pearson's correlation $r=0.37$, $p<0.05$). This is supported by previous research (section 11.6.4). For further investigations, only the imagination personality factor was considered.

Figure 7.4 shows a scatter plot of the participants' performance in the spatial ability test at 10 minutes versus imagination personality factor with the points labelled with the participants' performance in design. This plot visually shows that majority of the participants who are placed in top right hand corner have scored high in design mark. The plot was divided into four quadrants (section 7.6.2) by drawing two perpendicular lines at 75% for both spatial ability test and imagination personality factor. In five scenarios the relationship between participants' performance in design, their spatial ability and their personality trait imagination (section 7.6.3) were investigated.

The results (section 7.6) indicate that a number of participants, the majority of whom were in top right hand corner of the Figure 7.4, have overcome all these variabilities and produced designs of high quality. Section 7.6 (study I) highlighted that in order to score high in the design, the participant had to concentrate on the Holistic Persona and issues she had, overcome her/his own liking or disliking of the Holistic Persona's personality and provide a solution that is suitable to the Holistic Persona. The rubric for marking (chapter 6) was designed to distinguish the designers who would not be distracted by other problems and can provide solution targeted at the Holistic Persona's individual needs. The results indicate that participants, who scored above 75% in the imagination personality factor and spatial ability test, have applied the techniques of UCD in their design work; they had the highest effect size. They can think of design features that suit the Holistic Persona within a short period of time; they are identified as talented aspiring UCD designers. They can 'think on their feet' (Schön 1983). Section 7.6 of study I highlights the importance of the imagination personality trait and spatial ability in performing well in UCD design.

Table 11.1 and Table 11.2 show a sample of quotes from the participants which indicates the participants' awareness of the personalities of the personas. Some participants exhibited either intuitive or learnt knowledge of personality and incorporated these in their designs. For example Participant Id 3152's comments are in line with Hamburger and Ben-Artzi (2000) and Landers and Lounsbury (2006)'s findings; emotionally unstable women seek information online anonymously. Some participants considered personalities of the personas but did not provide an in-depth conceptual design for an application. For example participant Id 3154 (Table 11.1 and Table 11.2) did not provide a conceptual design for an application for Agneta. Some participants became aware of personality during the study. For example Participant Id 2132 (Table 11.1 and Table 11.2) gained awareness of the different personalities of personas during the study however he did not provide an in-depth conceptual designs. Another participant suggested a 'Fitness weight loss application' for the first persona, Minty. He suggested the same application for the second persona, Eliza, but added punishment and reward features. For the third persona, Doris, he removed the punishment feature.

11.6.4 *Categorization of Participants*

The participants were categorised into quadrants depending on their score in imagination personality factor and spatial ability. The categorisation allows statistical comparison of performance of participants in different categories. The participants who were close to the boundary line could belong to either of the categories. Hence their performance has to be examined closely and adjusted if needed. In this study to maintain integrity of the results no adjustment to the results were made. Our results indicate that there is a positive relationship between spatial ability, imagination and performance in UCD design.

11.6.5 *Previous Research and Importance of this Findings*

Our study confirms previous research that imagination is important for design work (Field 2007, Furnham and Bachtar 2008, Poropat 2009, Read et al. 2007, Silvia 2008) and findings of Ault and John (2010) that students with higher spatial ability, perform better in other fields. Professional software engineers may also have these personality traits and hence our results may be extendable to professionals. This assumption is based on finding that traits are less likely to change (Allport and Odbert 1936). Similarly correlations between a person's personality traits and ability to design, is an indicator that the volunteer participants have potential to become UCD designers.

11.7 **Conceptual Designs Tailored to the Personality of Holistic Persona**

To understand the role that personality of Holistic Persona can play in design, answers to the question 4 was explored in chapter 10: *Do the participants tailor their designs according to the personality traits of Holistic Personas?*

An affirmative answer to question 4 provides an answer to the research question: *Does the use of personas with different personalities result in different system or soft-ware requirements and conceptual designs tailored to that personality?*

Analysis of a designer's artefacts leads to requirements that the designer had in mind for her/his design. The requirements are explicitly expressed within the design artefact as the reason for the design; all requirements listed and statistics computed in chapter 10 are based on material that the participants entered in their design artefacts. No assumptions were made about the intention that the participants had in their design artefacts. Some participants identified all the factors that they considered in their design, while other participants made minimal comments about their design. The differences in design artefacts demonstrate the quality of thinking and expression, which are reflected in the statistics.

From Table 10.12 the differences in requirements due to the personality of the personas shows that the correlation of the requirements between Doris, extravert and emotionally

stable, and Eliza, introvert and emotionally unstable is large, negative ($r=-0.83$) and significant ($p<0.01$). This is as expected as their personality traits are largely opposite to each other and the participants saw this difference and incorporated them in their conceptual design. As these notes indicate, majority of participants designed different applications for the two Holistic Personas. Similarly Table 10.12 shows that the correlation of the requirements between Katie, extravert and emotionally unstable, and Minty, introvert and emotionally stable is large, negative ($r=-0.72$) and significant ($p<0.01$).

The correlations demonstrate that personality traits have a high modifier effect on design requirements.

Following are examples of comments that the participants entered in their design artefacts for various Holistic Personas.

Lack of confidence (section 10.3.8, Table 10.4 item 9 and Table 10.8) was identified for Eliza and Katie. For example a participant commented that these issues must be addressed otherwise the Holistic Persona would not use the application that she/he would design for her.

Peer reliance (section 10.3.10 and Table 10.4, Item 6) which refers to the requirement of relying on peers for reminders e.g., participant Id 2115 wrote: *'Potentially add a concept of having friends on this platform, and when you set reminders you can ping your friends to remind you at certain times'*. Peer competition (section 10.3.10, Table 10.4, item 7) is the requirement to motivate the Holistic Persona to undertake or accomplish an activity. e.g., participant Id 2113 wrote: *'If she completes the challenge she indicates so, and she can see who else in her group on the software has not yet completed the challenge'*.

Some participants saw music-related requirements as important or instrumental (section 10.3.11) to fulfil other needs. The designs related to music centred on two main categories of need to learn music (Table 10.4, item 11) and other music related requirements (Table 10.4, item 12). The second category was varied and hence its details are listed in Table 10.9. The examples of requirements for music related designs are: participant (Id 3160) stated *'... would help Katerina gain self confidence and get a better control with temper ... and music would be the obvious choice...'*. For Minty/Meta, a participant (Id 3139) stated: *'I would recommend a product that would help fuel her music passion and teach her how to better master the guitar. Meta is mostly a loner and at most occasions she is not socialising (sic) giving her more time to indulge in her new found hobby.'* Some participants in their design suggested that Eliza can learn to play guitar to improve her confidence and social skills. For example participant Id 2137 stated: *'Eliza could use GT to help build her guitar skills and her*

confidence. Removing the social interaction element of learning guitar would benefit Eliza's personal development.'

Cultural differences that were identified related to the way that Australian and Danish participants expressed their responses to and (dis)like of the personality traits of Eliza/Agneta and Katie/Katerina (section 10.3.14). The Australian participant Id 2131 stated: *'I dont [sic] recommend any product or apps for eliza as she is an unrealistic persona. All her traits are not likable and has no positive traits'*. The Danish participants stated: *'I don't have any recommendations for Katerina. I think she needs a personal coach'* (participant Id 3140) and another Danish participant mentioned *'I do not have any design to offer to Katerina.'* And again another Danish participant suggested *'an e-book to teach Katerina better behaviour'* (participant Id 3156). Another cultural difference the studies have identified (Table 10.13 item 14) is the higher percentage of group applications in study III which suggests that Danish participants place more emphasis on social connectedness.

The above evidence indicates that the participants tailored their designs according to the personality traits of Holistic Personas. Though further evidence is required the findings suggest that the use of personas with different personalities do result in different system or software requirements and conceptual designs tailored to that personality.

11.8 Chapter Summary

In this thesis UCD methodologies (Norman 1986), persona (Cooper 2004) and scenario (Goodwin 2009) were briefly presented. Presently persona is widely adopted in SE research and practices (Acuña et al. 2012). This thesis also presented literature showing different techniques used to author personas (Adlin and Pruitt 2010, Goodwin 2009, Switzky 2012) and there are controversies surrounding the use of personas (Chapman and Milham 2006, Massanari 2010, Matthews et al. 2012).

This thesis began on the postulation that 'providing Holistic Personas with personality to participants, irrespective of their previous training in taking into account the personality traits of a persona, will enable them to conceive tailored designs taking into account the needs of the Holistic Persona on mental and psychological level' (section 1.2). This postulation was based on the premise that Holistic Persona (Anvari and Tran 2013), a persona with five dimensions, better represents the users.

The investigation consisted of using literature for authoring Holistic Personas with variations in personality traits and test the Holistic Personas' personality (Goldberg 1993, Gosling et al. 2003).

The thesis has shown that the participants saw Holistic Personas' personality traits are as intended and they are like real persons (Anvari and Richards 2015, Anvari et al. 2015). The analysis of design artefacts show that the participants considered their requirements in designing a new or recommending an existing software application or product (chapter 10). The variation in design demonstrated that the Holistic Personas' personality traits have influenced the design (section 10.3.19).

This thesis also presented the finding that the participants who have high spatial ability and have high imagination personality traits are talented aspiring designers who can produce a design within UCD methodologies that matches Holistic Persona's needs considering her personality (section 7.6 and section 11.6).

Whilst further studies and more data are needed to provide conclusive evidence, the findings suggest that Personas with personality traits could be a viable approach to identify requirements suitable for different groups of users without needing to involve actual human subjects in the requirements elicitation process. Hence Holistic Persona can be used to represent a person with personality within UCD methodologies.

Table 11.1 : Participants' comments about personality of the persona – part I

Id	persona	Affected personality	Participants' comments
2113	Katie	Extravert / Emotionally unstable	<i>"Group improvement software designed to allow a group of individuals to try and improve in different areas (skills, exercise regularly, etc) and comparing their progress. Katie is a social animal, and so she would need societal peer pressure on her to improve herself in the ways she may wish to..."</i>
2120			<i>"The personalities helped me consider the different ways such a system could be interpreted by people of different emotional/mental states."</i>
2125	Minty	Introvert / Emotionally stable	<i>"... she is similar personality to me, so i can relate to her and design a better program for her ..."</i>
2127	Eliza	Introvert / Emotionally unstable	<i>"A single program or product will not help Eliza as she lacks self confidence nor is she sociable enough to seek help from others due to this underlying lack of self confidence."</i>
2127			<i>"Knowing how each personality planned out each day and the how likely it was that a external program or product would be utilised did influence each design to fit into each personas' hypothetical day so that it would have the greatest impact ..."</i>
2129	Katie	Extravert / Emotionally unstable	<i>"As Katie is quite disorganised and doesn't follow through with her plans, I would design a planner/ organiser/motivational app for her. The app would have tools such as a diary and reminder chimes, ohave motivational pictures and quotes, and help her to break down tasks so that her goals will be more achievable for her ... "</i>
2132			<i>"It makes you think about people and personality traits you might not have thought about."</i>
	Minty	Introvert / Emotionally stable	<i>"a diary/timetabling style application, so she can keep track of her busy uni lifestyle and when she can have time to herself. minty wants to go to a restaurant with her close friends, but when she o pens the app she is reminded that she has to tutor a socially disadvantaged person that evening. She is a little disappointed that she cant go to dinner but she brightens up when she meets her commitments."</i>
2134	Doris	Extravert / Emotionally stable	<i>"She seemed to be the best person to get concise specifications about what she wants the software to do."</i>
2135	Minty	Introvert / Emotionally stable	<i>"Rather have a persona that relates to me so I can further understand what they would want."</i>

Table 11.2 : Participants' comments about personality of the persona – part II

Id	persona	Affected personality	Participants' comments
3140	Katerina	Extravert / Emotionally unstable	<i>"I don't have any recommendations for Katerina. I think she needs a personal coach."</i>
3145			<i>"Generally I tried to add features based on their perceived personality. If I felt pity for them, I tried to add features that could make them "better". If I sympathized with them, I added features that supported their present personality"</i>
3148	Agneta	Introvert / Emotionally unstable	<i>"My idea is a piece of software that would help Agneta building trust in others. This could be with the help of psychical exercises, mentally through conversations or other activities through a mobile app. The app notices that Agneta is nearby others that are introverts, and that she has not planned anything for the afternoon, the app suggests that they go meet at the nearby cafe."</i>
3150	Meta	Introvert / Emotionally stable	<i>"she are more easier to construct a work-out application for, because she are more determined. Its hard to construct a mentally convincing application for people that do [not] have any self confidence or determinism in they everyday life."</i>
3152	Meta	Introvert / Emotionally stable	<i>"She might use a software to record her own songs and play them as motivation for working out. She might like it because she likes music and just learnt to play guitar, and she wants to lose weight. It could be a mobile app that keeps the records in a cloud service. Meta plays some song on her guitar and record them. After that, Meta goes for a run and start listening her most recent artistic achievements."</i>
3152	Agneta	Introvert / Emotionally unstable	<i>"I would recommend her a software to express ideas in an anonymous way so everyone can share thoughts without being directly criticized. Sometimes people like her wants to share what they think but they don't want to be identified..."</i>
3154	Agneta	Introvert / Emotionally unstable	<i>"Se needs a personal coch app. Maybe it should involve real people - so it's not a computer program which helps her, but volunteers in a way..."</i>
3164	Katerina	Extravert / Emotionally unstable	<i>"Katerina's personality forced me to think a way of how the application could engage and motivate person to perform some kind of physical activity and follow their diet plans..."</i>

12 Conclusion, Contributions and Further research

This chapter covers conclusion reached as result of the three studies, with contributions this thesis make to software engineering training and plans for future research on Holistic Persona.

12.1 Conclusion and Contributions

Section 7.6 analysed participants' performance in design and using their score in spatial ability test and imagination personality trait. Figure 7.4 showed that the participants scored above 75% in the imagination personality factor and spatial ability test can think of design features that suit the Holistic Persona, within a short period of time; they are identified as talented aspiring UCD designers. The implication of this result is that talented students who can design using UCD methodologies can be identified early in their studies; they can benefit by receiving advanced training. Likewise the less talented students can be given extra tutoring in either spatial ability or the imagination personality factor. This study contributes to the understanding of personality traits and abilities required in being a talented designer using UCD methodologies. The results of the studies highlight the importance of the imagination personality trait in performing well in UCD design. Professional software engineers may also have this personality trait and hence the results may be extendable to professionals. The studies confirms previous research that imagination is important for design work (Feist 1998, Field 2007, Furnham and Bachtiar 2008, Poropat 2009, Read et al. 2007, Silvia 2008).

The results of the three empirical studies demonstrate that the participants in the study, the majority of whom were students, can identify personality traits of the personas and the personas with personality traits affect designers at the conceptual design phase. The collected design notes and answers to the post design survey questionnaire indicate that the majority of the participants tailored their conceptual designs according to personalities of the personas. The practical implications for educators would be that teaching Software Engineering students to take account of personality in their design work would result in greater number of students being able to create conceptual designs taking into account needs of the users and would address requirements and validation issues around lack of access to real end users. While soliciting requirements for an application, it is important to consider cultural attitudes of the designers and of the targeted end users; the participants from Denmark and Australia saw the extreme personality requirements differently. As personality affects the way users interact with software applications or products (Behrenbruch et al.

2012, McRorie et al. 2009, Nov et al. 2013a, Oliveira et al. 2013, Svendsen et al. 2013, Vazire and Gosling 2004), it is expected that the target users would find software applications tailored to their personality to be more user friendly.

If a user is to be involved in a project for requirements elicitation, awareness that the user's personality may influence the design and development of the application assists the selection of appropriate participants for requirement elicitation. This deduction is based on findings from the three studies that participants in both countries report that the Holistic Personas resembled real persons (Anvari et al. 2015) and the observation that the participants' engagements with Holistic Personas were intense to the extent that some participants either could not produce any design or resonated with the Holistic Persona and produced a substantial design. Nevertheless, this conjecture needs further research. Special consideration must be paid to managing requirements for people who are introverts and emotionally unstable compared to those who are extraverts and emotionally stable. The studies provide empirical evidence that factor selection when building personas can direct the focus of requirements elicitation. This is a critical finding that requires additional studies to determine which factors to include or omit. Selection of certain factors or omission of other factors can lead to missing requirements for critical demographics. This is likely important for certain domains, for example, in health, certain personal characteristics may need additional support or product features to ensure users with those characteristics become engaged with the application. For example (Dennis et al. 2015) reported that patients who are low in conscientiousness would require different types of reminders for an Achieving Self-directed Integrated Cancer Aftercare Skin-Checker application. Consolvo et al. (2006) describe a mobile social application that peers encourage each other to increase their daily walking.

12.2 Plans for Future Studies

The empirical results presented in this thesis have indicated that the use of Holistic Personas has prompted design of applications which normally would not have been conceived. This needs to be further investigated and extended to professionals.

Interpersonal intelligence is one of the seven intelligences elucidated by Gardner (1993); apart from imagination personality trait (Goldberg 1993) and spatial ability (Gardner 1993). During the conception stage, the importance of interpersonal intelligence in relating with Holistic Persona and hence its effect on the usability of the resultant product requires further research.

Empathic designers through observation, information gathering, reflection and analysis, brainstorming, and prototyping have designed innovative products (Leonard and Rayport 1997). In an experiment Chen et al. (2011) used empathic design and personas as a

replacement for end users participation in the design and found that the designers were more focused on the users' emotions. Empathic design is effective when the software engineer practices reflection and has tacit knowledge to perform the role of the reflective end user (Anvari and Tran 2014). Reflection turns experience into knowledge (Schön 1983). Sengers et al. (2005) used reflective design for creating a unique application, living art in the museum, which would not have been achievable using normal design practices. It is conjectured that Holistic Personas assist designers to examine their fundamental assumptions and encourage them to reflect-in-action and reflect-on-action while holding dialogues with their tools (Schön 1983) - Holistic Personas. By examination of the assumptions and reflections, designers can design unique applications and products (Anvari and Tran 2014, Sengers et al. 2005).

Ultimately after evaluation of other dimensions of the Holistic Persona (Intelligent, Knowledge and Cognitive Process Dimensions) and devising and implementing an ontology for her (Anvari and Tran 2013, Anvari and Tran 2014), the Holistic Persona with consistent meanings will need to be shared across the design, development, test, marketing and sales teams; and her attributes and properties will be mapped to other design and development tools, such as actors, use cases and domain models. How that mapping can be achieved is a topic of future research. This thesis has laid a foundation for the exploration of these and other lines of research to improve user-centred design.

Appendix A : Study I – List of Activities

Activities in the study I:

1. Introduction to UCD (Appendix D)
2. Consent form (Appendix C)
3. Demographics questionnaire for Study I (Appendix J)
4. Self-assessed Personality Test (Appendix E)
5. Four Holistic Personas for rating activity (Appendix F)
Holistic Personas are presented in random order.
 - a. Jane
 - b. Jean
 - c. Jade
 - d. June
6. One Holistic Persona for design activity (Appendix G).
The Holistic Persona is presented from set of four Holistic Personas in random order but evenly distributed:
 - a. Doris
 - b. Katie
 - c. Minty
 - d. Eliza
7. Design questionnaire for study I (Appendix K)
8. Post design questionnaire for study I (Appendix K)
9. Spatial Ability Test – (Appendix M)

Appendix B : Studies II and III – List of Activities

List of activities in studies II and III:

1. Consent form / consent statement (Appendix C)
2. Demographics for studies II and III (Appendix L)
3. Introduction to UCD (Appendix D)
4. Self-assessment of Personality (Appendix E)
5. Four Holistic Personas for rating and design activity (Appendix G).
Holistic Personas from list below were presented in random order.
 - a. Doris
 - b. Katie
 - c. Minty
 - d. Eliza
6. Design modification and design questionnaire (Appendix H)
Holistic Personas were presented in the order below:
 - a. Doris
 - b. Katie
 - c. Minty
 - d. Eliza
7. Post design questionnaire for studies two and three (Appendix I)
8. Spatial Ability Test – (Appendix M)

Appendix C : Consent to Participate in Studies

Consent to participate in Study I



Participant Information and Consent Form

Name of Project: Holistic Persona Evaluation

You are invited to participate in a study of 'Holistic Persona Evaluation'. The purpose of the study is to improve the effectiveness of personas. Personas are tools used within User- Centred Design methodology.

The study is being conducted by, Mr. Farshid Anvari, Department of Computing, 61 (0)2 9850 9549, farshid.anvari@students.mq.edu.au to meet the requirements of Master of Philosophy under the supervision of Professor Deborah Richards, 61 (0)2 9850 9567, deborah.richards@mq.edu.au, of the Department of Computing, Faculty of Science.

If you decide to participate, you will be asked to fill a demographic questionnaire, perform personality and spatial ability tests, read and rate a number of personas, write a scenario for the use of a software application or product and fill a questionnaire regarding your experiences during the study. The duration of this study is expected to be 75 minutes.

We cannot offer any financial reward for participation. However you will gain understanding through exposure to the User-Centred Design methodologies and tools. You will be invited to attend a seminar during which we will present our findings.

Any personal details gathered in the course of the study are confidential, except as required by law. No individual will be identified in any publication of the results. Full data is only accessible to Farshid Anvari. All data will be anonymised before Professor Deborah Richards sees them. No personally identifiable data would be required for this research.

Participation in this study is entirely voluntary: you are not obliged to participate and if you decide to participate, you are free to withdraw at any time without having to give a reason and without consequence.

If you provide an email address, you will receive a copy of your work and invitation to attend the seminar. Participation in any future studies is entirely voluntary: you are not obliged to participate in any future studies and if you decide to participate in future studies, you are free to withdraw at any time without having to give a reason and without consequence.

If you give your consent quotes from your work may be used in publications. Your identity will not be disclosed under any circumstances.

The ethical aspects of this study have been approved by the Macquarie University Human Research Ethics Committee. If you have any complaints or reservations about any ethical aspect of your participation in this research, you may contact the Committee through the Director, Research Ethics (telephone (02) 9850 7854; email ethics@mq.edu.au). Any complaint you make will be treated in confidence and investigated, and you will be informed of the outcome.

Consent to participate in this research

I have read and understand the information above and any questions I have asked have been answered to my satisfaction. I agree to participate in this research, knowing that I can withdraw from further participation in the research at any time without consequence. I can print or store a copy of this form for future reference.

- ☐ Yes
☐ No

<< >>



I give consent for quotes from my work to be used in publications without disclosing my identity.

- ☐ yes
☐ no

An email address for my work to be sent to me.
(Optional - you may use any email address or create one under a pseudonym for this study)

I wish to be informed about any future studies.

- ☐ yes
☐ no

<< >>

Consent to participate in Study II



Participant Information and Consent Form

Name of Project: Holistic Persona Evaluation

You are invited to participate in a study of 'Holistic Persona Evaluation'. The purpose of the study is to improve the effectiveness of personas. Personas are tools used within User-Centred Design (UCD) methodology.

The study is being conducted by Mr. Farshid Anvari, Department of Computing, 61 (0)2 9850 9548, farshid.anvari@students.mq.edu.au to meet the requirements of Master of Philosophy under the supervision of Professor Deborah Richards, Department of Computing, 61 (0)2 9850 9567, deborah.richards@mq.edu.au, Associate Professor Michael Hitchens, Department of Computing, 61 (0)2 9850 9538, michael.hitchens@mq.edu.au and Dr Cécile Paris, Research Leader, CSIRO ICT Centre, 61 (0)2 9372 4704, cecile.paris@csiro.au

No personally identifiable data is required for this research. Any personal details gathered in the course of the study are confidential, except as required by law. No individual will be identified in any publication of the results. Full data is only accessible to Farshid Anvari. All email addresses will be removed before Professor Deborah Richards, Associate Professor Michael Hitchens and Dr Cécile Paris see the data.

If you decide to participate, you will perform the following activities:

- answer a demographic questionnaire
- receive a brief introduction to UCD methodologies and tools
- answer a personality questionnaire
- read and rate four Holistic Personas, write conceptual designs for software applications or products and write scenarios for the use of the software applications or products
- answer a questionnaire regarding your experiences during the study
- perform a spatial ability test

The study is expected to take a maximum of 110 minutes.

We cannot offer any financial reward for participation. However you will gain understanding through exposure to the User-Centred Design methodologies and tools. You will be invited to attend a seminar during which we will present our findings.

Participation in this study is entirely voluntary: you are not obliged to participate and if you decide to participate, you are free to withdraw at any time without having to give a reason and without consequence.

If you provide an email address (an anonymous email address is preferred), you will receive your personality and spatial ability test results and an invitation to attend the seminar. Participation in any future studies is entirely voluntary: you are not obliged to participate in any future studies and if you decide to participate in future studies, you are free to withdraw at any time without having to give a reason and without consequence.

If you give your consent, quotes from your work may be used in publications. Your identity will not be disclosed under any circumstances.

The ethical aspects of this study have been approved by the Macquarie University Human Research Ethics Committee (approval number -----). If you have any complaints or reservations about any ethical aspect of your participation in this research, you may contact the Committee through the Director, Research Ethics (telephone (02) 9850 7854; email ethics@mq.edu.au). Any complaint you make will be treated in confidence and investigated, and you will be informed of the outcome.

Print

Consent to participate in this research

I have read and understand the information above and any questions I have asked have been answered to my satisfaction. I agree to participate in this research, knowing that I can withdraw from further participation in the research at any time without consequence. I can print or store a copy of this form for future reference.

- ☐ Yes
☐ No

Survey Completion
0% 100%

>>

I give consent for quotes from my work to be used in publications without disclosing my identity.

- ☐ yes
☐ no

An email address for my test results to be sent to me.
(Optional - you may use any email address or create one under a pseudonym for this study)

I wish to be informed about any future studies.

- ☐ yes
☐ no

Survey Completion
0% 100%

>>

Consent to participate in Study III

Study title: Holistic Persona Evaluation for Design Work

You are going to participate in a study of 'Holistic Persona Evaluation' for design work. The objective of the study is to provide you with an opportunity to learn about the use of personas for designing software applications and helping us to assess the effectiveness of Holistic Personas for design.

Any personal details gathered in the course of the study are confidential. No individual will be identified in results that would be shared in the class or any other publications of the results.

You may be able to ask findings about your individual tasks.

In this study you will perform the following activities:

Answer a demographic questionnaire. Receive a brief introduction to UCD methodologies and tools, Answer a personality questionnaire; read and rate four Holistic Personas, write conceptual designs for software applications or products and write scenarios for the use of the software applications or products.

Then answer a questionnaire regarding your experiences during the study and perform a spatial ability test

The study is expected to take a maximum of 90 minutes.

You have the right to choose not to give a consent that the data generated from your participation are used for analysis and reporting the findings from this activity.

Consent

I consent that the data generated from my participation are used for analysis and reporting the findings from this activity.

- ☐ Yes
- ☐ No

I give consent for quotes from my work to be used in publications without disclosing my identity.

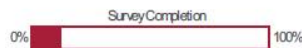
- ☐ yes
- ☐ no

An email address for my test results to be sent to me.

(Optional - you may use any email address or create one under a pseudonym for this study)

Appendix D : Introduction to UCD

The next four screens contain introduction to User-Centred Design (UCD), Persona and Scenario.



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User-Centred Design (UCD):

"The purpose of the system is to serve the user,
not to use a specific technology,
not to be an elegant piece of programming."
Norman, D. A. (1986).

Please answer the quiz below

Within the User-Centred Design methodology

- ☐ Code should be written elegantly
- ☐ User is the center of the design
- ☐ Interfaces should be colorful



>>

Persona:

The goal in User-Centred Design methodology is to develop applications that meet the needs of users. It is difficult and expensive to identify typical users and involve them in the development of applications. Instead of users, personas, archetypical users, are authored and used.

Personas are fictitious characters. Personas have the necessary attributes of the users of applications. Personas generally have names, may be identified with photos or illustrations which are representative of the users, brief descriptions of their characters.

Personas are introduced at the early stage of the project and are refined using market research, stakeholders' views etc. When the target users are diverse, a number of personas representing each group of users are authored.

Personas support the design of software application or product by focusing on target users, and facilitating communication with stakeholders regarding the scope and the expected outcome of software application or product (Goodwin, 2009 pp 231-234).

Consider an application that is targeted at people who are interested in using bicycles. There are many groups and hence a number of personas representing each group would be authored.

Following persona represents affluent, middle aged women who live in the inner suburb of Sydney.

Kim who lives in a 3 bed-room house in Leichhardt, Sydney, is 47 years old. Recently she has developed interest in riding her bicycle to work, visiting friends and doing her shopping. ... Kim sometimes forgets to take her shopping list with her when she goes shopping. This annoys her....

Please answer the following quizzes

Personas are

- ☐ archetypical users
- ☐ real people
- ☐ users

Personas support the design by

- ☐ managing the project
- ☐ considering the needs of all users
- ☐ focusing on target users



>>

Design ideas:

At the very early stages of design, the designer visualises solutions at a very high level. The designer may see the solution as a software application or product (e.g. a web-based application, a stand-alone application, a game or a mechanical device), the main purpose of the solution (e.g. motivational, instructive, informative, recreational) and how the solution functions (e.g. on an existing device such as mobile phone, stand-alone console, personal computer or a new device). At these stages, design ideas are described at a high level.

An example of a design idea is as follows:

Reflective Diary (RD) allows Kim to keep record of the distance she travels on her bicycle, amount of calories she consumes. RD also allows Kim to keep track of her food consumptions and is a reminder.

Scenarios:

Scenarios describe how the persona, Kim, interacts with her *Reflective Diary*.

In the initial stages of the project, scenarios are written at a high level. The scenarios are refined by adding more details as the project progresses. Software Engineers refine scenarios to Use Cases and, personas to Actors.

Scenario 1: Kim enters her personal details into the RD. Kim can modify the exiting entries such as her weight or add new entries such as her dietary requirements and daily schedules.

Scenario 2: RD reminds Kim to start her scheduled ride, where she has planned to go and things she needs to take with her.

In scenario 1, Kim can enter and modify the information in her RD without specifying whether she uses her laptop or other means. In scenario 2, details of how RD reminds Kim are not specified.

In the above scenarios instead of using the term 'user', we are concentrating on Kim and her needs. We are referring to *Reflective Diary* as the software application or the product under consideration which allows Kim to achieve her goals. We use scenarios to describe interaction between Kim and her *Reflective Diary*.



>>

The answers to the quizzes are:

Within the User-Centred Design methodology *User is the center of the design*

Personas are *archetypical users*

Personas support the design by *focusing on target users*

References for the work in previous slides:

Goodwin, K., (2009) Designing for the digital age: How to create human-centered products and services, Wiley publishing.

Norman, D. A. (1986) Cognitive engineering. User Centered System Design, 31-61.



>>

Appendix E : Self-assessment of Personality

Personality Test

In the next 5 set of questions

Describe yourself as you generally are now, not as you wish to be in the future.

Describe yourself as you honestly see yourself, in relation to other people you know of the same sex, and roughly same age as you are.

So that you can describe yourself in an honest manner, your responses will be kept in absolute confidence.

>>

Personality Test Q1-10

	Very Inaccurate	Moderately Inaccurate	Neither Accurate Nor Inaccurate	Moderately Accurate	Very Accurate
I am the life of the party.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel little concern for others.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am always prepared.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I get stressed out easily.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have a rich vocabulary.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I don't talk a lot.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am interested in people.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I leave my belongings around.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am relaxed most of the time.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have difficulty understanding abstract ideas.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

>>

Personality Test Q11-20

	Very Inaccurate	Moderately Inaccurate	Neither Accurate Nor Inaccurate	Moderately Accurate	Very Accurate
I feel comfortable around people.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I insult people.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I pay attention to details.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I worry about things.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have a vivid imagination.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I keep in the background.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I sympathize with others' feelings.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I make a mess of things.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I seldom feel blue.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am not interested in abstract ideas.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

>>

Personality Test Q21-30

	Very Inaccurate	Moderately Inaccurate	Neither Accurate Nor Inaccurate	Moderately Accurate	Very Accurate
I start conversations.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am not interested in other people's problems.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I get chores done right away.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am easily disturbed.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have excellent ideas.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have little to say.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have a soft heart.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I often forget to put things back in their proper place.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I get upset easily.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I do not have a good imagination.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

>>

Personality Test Q31-40

	Very Inaccurate	Moderately Inaccurate	Neither Accurate Nor Inaccurate	Moderately Accurate	Very Accurate
I talk to a lot of different people at parties.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am not really interested in others.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I like order.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I change my mood a lot.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am quick to understand things.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I don't like to draw attention to myself.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I take time out for others.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I shirk my duties.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I have frequent mood swings.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I use difficult words.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

>>

Personality Test Q41-50

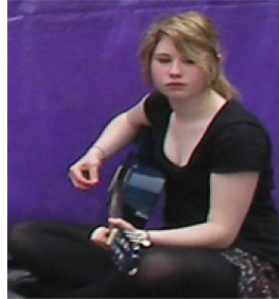
	Very Inaccurate	Moderately Inaccurate	Neither Accurate Nor Inaccurate	Moderately Accurate	Very Accurate
I don't mind being the center of attention.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I feel others' emotions.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I follow a schedule.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I get irritated easily.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I spend time reflecting on things.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am quiet around strangers.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I make people feel at ease.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am exacting in my work.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I often feel blue.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I am full of ideas.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

>>

Appendix F : Study I - Holistic Personas for assessment and assessment questionnaires

Four Holistic Personas, Jane, Jean, Jade and June and questionnaires for their assessment are presented:

Holistic Persona - Jane



Jane's grand-parents settled in Australia during the early 1920's. Her parents are university educated. Jane is studying at the University of Tasmania and is midway through her Bachelor of Musical Arts. Since childhood, she has had interest in music and recently learnt to play guitar.

Jane often goes out and meets people. While she is at home, she is busy with helping family, listening to an album from her large record collection or playing her guitar. Jane is active member of a number of clubs and societies and she is actively engaged in her local community. She has been a long time member of a volunteer tutoring group that helps refugees to adjust to their new environment.

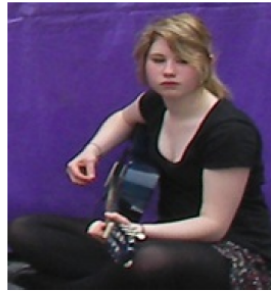
Jane often expresses her views and when they are not accepted, she calmly learns from the experience. She is happy with her achievements and feels good about herself. She makes plans for her future and is full of hope. She does not worry if she has to reject requests for help from her friends when she is already committed. She knows her limits. Her family and friends know that she fulfils her commitments with high spirits.

Please rate your feelings for Jane.

	Disagree strongly	Disagree moderately	Disagree a little	Neither agree nor disagree	Agree a little	Agree moderately	Agree strongly
I like the personality of Jane.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I like to work for Jane.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I empathise with Jane.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I emotionally resonate with Jane.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Jane as conventional, uncreative.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Jane as extraverted, enthusiastic.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Jane as critical, quarrelsome.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Jane as dependable, self-disciplined.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Jane as anxious, easily upset.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Jane as open to new experiences, complex.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Jane as reserved, quiet.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Jane as sympathetic, warm.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Jane as disorganized, careless.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Jane as calm, emotionally stable.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I think Jane is a real person.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

>>

Holistic Persona - Jean



Jean's grand-parents settled in Australia during the early 1920's. Her parents are university educated. Jean is studying at the University of Tasmania and is midway through her Bachelor of Musical Arts. Since childhood, she has had interest in music and recently learnt to play guitar.

Jean often goes out and meets people. While she is at home, she is reading, listening to an album from her large record collection, playing her guitar or helping family. Jean often meets new people by engaging in activities around the university campus. Occasionally, she takes part in community activities. Recently she joined the 'Helping the refugee Group' that helps refugees to settle in Tasmania. She is not sure whether she will continue working with the group.

Jean is vocal and often expresses her views. When her views are rejected, she often gets upset and becomes defensive. She lacks confidence in her abilities and is envious of others. She often rejects any requests her friends make from her. However her family and friends know that when she makes a commitment, she tries hard and usually fulfils it.

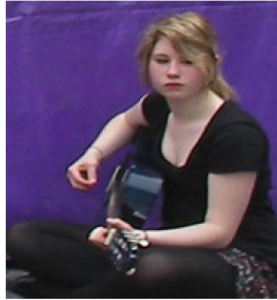
Please rate your feelings for Jean.

	Disagree strongly	Disagree moderately	Disagree a little	Neither agree nor disagree	Agree a little	Agree moderately	Agree strongly
I like the personality of Jean.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I like to work for Jean.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I empathise with Jean.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I emotionally resonate with Jean.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Jean as conventional, uncreative.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Jean as extraverted, enthusiastic.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Jean as critical, quarrelsome.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Jean as dependable, self-disciplined.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Jean as anxious, easily upset.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Jean as open to new experiences, complex.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Jean as reserved, quiet.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Jean as sympathetic, warm.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Jean as disorganized, careless.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Jean as calm, emotionally stable.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I think Jean is a real person.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

<<

>>

Holistic Persona - Jade



Jade's grand-parents settled in Australia during the early 1920's. Her parents are university educated. Jade is studying at the University of Tasmania and is midway through her Bachelor of Musical Arts. Since childhood, she has had interest in music and recently learnt to play guitar.

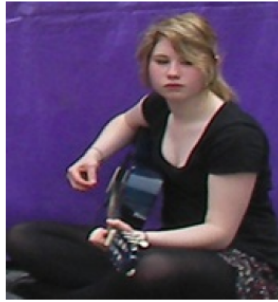
Jade seldom goes out and meets people, but she responds positively to people who approach her. Jade keeps herself busy doing her studies, reading, helping family and friends. For relaxation, Jade listens to an album from her large record collection or plays her guitar. Jade is not a member of any clubs or societies. When the team leader of the 'Volunteer Tutors Group' approached her to help refugee students, Jade offered teaching them English during her lunch time at the university campus.

Jade seldom expresses her view unless she feels strongly about an issue and has investigated it well. When her view is challenged or not accepted, she calmly learns from the experience. She is happy with her achievements and feels good about herself. She makes plans for her future and is full of hope. She does not worry if she has to reject requests for help from others when she does not feel like helping. However she always fulfils her commitments .

Please rate your feelings for Jade.

	Disagree strongly	Disagree moderately	Disagree a little	Neither agree nor disagree	Agree a little	Agree moderately	Agree strongly
I like the personality of Jade.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I like to work for Jade.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I empathise with Jade.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I emotionally resonate with Jade.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Jade as conventional, uncreative.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Jade as extraverted, enthusiastic.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Jade as critical, quarrelsome.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Jade as dependable, self-disciplined.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Jade as anxious, easily upset.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Jade as open to new experiences, complex.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Jade as reserved, quiet.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Jade as sympathetic, warm.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Jade as disorganized, careless.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Jade as calm, emotionally stable.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I think Jade is a real person.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Holistic Persona - June



June's grand-parents settled in Australia during the early 1920's. Her parents are university educated. June is studying at the University of Tasmania and is midway through her Bachelor of Musical Arts. Since childhood, she has had interest in music and recently learnt to play guitar.

June seldom goes out or meets people. June keeps herself busy reading and helping family. June often listens to an album from her large record collection or plays her guitar. June is not a member of any clubs or societies. When the team leader of the 'Volunteer Tutors Group' approached her to help refugee students, June refused to assist as she lacks self-confidence.

June seldom expresses her views. When she does express an idea and her idea is rejected, she becomes fretful and withdrawn. She is envious of others. She often rejects any requests her friends make from her. However her friends and family know that when she makes a commitment, she tries hard and usually fulfils it.

Please rate your feelings for June.

	Disagree strongly	Disagree moderately	Disagree a little	Neither agree nor disagree	Agree a little	Agree moderately	Agree strongly
I like the personality of June.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I like to work for June.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I empathise with June.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I emotionally resonate with June.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see June as conventional, uncreative.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see June as extraverted, enthusiastic.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see June as critical, quarrelsome.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see June as dependable, self-disciplined.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see June as anxious, easily upset.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see June as open to new experiences, complex.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see June as reserved, quiet.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see June as sympathetic, warm.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see June as disorganized, careless.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see June as calm, emotionally stable.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I think June is a real person.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>


Appendix G : Holistic Personas for Design and assessment questionnaire

Four Holistic Personas, Doris, Katie, Minty and Eliza, questionnaires for their assessment and the design activity instructions are presented below.

The screen captures shows the preliminary screen, four Holistic Personas, Katie, Eliza, Minty and Doris, each followed with assessment questionnaire and design instruction for studies II and III. As the Holistic Personas were presented in random order, hence the order of presentation here is different to the order of presentation for design modification activity (Appendix H). For the second, third and fourth Holistic Personas (in this case: Eliza, Minty and Doris), the previous designs were displayed.

In study I, only one of the four Holistic Personas and the relevant design instruction was presented.

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In the next four screens you will be presented with four Holistic Personas.

Please read the Holistic Personas and rate them then provide a conceptual design of a software application or product that you would recommend to assist each of the Holistic Persona.

Later you will have opportunity to modify your conceptual design.

Survey Completion

0%

100%

>>



The count down timer is for your reference. Please spend about 15 minutes on this activity.

Holistic Persona - Katie

The following *Holistic Persona*, Katie, represents an archetypical user of the product or software application which you are designing or recommending to her.



Katie's grand-parents migrated to Tasmania during the early 1940's. Her parents are busy in their professional careers. Katie is studying at the University of Tasmania and is midway through her Bachelor of Arts. Since childhood, she has had interest in music and recently learnt to play guitar.

Katie is an outgoing person and likes to meet people. She likes musical concert and attends all musical events in Hobart. After the concerts, she goes out with her friends to local restaurants. She has a large collection of records and enjoys sharing albums with her friends. Katie meets new people by engaging in activities around the university campus. Occasionally, she takes part in community activities. Recently she joined the 'Assisting Socially Disadvantaged Group', a volunteer group that helps refugees and socially disadvantaged people in Tasmania. She is not sure whether she will continue working with the group.

Katie is short sighted and has sensitive skin but she often forgets to take her glasses with her or apply sun-screen lotion when she goes out.

Katie is vocal. She rarely listens to other people's point of view. She frets when her views are challenged. Katie's friends feel that Katie is high-strung and anxious. She talks about her plans but she rarely follows them through. She often rejects any requests for help from her friends as she lacks confidence in her abilities, but internally she feels guilty.

Katie is allergic to peanut but she often forgets to mention this fact while ordering her meals. Katie has read about relationships between height, weight and energy content of various foods.

Katie has realised that she is overweight and wishes to reduce her weight.

Please rate your feelings for Katie.

	Disagree strongly	Disagree moderately	Disagree a little	Neither agree nor disagree	Agree a little	Agree moderately	Agree strongly
I like the personality of Katie.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I like to work for Katie.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I empathise with Katie.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I emotionally resonate with Katie.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Katie as conventional, uncreative.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Katie as extraverted, enthusiastic.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Katie as critical, quarrelsome.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Katie as dependable, self-disciplined.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Katie as anxious, easily upset.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Katie as open to new experiences, complex.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Katie as reserved, quiet.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Katie as sympathetic, warm.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Katie as disorganized, careless.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Katie as calm, emotionally stable.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I think Katie is a real person.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please spend about 10 minutes on the following tasks:

- Recommend a software application or product
- Briefly describe your design ideas or recommendation.
- Write a scenario in which Katie uses your software application or product

Please write your thoughts in the space below (dot points, phrases or sentences).

Conceptual design for Katie





The count down timer is for your reference. Please spend about 15 minutes on this activity.

Holistic Persona - Eliza

The following *Holistic Persona*, Eliza, represents an archetypical user of the product or software application which you are designing or recommending to her.



Eliza's grand-parents migrated to Tasmania during the early 1940's. Her parents are busy in their professional careers. Eliza is studying at the University of Tasmania and is midway through her Bachelor of Arts. Since childhood, she has had interest in music and recently learnt to play guitar.

Eliza often spends her time alone. When she is with people, she never initiates a conversation with strangers. She often feels threatened when strangers try to talk to her or ask her for assistance. Occasionally she goes out to local restaurants with her friends. Eliza likes to listen to an album from her large record collections and play her guitar. Eliza is not a member of any clubs or takes part in any activities. She often has seen her neighbour who is elderly, struggling to bring her shopping home. Eliza never offered a helping hand and has not spoken to her.

Eliza is short sighted and has sensitive skin but she often forgets to take her glasses with her or apply sun-screen lotion when she goes out.

Eliza is quiet and withdrawn. When she expresses an idea and it is rejected, she becomes fretful and feels envious of others. She is worried about her future. She often rejects any requests for help from her friends as she lacks confidence in her abilities, but internally she feels guilty. Eliza's family feel that Eliza is nervous, suggestible and has difficulty meeting her commitments.

Eliza is allergic to peanut but she often forgets to mention this fact while ordering her meals. Eliza has read about relationships between height, weight and energy content of various foods.

Eliza has realised that she is overweight and wishes to reduce her weight.

Please rate your feelings for Eliza.

	Disagree strongly	Disagree moderately	Disagree a little	Neither agree nor disagree	Agree a little	Agree moderately	Agree strongly
I like the personality of Eliza.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I like to work for Eliza.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I empathise with Eliza.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I emotionally resonate with Eliza.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Eliza as conventional, uncreative.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Eliza as extraverted, enthusiastic.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Eliza as critical, quarrelsome.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Eliza as dependable, self-disciplined.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Eliza as anxious, easily upset.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Eliza as open to new experiences, complex.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Eliza as reserved, quiet.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Eliza as sympathetic, warm.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Eliza as disorganized, careless.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Eliza as calm, emotionally stable.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I think Eliza is a real person.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please spend about 10 minutes on the following tasks:

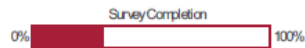
- Recommend a software application or product (can be an idea only)
- Briefly describe your design ideas or recommendation.
- Write a scenario in which Eliza uses your software application or product

Please write your thoughts in the space below (dot points, phrases or sentences).

Conceptual design for Eliza

For your reference below is your conceptual design for Katie:

Conceptual design for Katie



>>



The count down timer is for your reference. Please spend about 15 minutes on this activity.

Holistic Persona - Minty

The following *Holistic Persona*, Minty, represents an archetypical user of the product or software application which you are designing or recommending to her.



Minty's grand-parents migrated to Tasmania during the early 1940's. Her parents are busy in their professional careers. Minty is studying at the University of Tasmania and is midway through her Bachelor of Arts. Since childhood, she has had interest in music and recently learnt to play guitar.

Minty seldom goes out and meets people, but she responds positively to people who approach her. She has few good friends that have known each other for many years. They often visit her and occasionally she goes out with them to local restaurants. She likes musical concert and attends important musical events in Hobart. She has a large collection of records and enjoys listening to the albums. Minty is not a member of any clubs or societies. However when the team leader of the 'Assisting Socially Disadvantaged Group' approached her for help, Minty offered to tutor students in her home.

Minty is short sighted and has sensitive skin but she often forgets to take her glasses with her or apply sun-screen lotion when she goes out.

Minty is quiet and seldom expresses her views unless she feels strongly about an issue and has investigated it well. She listens to other people's point of view and learns from the experience. Her friends feel that she is calm, independent and confident. She makes plans for her future and is full of hope. She does not worry if she has to reject requests for help from others when she does not feel like helping. However she always meets her commitments with high spirits.

Minty is allergic to peanut but she often forgets to mention this fact while ordering her meals. Minty has read about relationships between height, weight and energy content of various foods.

Minty has realised that she is overweight and wishes to reduce her weight.

Please rate your feelings for Minty.

	Disagree strongly	Disagree moderately	Disagree a little	Neither agree nor disagree	Agree a little	Agree moderately	Agree strongly
I like the personality of Minty.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I like to work for Minty.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I empathise with Minty.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I emotionally resonate with Minty.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Minty as conventional, uncreative.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Minty as extraverted, enthusiastic.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Minty as critical, quarrelsome.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Minty as dependable, self-disciplined.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Minty as anxious, easily upset.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Minty as open to new experiences, complex.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Minty as reserved, quiet.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Minty as sympathetic, warm.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Minty as disorganized, careless.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Minty as calm, emotionally stable.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I think Minty is a real person.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please spend about 10 minutes on the following tasks:

- Recommend a software application or product
- Briefly describe your design ideas or recommendation.
- Write a scenario in which Minty uses your software application or product

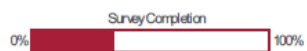
Conceptual design for Minty

For your reference below is your conceptual design for Katie:

Conceptual design for Katie

For your reference below is your conceptual design for Eliza:

Conceptual design for Eliza



>>



The count down timer is for your reference. Please spend about 15 minutes on this activity.

Holistic Persona - Doris

The following Holistic Persona, Doris, represents an archetypical user of the product or software application which you are designing or recommending to her.



Doris' grand-parents migrated to Tasmania during the early 1940's. Her parents are busy in their professional careers. Doris is studying at the University of Tasmania and is midway through her Bachelor of Arts. Since childhood, she has had interest in music and recently learnt to play guitar.

Doris is an outgoing person and likes to meet people. She likes musical concert and attends all musical events in Hobart. After the concerts, she goes out with her friends to local restaurants. She has a large collection of records and enjoys sharing albums with her friends. Doris is an active member of university clubs. Doris has many friends and enjoys their company. She has been a long time member of the 'Assisting Socially Disadvantaged Group', a volunteer group that help refugees and socially disadvantaged people in Tasmania.

Doris is short sighted and has sensitive skin but she often forgets to take her glasses with her or apply sun-screen lotion when she goes out.

Doris is vocal and enjoys debates. She listens to other people's point of view and learns from the experience. Doris' friends feel that Doris is calm, independent and confident. She makes plans for her future and is full of hope. She does not worry if she has to reject requests for help from her friends when she is already committed. She knows her limits. She always meets her commitments with high spirits.

Doris is allergic to peanut but she often forgets to mention this fact while ordering her meals. Doris has read about relationships between height, weight and energy content of various foods.

Doris has realised that she is overweight and wishes to reduce her weight.

Please rate your feelings for Doris.

	Disagree strongly	Disagree moderately	Disagree a little	Neither agree nor disagree	Agree a little	Agree moderately	Agree strongly
I like the personality of Doris.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I like to work for Doris.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I empathise with Doris.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I emotionally resonate with Doris.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Doris as conventional, uncreative.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Doris as extraverted, enthusiastic.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Doris as critical, quarrelsome.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Doris as dependable, self-disciplined.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Doris as anxious, easily upset.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Doris as open to new experiences, complex.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Doris as reserved, quiet.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Doris as sympathetic, warm.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Doris as disorganized, careless.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I see Doris as calm, emotionally stable.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>
I think Doris is a real person.	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Please spend about 10 minutes on the following tasks:

- Recommend a software application or product
- Briefly describe your design ideas or recommendation.
- Write a scenario in which Doris uses your software application or product

Please write your thoughts in the space below (dot points, phrases or sentences).

Conceptual design for Doris

For your reference below is your conceptual design for Katie:

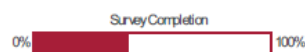
Conceptual design for Katie

For your reference below is your conceptual design for Minty:

Conceptual design for Minty

For your reference below is your conceptual design for Eliza:

Conceptual design for Eliza



>>

Appendix H: Studies II and III - Design Modifications and Design Questionnaires

The presentations below are screen captures for redesign activity and design questionnaire for Holistic Persona Doris. These were repeated for Holistic Personas Katie, Minty and Eliza (not included).

Following the presentations is the rational for the questions.



In the next four screens you will have opportunity to add new features to, or modify, or delete any exiting features from your conceptual designs of software applications or products that you have recommended for each of the four Holistic Personas.

Please spend about 3 minutes for activities on each screen.



You have provided the following conceptual design for Doris:

Conceptual design for Doris

If you would like to modify, add or remove any features from your conceptual design please enter in the space below (for your reference the description of Doris is at the end of this page):

I was totally engaged with Doris's personality while I was designing for Doris.

Strongly disagree ☐ Moderately disagree ☐ Neither agree nor disagree ☐ Moderately agree ☐ Strongly agree ☐

The personality of Doris positively influenced my design for Doris.

Strongly disagree ☐ Moderately disagree ☐ Neither agree nor disagree ☐ Moderately agree ☐ Strongly agree ☐

I was thinking of a real person that I know when I was designing for Doris.

Yes ☐ No ☐

I was thinking of a person who had same personality as Doris when I was designing for Doris.

Strongly disagree ☐ Moderately disagree ☐ Neither agree nor disagree ☐ Moderately agree ☐ Strongly agree ☐

I would like to do another scenario writing / design activity with Doris or a *Holistic Persona* that has similar personality to Doris.

Strongly disagree ☐ Moderately disagree ☐ Neither agree nor disagree ☐ Moderately agree ☐ Strongly agree ☐

Below is the description of *Holistic Persona* Doris:

Below is the design questionnaire and the rational for each question:

1 - Engagement with Holistic Persona

Statement: I was totally engaged with [Holistic Persona]'s personality while I was designing for [Holistic Persona]

Participant's selection (Answer): On a 5-point scale: (1) Strongly disagree, (2) Moderately disagree, (3) Neither agree nor disagree, (4) Moderately agree, (5) Strongly agree

Reason for the question: to evaluate the participant's perception of her/his level of engagement with Holistic Persona's personality

Newness: This is a slightly modified version of the question that was asked in the first system.

Compulsory: yes, the system ask the participant to answer the question

2 - Influence of personality of the Holistic Persona on design work

Statement: The personality of [Holistic Persona] positively influenced my design for [Holistic Persona].

Participant's selection (Answer): On a 5-point scale: (1) Strongly disagree, (2) Moderately disagree, (3) Neither agree nor disagree, (4) Moderately agree, (5) Strongly agree

Reason for the question: does the participant find Holistic Persona's personality influence her/his design?

Newness: To clarify that the object of the influence is the design activity and not scenario writing, for studies two and three, the word scenario is removed. In the Study I this statement was: The personality of the Holistic Persona positively influenced the scenario writing / design activity.

Compulsory: yes, the system ask the participant to answer the question

3 - Influence of personality of the Holistic Persona on reminding the participant about a person they know

Statement: I was thinking of a real person that I know when I was designing for [Holistic Persona].

Participant's selection (Answer): Either a Yes or No

Reason for the question: Does the designer find Holistic Persona remind her/him about a real person that s/he knows? In this question, the influence of a real person on the design is measured. This influence can be negative as the person remembered may not have the same problems that the Holistic Persona has hence the design would not be appropriate for the Holistic Persona.

Newness: This statement is similar to the statement in the first system.

Answer required: Yes, the system requires the participant to answer the question

4 - Effect of the personality of the Holistic Persona on the participant's thinking

Statement: I was thinking of a person who had same personality as [Holistic Persona] when I was designing for [Holistic Persona].

Participant's selection (Answer): On a 5-point scale: (1) Strongly disagree, (2) Moderately disagree, (3) Neither agree nor disagree, (4) Moderately agree, (5) Strongly agree

Reason for the question: If the designer was thinking of a person, answered positively to the previous questions, then did the person have same personality as, or different personality to, the Holistic Persona. If the answer to the previous question is negative, than this question has to be evaluated in association with the design artefact as it may mean that the participant did not think of a real person but of an object or the participant may form a list of specification and designed according to the specification or thought of an imaginary person who had a personality similar to, or different from, the Holistic Persona.

Newness: This statement is modified in study two and three.

Answer required: Yes, the system requires the participant to answer the question

5 – Participant's choice of the Holistic Persona for future design

Statement: I would like to do another scenario writing / design activity with [Holistic Persona] or a Holistic Persona that has similar personality to [Holistic Persona].

Participant's selection (Answer): On a 5-point scale: (1) Strongly disagree, (2) Moderately disagree, (3) Neither agree nor disagree, (4) Moderately agree, (5) Strongly agree

Reason for the question: Did the Holistic Persona create enough empathy in the designer that s/he would like to do another design activity with another Holistic Persona that has same personality.

Newness: This statement is modified in study two and three.

Answer required: Yes, the system requires the participant to answer the question

Appendix I : Studies II and III - Post Design Questionnaires

This appendix presents post design questionnaire followed by the rational for the questions.



The following pages contain survey questions about your overall experiences during this study.



I found that the design activities/ scenario writings were easy.

Disagree strongly ☐ Disagree moderately ☐ Neither agree nor disagree ☐ Agree moderately ☐ Agree strongly ☐

Considering personalities of *Holistic Personas*, I added features to designs which otherwise I would not have added.

Yes ☐ No ☐



Comments on the features added due to *Holistic Personas'* personalities:

For my future design activity, if I have to choose only one *Holistic Persona* I would choose

Doris
☐

Katie
☐

Minty
☐

Eliza
☐

I cannot remember the
name
☐


Comments on my choice of *Holistic Persona* for my future design:

At least one of the software applications or products I selected for design sessions was one that I was familiar with it.

Yes
☐

No
☐

While I was conceiving solutions, foremost thoughts on my mind were:

Survey Completion
0%  100%

>>

Rational for post design questions:

1 - Ease of design / scenario writing

Statement: I found that the design activities/ scenario writings were easy.

Participant's selection (Answer): On a 5-point scale: (1) Strongly disagree, (2) Moderately disagree, (3) Neither agree nor disagree, (4) Moderately agree, (5) Strongly agree

Reason for the question: Can ease of writing scenario be an indicator of the participant liking Holistic Persona and having design ability?

Newness: This statement is similar with the statement in the first system.

Response required: Yes, the system asks the participant to answer the question

2 - Influence of the Holistic Persona's personality on features added

Statement: Considering personalities of Holistic Personas, I added features to designs which otherwise I would not have added.

Participant's selection (Answer): Either a Yes or No. If the participant selected yes for their answer, participant were asked to enter in a text box the details of the features they have added.

Reason for the question: The participant perception about the feature they have added to their design which was influenced by the Holistic Persona's personality.

Newness: This statement is similar with the statement in the first system.

Response required: Yes, the system asks the participant to answer the question. When they selected yes, the system asks the participant to make an entry in the text box.

3 - Choice of a Holistic Persona based on her personality

Statement: For my future design activity, if I have to choose only one Holistic Persona I would choose.

Participant's selection (Answer): Either a selection from Holistic Personas presented for design activities (Doris, Katie, Minty or Eliza) or I cannot remember the name.

The participant can enter in a text box comments on her/his choice of Holistic Persona for their future design.

Reason for the question: This question is to find which of the Holistic Personas' personality made an enduring effect on the participant.

Newness: This statement is similar with the statement in the first system.

Response required: Yes, the system asks the participant to answer the question. The system also asks the participant to make an entry in the text box.

4 - Influence of the previous design work

Statement: At least one of the software applications or products I selected for design sessions was one that I was familiar with it.

Participant's selection (Answer): Either a Yes or No

Reason for the question: To assess the effect of the participant's previous design experience for a similar system.

Newness: This statement is similar with the statement in the first system.

Response required: Yes, the system asks the participant to answer the question.

5 - What factors were significant during design conception?

Statement: While I was conceiving solutions, foremost thoughts on my mind were:

Participant's selection (Answer): The participant can enter in a text box comments on her/his thinking during the design activities.

Reason for the question: To find out the designer's foremost thought at the moment of conceiving a solution and the factors that influenced her/his thinking. Was the thinking influenced by personality or other features of the Holistic Persona or there were other personalities foremost in their thought.

Newness: This statement is new in the second system.

Response required: Yes, the system asks the participant to make an entry in the text box.

Appendix J : Study I – Demographics Questionnaire

This appendix presents demographics questionnaire for study I. Rational for relevant questions are provided in Appendix L.

My gender is

- ☐ Male
- ☐ Female

I was born in the year (e.g. 1995)

I am

- ☐ an under-graduate student
- ☐ a post-graduate student
- ☐ an academic
- ☐ a professional
- ☐ none of the above

I have (choose all that applies)

- ☐ studied design subjects
- ☐ design experience
- ☐ Interest in design

English is

- ☐ my first language
- ☐ not my first language

I have spoken and written in English for

- ☐ less than 1 year
- ☐ 1 - 3 year
- ☐ more than 3 years

I spent most of my youth in

(Dropdown lists the countries of world.)

I am studying or have studied (choose all that applies)

- ☐ Software engineering
- ☐ Arts and literature studies
- ☐ Fine arts and music
- ☐ Science

- ☐ Human science
- ☐ Business and economics
- ☐ Other



I am studying or have studied (choose all that applies)

- ☐ Software engineering
- ☐ Arts and literature studies
- ☐ Fine arts and music
- ☐ Science

- ☐ Human science
- ☐ Business and economics
- ☐ Other



Appendix K : Study I - Design and Post design Questionnaire

This appendix presents design and post design questionnaire followed by the rational for the questions.

My scenario writing / design activity was with *Holistic Persona*:

Doris

☐

Katie

☐

Minty

☐

Eliza

☐

Cannot remember

☐

Reflecting back at Spatial Ability test, I have done similar test before.

Yes

☐

No

☐

I found that the scenario writing / design activity was easy.

Disagree strongly

☐

Disagree moderately

☐

Neither agree nor
disagree

☐

Agree moderately

☐

Agree strongly

☐

I was totally engaged with the *Holistic Persona*'s personality while carrying out the scenario writing / design activity.

Disagree strongly

☐

Disagree moderately

☐

Neither agree nor
disagree

☐

Agree moderately

☐

Agree strongly

☐

The personality of the *Holistic Persona* positively influenced the scenario writing / design activity.

Disagree strongly

☐

Disagree moderately

☐

Neither agree nor
disagree

☐

Agree moderately

☐

Agree strongly

☐

To meet the *Holistic Persona*'s needs, I added features to the design which otherwise I would not have added.

Yes

☐

No

☐

>>

Comments on the features added:

I would like to do another scenario writing / design activity with the same *Holistic Persona* or a persona that has similar personality again.

Yes

☒

No

☐

I was thinking of a real person that I know when I was conducting the design.

Yes

☒

No

☐

>>

The person I was thinking had same personality as the *Holistic Persona*.

Yes

☐

No

☐

For my future design activity, if I have to choose only one *Holistic Persona* I would choose

Jane

☐

Jean

☐

Jade

☐

June

☐

I cannot remember the name

☐

Comments on my choice of *Holistic Persona*:

The software application or product I selected for design session was one of my previous design work or I was familiar with it.

☐ Yes

☐ No

<<

>>

- **Ease of scenario writing**

Question number:

Statement (question): I found that the scenario writing / design activity was easy.

Participant's response (answer): A selection on a 5-point Likert scale ranging from (1) disagree strongly to (5) agree strongly

Reason for the question: To assess if there is any relationship between ease of scenario writing, the participants liking the Holistic Persona and having design ability.

Compulsory: yes, the system ask the participant to select an option

- **Previous experience in Spatial Ability**

Question number:

Statement (question): Reflecting back at Spatial Ability test, I have done similar test before.

Participant's response (answer): Yes/No

Reason for the question: to check the relationship between previous training in spatial ability and the score in spatial ability test.

Compulsory: yes, the system ask the participant to select an option

- **Familiarity with design**

Question number:

Statement (question): The software application or product I selected for design session was one of my previous design work or I was familiar with it.

Participant's response (answer): A selection on a 5-point Likert scale ranging from (1) disagree strongly to (5) agree strongly

Reason for the question: To assess if familiarity with the design would make scenario writing easier

Compulsory: yes, the system ask the participant to make a selection

Appendix L : Studies II and III – Demographics Questionnaire



My gender is

- ☐ Male
- ☐ Female
- ☐ Prefer not to answer

I was born in the year (e.g. 1996)

My main profession is

- ☐ an under-graduate student
- ☐ a post-graduate student
- ☐ an academic / a researcher
- ☐ a professional
- ☐ none of the above

I have (choose all that applies)

- ☐ studied design subjects
- ☐ design experience
- ☐ Interest in design
- ☐ none of the above

I have experience and/or training in (choose all that applies)

☐ user-centred design

☐ screen / interface design

☐ interactive design

☐ industrial design

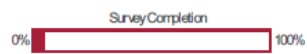
☐ other types of design

☐ none of the above

English is

☐ my first language

☐ not my first language



>>

I have spoken and written in English for

- ☐ less than 1 year
☐ 1 - 3 year
☐ more than 3 years

I spent most of my youth in

I am studying or have studied (choose all that applies)

- | | |
|------------------------------------------------------|-----------------------------------------------------------|
| <input type="checkbox"/> Game Design | <input type="checkbox"/> Business and economics |
| <input type="checkbox"/> Software engineering | <input type="checkbox"/> Science <input type="text"/> |
| <input type="checkbox"/> Arts and literature studies | <input type="checkbox"/> Engineering <input type="text"/> |
| <input type="checkbox"/> Fine arts and music | <input type="checkbox"/> Other <input type="text"/> |
| <input type="checkbox"/> Human science | |

I have been trained in Spatial Ability.

- | | | | | |
|-----------------------|-----------------------|----------------------------|-----------------------|-----------------------|
| Disagree strongly | Disagree moderately | Neither agree nor disagree | Agree moderately | Agree strongly |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | <input type="radio"/> |

Survey Completion
0% 100%

>>

Rational for the questions:

1 - Gender

Statement (question): My Gender is

Participant's response (answer): Single selection from the following list:

- Male
- Female

Reason for the question: to investigate gender related influences in design

Response required: Yes, the system asks the participant to select an option

2 - Age

Statement (question): I was born in the year (e.g. 1995)

Participant's response (answer): four digit number

Reason for the question: to investigate age related influences in design

Response required: Yes, the system asks the participant to provide a four digit number in the range 1929-1995 (70 years – 18 years old in 2013)

3 - Profession

Statement (question): I am

Participant's response (answer): Single selection from the following list:

- an under-graduate student
- a post-graduate student
- an academic
- a professional
- none of the above

Reason for the question: to investigate influence of profession on design

For in-between comparison with participants who are from different professional

Compulsory: yes, the system ask the participant to make a selection

4 - Design interest experiences and interest

Statement (question): I have (choose all that applies)

Participant's response (answer): One or more selections from the following list:

- studied design subjects
- design experience
- Interest in design

Reason for the question: to investigate level of interest in design

For in-between comparison with participants who different design experience or interest

If a participant is not interested in design than s/he would not be taking part in this study

Compulsory: yes, the system ask the participant to make at least one selection

5 - Native English speakers

Statement (question): English is

Participant's response (answer): one selection from the following list:

- my first language
- not my first language

Reason for the question: The study relies on understanding of English language

For in-between comparison between native English speakers and non-native speakers

Compulsory: yes, the system ask the participant to make a selection

6 - Knowledge of English language

Statement (question): I have spoken and written in English for

Participant's response (answer): one selection from the following list:

- less than 1 year
- 1 - 3 year
- more than 3 years

Reason for the question: The study relies heavily on understanding of English language. This is to identify the participant's knowledge of English language and if they can understand the subtle points about personality.

If the participant is speaking and writing English for less than 3 years than her/his data needs checking to ensure s/he understood the questions

Compulsory: yes, the system ask the participant to make a selection

7 - Cultural background

Statement (question): I spent most of my youth in

Participant's response (answer): one selection from the list of all the countries

Reason for the question: The study relies heavily on understanding of Western culture

For in-between comparison between western and other cultures

Compulsory: yes, the system ask the participant to make a selection

Statement (question): I have spoken and written in English for

Participant's response (answer): one selection from the following list:

- less than 1 year
- 1 - 3 year
- more than 3 years

Reason for the question: The study relies heavily on understanding of English language. This is to identify the participant's knowledge of English language and if they can understand the subtle points about personality.

If the participant is speaking and writing English for less than 3 years than her/his data needs checking to ensure s/he understood the questions

Compulsory: yes, the system ask the participant to make a selection

8 - Educational background

Statement (question): I am studying or have studied (choose all that applies)

Participant's response (answer): Multiple selections from the following list:

- Software engineering
- Arts and literature studies
- Fine arts and music
- Science
- Human science
- Business and economics
- Other

Reason for the question: Educational background helps in assessing the participants design and spatial ability.

It allows in-between comparison e.g. scientific and artist mind set.

Compulsory: yes, the system ask the participant to make at least one selection

Appendix M: Purdue Visualization of Rotations (PVR) Test

20-item Purdue Visualization of Rotations (PVR) Test

The time limit for this test is 10 minutes, excluding the time to read direction.

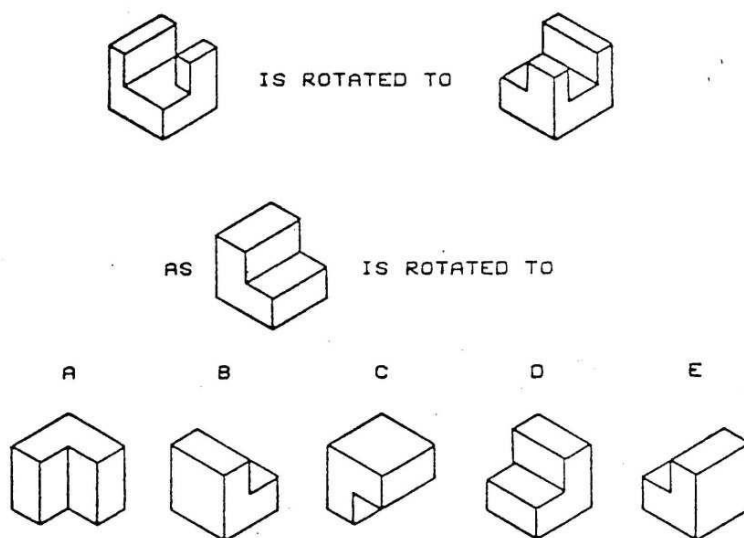
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<http://journals.springer-ny.com/chedr>
S 1430-4171 (97) 04138-X

Do NOT make any marks on this exam.
Mark your answers on the separate answer sheet

DIRECTIONS

This test consists of 20 questions designed to see how well you can visualize the rotation of three-dimensional objects. An example of the type of question included in this test is shown below.



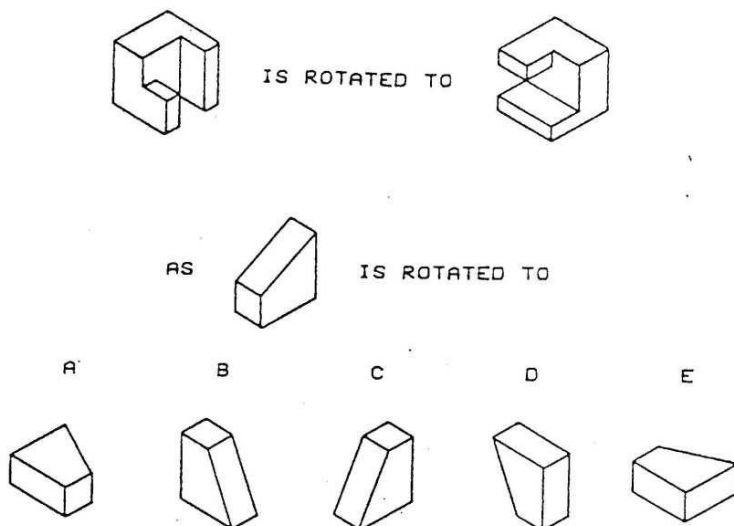
For each question, you should:

- I. Study how the object in the top line of the question is rotated.
- II. Picture in your mind what the object shown in the middle line of the question looks like when rotated in exactly the same manner.
- III. Select from among the five drawings (A, B, C, D, or E) given in the bottom line of the question the one that looks like the object rotated in the correct position.

What is the correct answer to the example shown above?

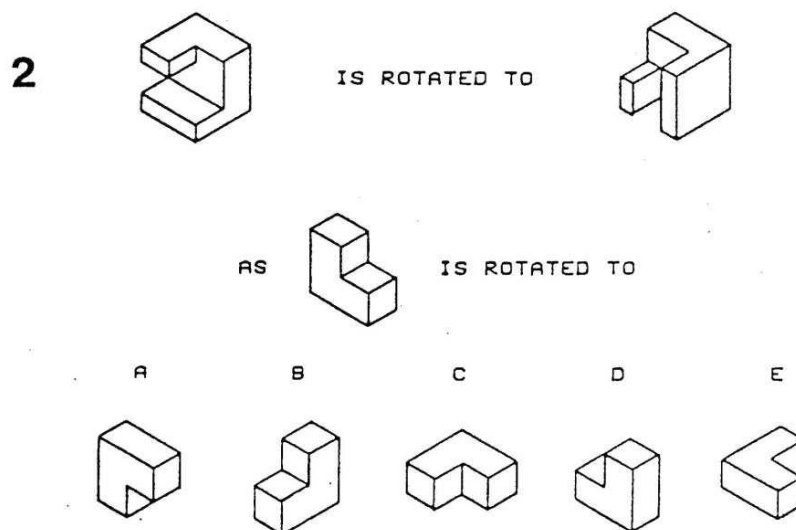
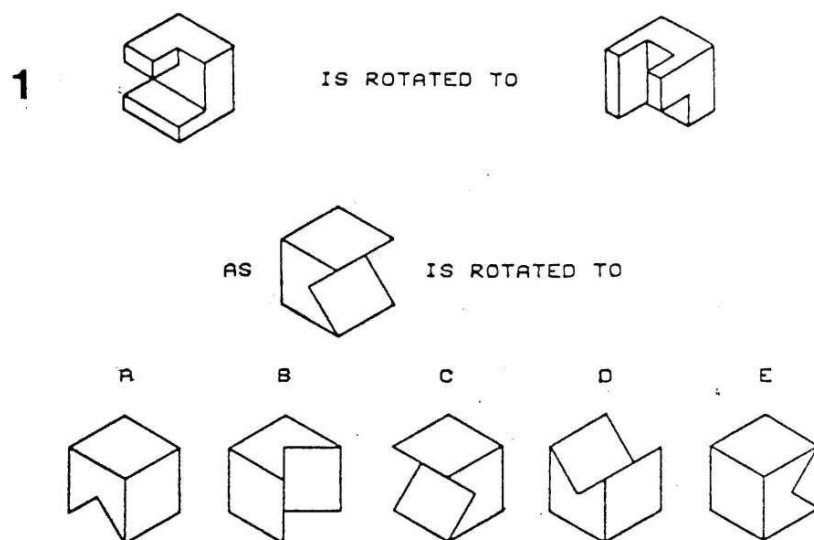
Answers A, B, C, and E are wrong. Only drawing D looks like the object after it has been rotated. Remember that each question has only one correct answer.

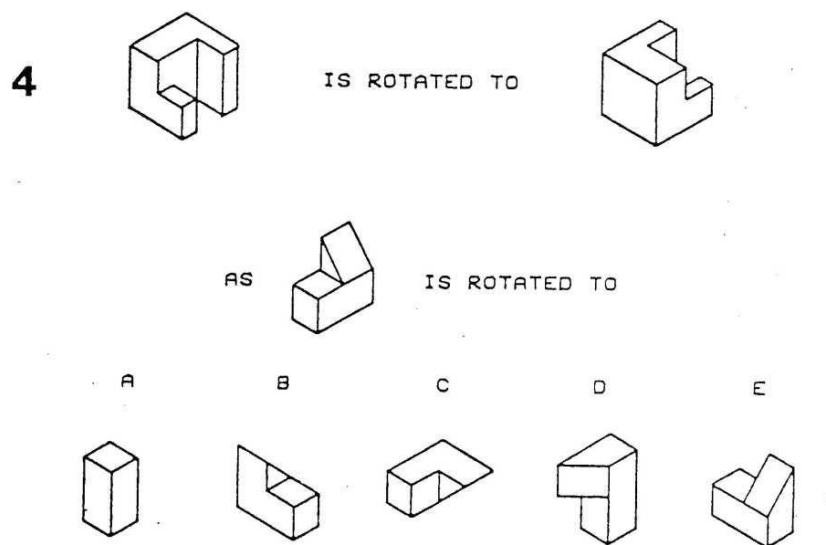
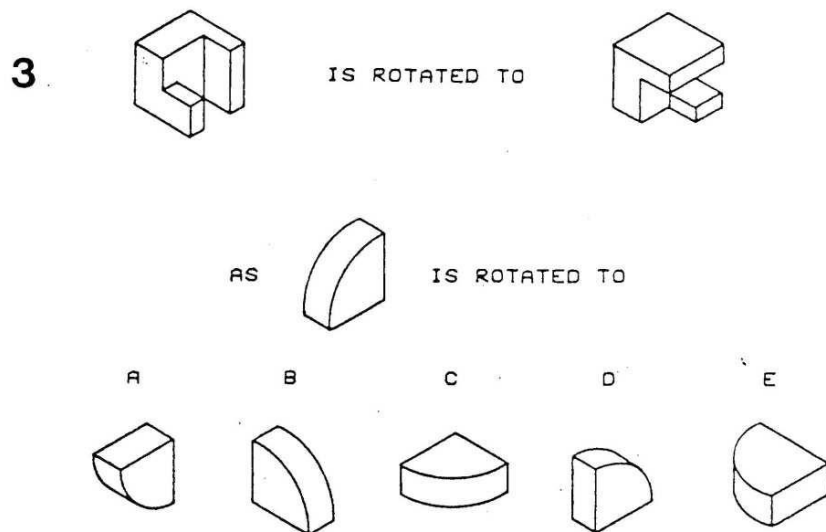
Now look at the example shown below and try to select the drawing that looks like the object in the correct position when the given rotation is applied

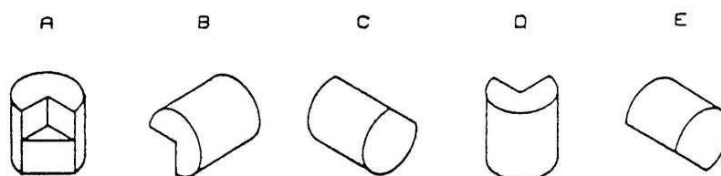
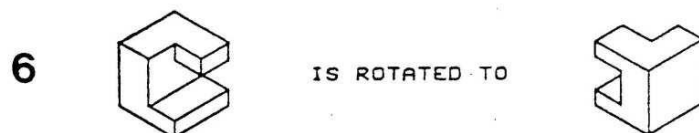
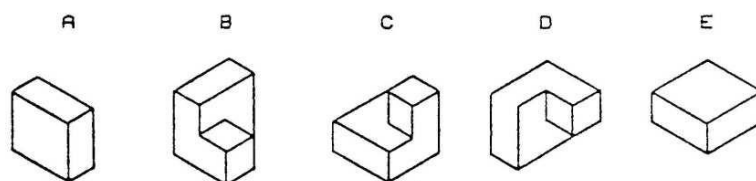
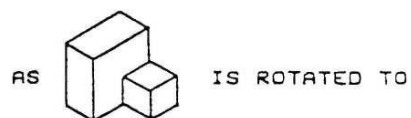
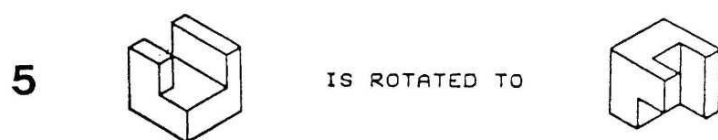


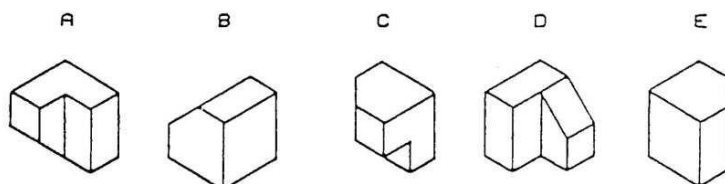
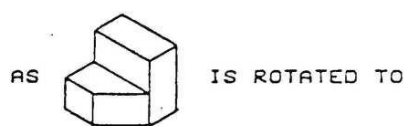
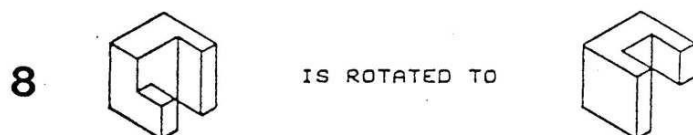
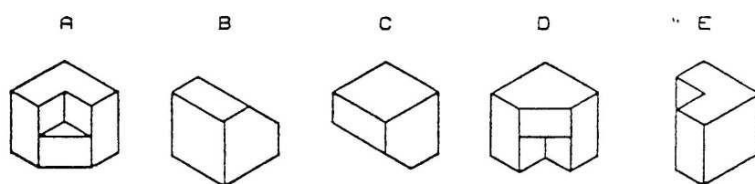
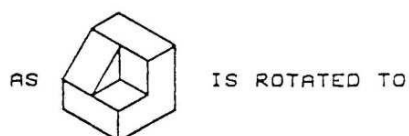
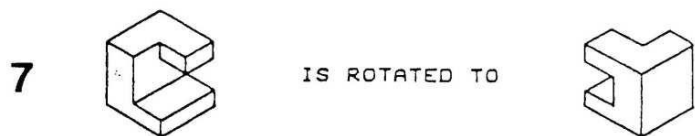
Note that the rotation in this example is more complex. The correct answer for this example is B.

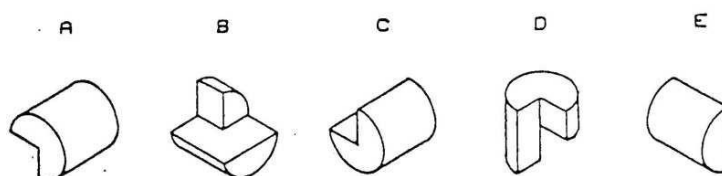
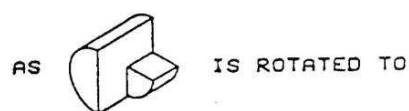
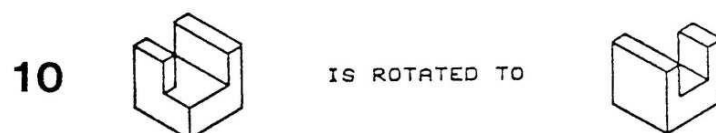
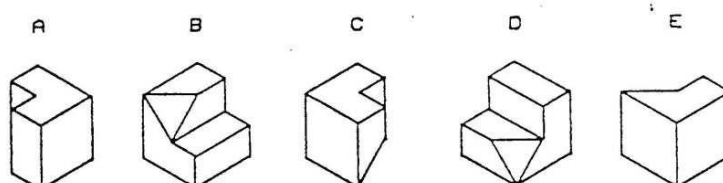
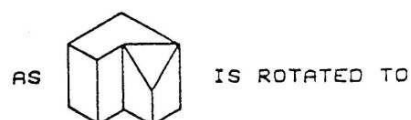
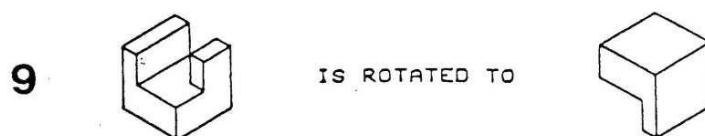
Do NOT make any marks in this booklet.
Mark your answers on the separate answer sheet.
You will be told when to begin

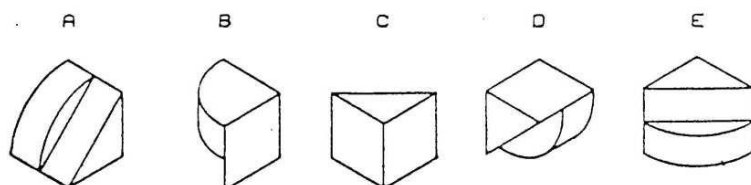
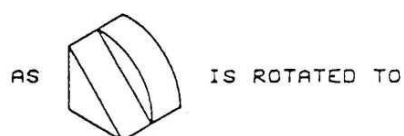
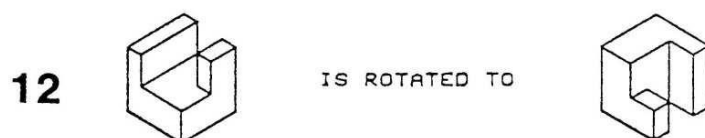
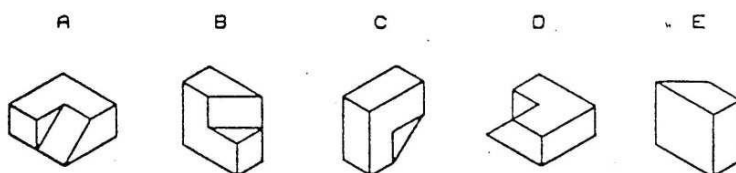
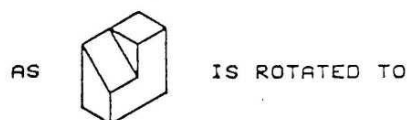


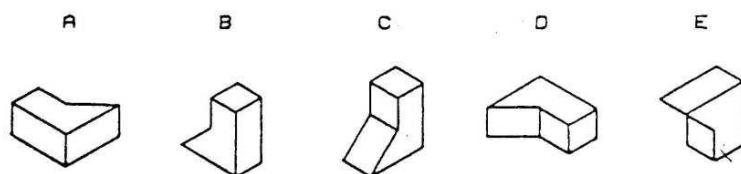
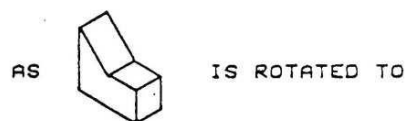
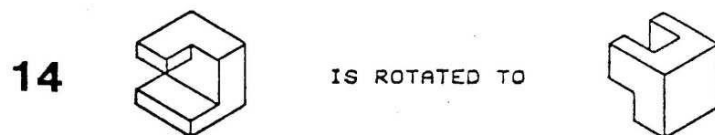
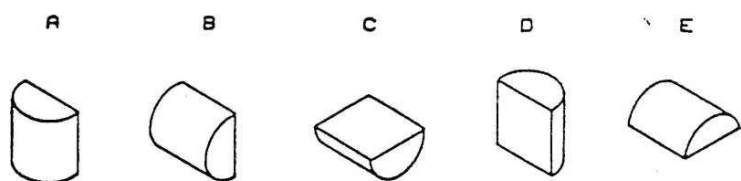
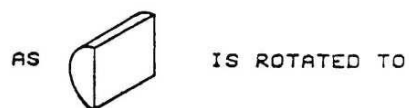




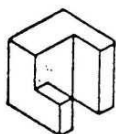




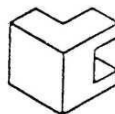




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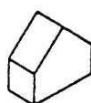


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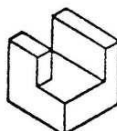
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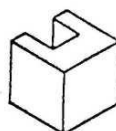
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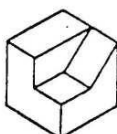
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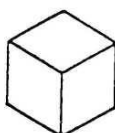


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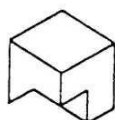


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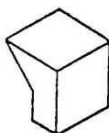
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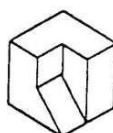
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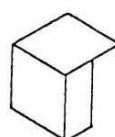
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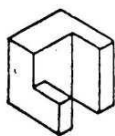
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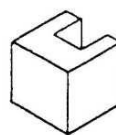
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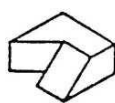


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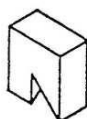


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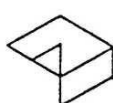
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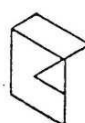
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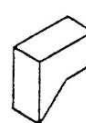
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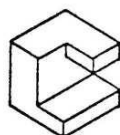
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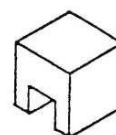
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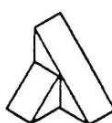
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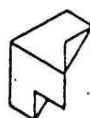


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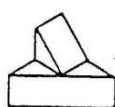


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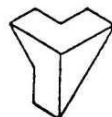
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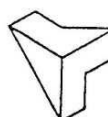
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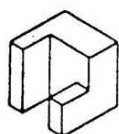
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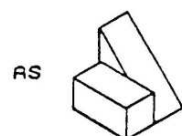
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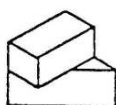


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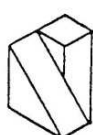
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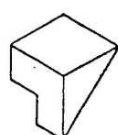
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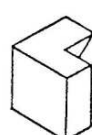
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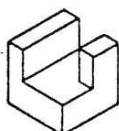
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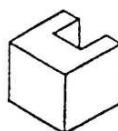
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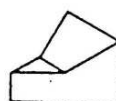


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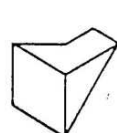


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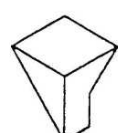
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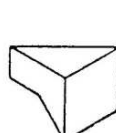
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Appendix N : Ethics Approval Letter

Original ethics approval – 14 August 2013

From: **Faculty of Science Research Office** <sci.ethics@mq.edu.au>

Date: Wed, Aug 14, 2013 at 8:28 AM

Subject: Approved

To: Prof Deborah Richards <deborah.richards@mq.edu.au>, Mr Farshid Anvari
<farshid.anvari@students.mq.edu.au>

Cc: Prof Richie Howitt <richie.howitt@mq.edu.au>, Ms Katherine Wilson <katherine.wilson@mq.edu.au>

Dear Prof Richards,

RE: Ethics project entitled: "Holistic persona evaluation"

Ref number: 5201300553.

Thank you for your recent correspondence. Your response has addressed the issues raised by the Faculty of Science Human Research Ethics Sub-Committee and approval is granted to this application. This email constitutes ethical approval only.

This research meets the requirements of the National Statement on Ethical Conduct in Human Research (2007). The National Statement is available at the following web site:

http://www.nhmrc.gov.au/_files_nhmrc/publications/attachments/e72.pdf.

The following personnel are authorised to conduct this research:

Mr Farshid Anvari

Prof Deborah Richards

NB. STUDENTS: IT IS YOUR RESPONSIBILITY TO KEEP A COPY OF THIS APPROVAL EMAIL TO SUBMIT WITH YOUR THESIS.

Please note the following standard requirements of approval:

1. The approval of this project is conditional upon your continuing compliance with the National Statement on Ethical Conduct in Human Research

(2007).

2. Approval will be for a period of five (5) years subject to the provision of annual reports.

Progress Report 1 Due: 14 August 2014

Progress Report 2 Due: 14 August 2015

Progress Report 3 Due: 14 August 2016

Progress Report 4 Due: 14 August 2017

Final Report Due: 14 August 2018

NB. If you complete the work earlier than you had planned you must submit a Final Report as soon as the work is completed. If the project has been discontinued or not commenced for any reason, you are also required to submit a Final Report for the project.

Progress reports and Final Reports are available at the following website:

http://www.research.mq.edu.au/for/researchers/how_to_obtain_ethics_approval/human_research_ethics/forms

3. If the project has run for more than five (5) years you cannot renew approval for the project. You will need to complete and submit a Final Report and submit a new application for the project. (The five year limit on renewal of approvals allows the Committee to fully re-review research in an environment where legislation, guidelines and requirements are continually changing, for example, new child protection and privacy laws).

4. All amendments to the project must be reviewed and approved by the Committee before implementation. Please complete and submit a Request for Amendment Form available at the following website:

http://www.research.mq.edu.au/for/researchers/how_to_obtain_ethics_approval/human_research_ethics/forms

5. Please notify the Committee immediately in the event of any adverse effects on participants or of any unforeseen events that affect the continued ethical acceptability of the project.

6. At all times you are responsible for the ethical conduct of your research in accordance with the guidelines established by the University.

This information is available at the following websites:

<http://www.mq.edu.au/policy/>

http://www.research.mq.edu.au/for/researchers/how_to_obtain_ethics_approval/human_research_ethics/policy

If you will be applying for or have applied for internal or external funding for the above project it is your responsibility to provide the Macquarie University's Research Grants Management Assistant with a copy of this email as soon as possible. Internal and External funding agencies will not be informed that you have approval for your project and funds will not be released until the Research Grants Management Assistant has received a copy of this email.

If you need to provide a hard copy letter of approval to an external organisation as evidence that you have approval, please do not hesitate to contact the Ethics Secretariat at the address below.

Please retain a copy of this email as this is your official notification of ethics approval.

Yours sincerely

Faculty of Science Human Ethics Committee Secretariat
Professor Richard Howitt (Chair, Dept of Environment & Geography)
Katherine J. Wilson, Research Administrator
Faculty of Science
E6A 202
Macquarie University
NSW 2109 Australia
T: +61 2 9850 9112
F: +61 2 9850 9102
E: sci.ethics@mq.edu.au
mq.edu.au

Ethics Amendment Approved – 11 February 2014

From: Faculty of Science Research Office <sci.ethics@mq.edu.au>

Date: 11 February 2014 at 12:27

Subject: Amendment Approved

To: Associate Professor Michael Hitchens <michael.hitchens@mq.edu.au>, Prof Deborah Richards <deborah.richards@mq.edu.au>, Mr Farshid Anvari <farshid.anvari@students.mq.edu.au>

Cc: Professor Richie Howitt <richie.howitt@mq.edu.au>, Ms Katherine Wilson katherine.wilson@mq.edu.au

Dear Prof Richards,

RE: Ethics Application Entitled: "Holistic persona evaluation".

Reference number: 5201300553.

Thank you for your recent correspondence. The following amendments have been approved:

Addition of Michael Hitchens and Cecile Paris

Minor modifications to questions and processes as outlined

Add COMP 260

Please do not hesitate to contact the Faculty of Science Research team at sci.ethics@mq.edu.au should you wish to discuss this matter further.

Regards

Faculty of Science Human Ethics Committee Secretariat

Professor Richard Howitt (Chair, Dept of Environment & Geography)

Katherine J. Wilson, Research Administrator

Faculty of Science

E6A 202

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E: sci.ethics@mq.edu.au

mq.edu.au

Ethics Amendment Approved – 19 November 2014

----- Forwarded message -----

From: Faculty of Science Research Office <sci.ethics@mq.edu.au>

Date: Tue, Sep 23, 2014 at 10:49 AM

Subject: Ethics Project 5201300553 Amendment Approved

To: Prof Deborah Richards <deborah.richards@mq.edu.au>

Cc: Professor Richie Howitt <richie.howitt@mq.edu.au>, Ms Cathi Humphrey-Hood <cathi.humphrey-hood@mq.edu.au>

Dear Professor Richards,

RE: Ethics Application Entitled: "Holistic Persona Evaluation"

Reference number: 5201300553

Thank you for your recent correspondence. The following amendment has been approved:

Inclusion of data collected by a Danish researcher with students in his software engineering class (similar to the recruitment pool used in Australia) using the instrument designed at MQ.

Replacement of the first page of the study with the first page from the Danish researcher, including a description of methodologies and consent information as set out in the amendment application.

Please do not hesitate to contact the Faculty of Science Research team at sci.ethics@mq.edu.au should you wish to discuss this matter further.

Regards,
Richie Howitt, Chair
Faculty of Science Human Research Ethics Sub-Committee
Macquarie University
NSW 2109

Ethics Amendment Approved – 19 November 2014

From: Faculty of Science Research Office <sci.ethics@mq.edu.au>

Date: Wed, Nov 19, 2014 at 4:46 PM

Subject: Ethics Project 5201300553 - Amendment Approved

To: Prof Deborah Richards <deborah.richards@mq.edu.au>

Cc: Faculty of Science Research Office <sci.ethics@mq.edu.au>, Ms

Cathi Humphrey-Hood <cathi.humphrey-hood@mq.edu.au>, Mrs Katherine

Shevelev <katherine.shevelev@mq.edu.au>

Dear Professor Richards

RE: Ethics Application Entitled: "Holistic Persona Evaluation"

Reference number: 5201300553

Thank you for your recent correspondence. The following amendment has been approved:

Adding Hien Minh Tran to independently check the marks assigned to design activities.

Please do not hesitate to contact the Faculty of Science Research team at sci.ethics@mq.edu.au should you wish to discuss this matter further.

Regards,

Richie Howitt, Chair

Faculty of Science Human Research Ethics Sub-Committee

Macquarie University

NSW 2109

Appendix O : UCD Rubric - Details

Abstract design or recommendation and the impetus requirements

Rubric reference Number: 1

Rubric reference Name: Abstract design

Description: As the design is open ended, the participant can recommend an existing system, a software application or a product or conceive an abstract design that is new both in terms of hardware and software.

For an abstract design, the description provides enough information to visualise the functioning of the new software application or product.

The existing system, application or product that is recommended is generally a diary, a calendar, a reminder or a forum. The recommended applications can be generic (e.g. an online diary) or specialised (e.g. a forum that caters for sporting needs or is used by introverts). In the description of the design, sufficient details are provided which explains how the product functions.

Also in this section, for each design idea, the requirements which would have been the impetus for the design idea is identified.

Table XXXIV presents a summary of the top-level requirements and the frequency with which each requirement occurred in the design artefacts produced for each of the Holistic Personas.

Maximum mark for this part: 5 marks

Assignment of the mark for conceptual design: The marks are assigned progressively as shown below depending on the design and the details provided.

1 mark: A participant makes mention of a software application or product that is to be used by the Holistic Persona. By naming a product, the participant has shown thoughtfulness and an attempt to provide a solution for the Holistic Persona.

In terms of Blooms taxonomy, in knowledge dimension this provides for factual information and for cognitive process this demonstrates remember process.

2 marks: A participant has attempted to provide a description of the software application or product, but the description does not demonstrate how the software application or product functions; or a very simple application is recommended. For example recommendation of an alarm clock which has to be set every time that there is a need for a reminder.

In terms of Blooms taxonomy, in knowledge dimension this activity provides conceptual knowledge as the designer is aware of the principles and generalises the concept to new situation and attempting to present an interpretation of the design in the new form. In terms

of cognitive process dimension this demonstrates understand process as the designer is describing a design work.

3 marks: In the description of the application provide details to demonstrate that the design is for a simple standalone or internet based application. This kind of application would provide information such as dietary advice or is a forum or is diary. From information given, it can be derived that it has a database for information repository and retrieval. The information is supplied manually via a user interface or keyboard and information is retrieved by issuing a command. This kind of application does not have automation built in it.

In terms of Blooms taxonomy, in knowledge dimension this activity provides procedural knowledge as the designer has knowledge of specifics such as information retrieval systems and applies the concept to new situation and presents an interpretation of the concept in the new form. In terms of cognitive process dimension this demonstrates analysing process as the designer is breaking a design work into constituent parts and explains how the parts work and can provide for an overall description of the structure of the system and purpose of design.

4 marks: The design provides for features such as GPS to detect location, online connectedness with other systems and applications. These technologies can be used in new situations and provide for innovative features to allow data to automatically be loaded, provide information or reminder by detecting location, allow for data input by detecting motion, etc.

This is similar to earlier process but uses more advanced technology innovatively.

In terms of Blooms taxonomy, in knowledge dimension this activity provides procedural knowledge as the designer has knowledge of specifics such as GPS systems and applies the concept to new situation and presents an interpretation of the concept in the new form. In terms of cognitive process dimension this demonstrates *evaluate* process as the designer is breaking a design work into constituent parts and explaining how each part work and put the parts together in a new form that produces a new design.

5 marks: if the application has advanced features such as suggestive goal setting, automated reminder and advisory activities.

In terms of Blooms taxonomy this step provides for highest level of knowledge and highest rung of the cognitive processes: in knowledge dimension this activity demonstrates *meta-cognitive knowledge* as the designer has knowledge of specifics systems such as GPS, mobile systems, interconnection, artificial intelligence and etcetera, and applies the concept creatively. In terms of cognitive process dimension this demonstrates *creative process* as the designer is creating an innovative design for the new situation.

Scenario

Rubric reference Number: 2

Rubric reference Name: Scenario

Description: Holistic persona's interaction with the application

A scenario for the Holistic Persona to interact with the application should elucidate the conceptual design by interacting with the software application or product to carry out a task. A scenario can be specific or embedded in design notes by presenting the detailed explanation of how the design works.

Maximum mark for this part: 3 marks

Assignment of the mark: The marks are assigned progressively as shown below depending on the details of scenario provided.

1 mark – The interaction with the application is embedded in design notes or the interaction is a simple one. It is sufficient that the designer demonstrates that s/he was aware that the design is meant to be used by a Holistic Persona.

2 marks – An interaction with the design which clarifies the functioning of one or more aspects of the design. The activities can be execution of a query to retrieve information or application displays some information. More elaborate interaction with application compared to above or scenarios that are embedded in design.

3 marks – Describe an interaction with the design to carry out a significant task and the interaction demonstrates that the conceptual design is feasible.

Note: a high design mark often attracts a high scenario mark as most of the interactions are explained in design work. Similarly a low design mark often attracts a low scenario marking as there is little design work.

Factual Information

Rational:

It is important to remember factual information from the Holistic Persona for design work as factual knowledge is the first level of the Knowledge dimension (Krathwohl 2002).

Some of the factual information are in problem area and some (e.g. name) are factual information that are to be used for the system design. Weight though being one of the factual information but due to its complexity, importance and extra emphasis made in the Holistic Persona's description is treated separately as it is a significant issue and has its own relevancies.

Rubric reference Number: 3

Rubric reference Name: Factual information

Description:

Holistic Persona has trouble remembering to apply skin lotion when she goes out into sun, take her eye glasses for certain appointment or in restaurants to ensure that the food does not have peanut as she has allergies. The application that reminds the Holistic Persona to apply skin lotion if she intends to walk in the sun, carry eye glasses for certain appointments, and alert her to her allergies while ordering food receives credit for it.

The participant is expected to refer to the Holistic Persona by her name. Two objectives are achieved:

1. Using a name illustrates that the participant has some affinity with Holistic Persona,
2. The design is meant for the Holistic Persona and is not just a copy of a design which was for another purpose.

Hence to get the full mark, the designer uses Holistic Persona's name and addresses these issues: Allergy, Skin lotion, Short sightedness

Maximum mark for this part: 2 marks

Assignment of the mark: The marks are assigned cumulatively for each item that the participant addresses during her/his design activity.

0.5 mark –referring to Holistic Persona by name

0.5 mark – referring to her allergy

0.5 mark – referring to her skin disorder

0.5 mark – referring to her short-sightedness

Weight issue

Rubric reference Number: 4

Rubric reference Name: Weight issue

Description:

Holistic Persona has realised that she is overweight and wishes to reduce her weight. The application that assists the Holistic Persona to manage her weight will be credited.

Maximum mark for this part: 2 marks

Assignment of the mark: The marks are assigned progressively for each item that the participant addresses during her/his design activity.

0.5 mark – acknowledging the problem by mentioning weight, food or exercise.

1 mark - giving a simple feature that considers either diet or exercise e.g. an exercise reminder application.

2 marks – Addressing either directly or by implication both exercise regime and diet. The designer needs to provide a feature that address the weight issue e.g. graph of BMI, food intake, calorie counter, exercise reminder.

Suitability of Design to Holistic Persona

Rubric reference Number: 5

Rubric reference Name: Suitable to the Holistic Persona

Maximum mark for this part: 3 marks

Description:

These features help the application to be more suitable to the Holistic Persona by meeting her needs on a subtle and personal level.

Assignment of the mark: The marks are assigned progressively for each item that the participant addresses during her/his design activity.

1 mark: Ideas – The designer has realised the effect that the Holistic Persona might have on usability of the product. The designer put forward some ideas only without elaboration.

2 marks: Connections –The designer has made connections with the Holistic Persona; the designer has incorporated basic ideas that would make the application more suitable to the Holistic Persona e.g. design a private application for an introvert personality or a social application for an extravert personality. Usually the design notes do not reveal the reasons for the design selection as the design is without depth.

3 marks: Extensions –The designer has incorporated ideas into design that takes into account the needs of Holistic Persona beyond normal expectation. The designer demonstrates her/his in-depth knowledge and the design notes reveal the reasons for selections made and how it will suit the personality of the Holistic Persona.

All Holistic Personas had musical, logical and linguistic intelligences. They played guitar, had a large collection of musical records, were studying in University of Tasmania and were midway through their Bachelor of Arts degree. Hence they all had similar factual knowledge and limited conceptual knowledge of weight related issues. For cognitive processes Holistic Personas had problem remembering to carryout routine tasks such as carry eye glasses when they will need to read. However they do remember scholarly facts and understand them as they are in second year of Arts Degree. Regarding items that are raised as issues such as their weight, they need to remember, understand and apply as they have limited conceptual knowledge to understand the issues and procedural knowledge to apply the knowledge gained; '[Holistic Persona] has read about relationships between height, weight and energy content of various foods. She has realised that she is overweight and wishes to reduce her weight (Appendix A and Appendix B). An extended and in-depth design would motivate the Holistic Persona and raise her level of engagement so that she pursues her goals. Some of the principles that Bonk and Khoo (2014) suggested to motivate users and have them committed to the use of an application are:

1. Making the design safe, comfortable and provide for a sense of belonging
2. Providing feedback for encouragement and support
3. Providing Intriguing and surprising measures

4. Making the use of application fun
5. Providing choice and opportunities
6. Making the use of the application meaningful and interesting,
7. Providing opportunities for collaboration and team based activity
8. Making the application engaging and challenging
9. Providing challenging Features
10. Providing a purpose and goal

The design that considers any of the above suggestions is considered extended design. Other design criteria that show extension in design are: a suggestive application for an extravert, an informative application for an emotionally stable personality, a directive application for a person who is not emotionally stable and use encouragement or peer pressure as appropriate to the personality.

Qualitative assessment of the personality consideration in design

Rubric reference Number: 6

Rubric reference Name: personality consideration in design

Description: Qualitative assessment of the personality consideration in design clarifies how knowledgeable the designers were in use of personality in the design work that they produced. There are a number of points in the experiment that make the designers aware of the personality dimension of the Holistic Persona:

- Self-assessed Personality questionnaire
- Holistic Persona personality assessment
- Questions about liking the Holistic Persona personality

The design and post design questionnaire is assessed qualitatively to evaluate the designer's awareness of the personality dimension of the Holistic Persona during the design activity. On most occasions such consideration is incorporated into the conceptual design, but some designers only show awareness of the personality of the Holistic Persona without incorporating this in their design work. This awareness is expressed either during their design work or in answering to the questions without including these into conceptual design. Hence they are aware of the personality of the Holistic Persona but due to lack of knowledge of how to handle personality issues, they have not incorporated these in the design. All anecdotal evidences are considered in assessing the design work. In addition to design notes, the following design and post design questionnaire are taken into consideration while assessing the design activities for this topic:

S 1.The personality of the Holistic Persona positively influenced the scenario writing / design activity: the participant can select their answers based on a five point Likert scale, strongly disagree to strongly agree.

S 2.To meet the Holistic Persona's needs, I added features to the design which otherwise I would not have added: In study I, the participant can select from either Yes or No option. In studies II and III, the participant can select their answers based on a five point Likert scale, strongly disagree to strongly agree.

S 3.Comments on the features added: the participant can enter her/his comments.

A positive answer to the question S1 indicates that the designer was aware of the personality of the Holistic Persona. A positive answer to question S2 indicates that the designer attempted to include features that match the Holistic Persona needs. The additional explanation in S3 provides insight into how the designer incorporated the needs (whether it is the Holistic Persona's personality or other dimensions) into her/his design.

In analysis of the design notes I took into consideration that some of the participants lacked professional experience; within a time frame of about fifteen minutes they would be required to read and comprehend a Holistic Persona and her needs and prepare a design which would assist the Holistic Persona. These were significant and demanding tasks. The range of designs including the level of detail and quality was varied making objective assessment of the consideration given to the personality of the Holistic Persona in the design a difficult task. Hence a qualitative analysis of the design work is used for this topic using the following categorisation:

- N – Not considered: For study I the participants offered a generic design or for studies II and III the participants offered one design for all four Holistic Personas. In cases where a participant offered different designs for each of the Holistic Personas but the participant did not explain how each of the different designs would suit each one of the Holistic Personas, the designs were considered generic designs. In such cases, in order to assess whether the participant has considered the personality of the Holistic Persona in her/his design work, design and post design questionnaires were examined.

If in the post design questionnaire the participant answers were negative or neutral to the statements S1 and S2, and in S3 no meaningful comment inserted or no additional features relevant to the use of the application by the Holistic Persona were mentioned then for that design, the personality of the Holistic Persona has not been considered.

- C – Considered: The participant offered an explanation in the design notes but the explanation is not adequate or cannot be supported by literature. In cases where they were asked to provide multiple designs for a number of Holistic Personas (study II and III), the participant offered varied design for every Holistic Personas especially if the design was an attempt to be tailored to the Holistic Persona's personality and participant provided some reasoning how the different designs would suit each one of the Holistic Personas. In this case the participant has considered the personality of the Holistic Persona. If the design notes does not refer to the personality of the Holistic persona design and post design questionnaires were examined.

If in the post design questionnaire the participant answered positively to the statements S1 and S2 above, the design can be classed as considered the personality of the Holistic Persona. This is strengthened by the participant adding some notes on the extra feature or features she/he has added to the design so that the software application or the product match the personality of the Holistic Persona.

- I – In-depth: The design reflects that the participant has considered the personality in the design and there is literature support for the suitability of the design to the Holistic Persona's personality.

Following are few examples of literature illustrating personality differences and their effect on use of technology. Lane and Manner (2011) in a study of a sample of 312 participants reported that extraverts were more likely to own a smart phone and used it more often for texting messages. In the same study Lane and Manner (2011) found that agreeable personalities used the smart phone for voice communication. Devaraj et al. (2008) in a study of the technology acceptance and the personality traits reports that extraverts are more likely to use technology; extraverts are also more likely to act based on the opinions of those whom they consider as significant. A number of researchers have reported that extraverts prefer to use applications on their mobile phone (Butt and Phillips 2008, Chittaranjan et al. 2011, Oliveira et al. 2013). Correa et al. (2010) conducted an study of the personality, gender and social media use based on a sample of 959 adult population in US and concluded that extraverted personalities, especially young adults and emotionally unstable, mature men were regular users of social media. Correa et al. (2010) speculate that emotionally unstable people have more time to think over their communication hence they prefer online communication.

Is the design in problem space

Rubric reference Number: 7

Rubric reference Name: Is the design in problem space

Description: Qualitative assessment of the design which addressed the weight or memory issues. The following categories are used:

Y – If in any part of the design helps the Holistic Persona to overcome the stated problems of weight issues or remind her about sun cream or glasses

N – If the designs offered does not help the Holistic Persona in her weight or memory issues but assist her purely in other areas such as her study or musical ability.

Appendix P : UCD Rubric - Examples of Marks Allocated

Examples of the design and mark allocation:

In the examples below, marks are assigned progressively as details of each design are evaluated.

Example 1

Participant Id: 1019

Holistic Persona: Katie

Consent to quote: Yes

Motivating Requirements:

Music event calendar/forum

Social event with friends

Connected app

Design activity marks: 4

Design Artefact:

Music listening/recommendation software: Based on the bands she currently listens to, this software will recommend similar artists. Also may work with individual songs, maybe like last.fm. There may also be features which alert her to bands playing locally, and upcoming events such as new releases. Would also provide or take into account review scores from online sources (e.g. Pitchfork). There would also be a community centered around the discussion of music. Would also allow for easy recommendation of albums from the user to other users. Would also allow for events to be created by users, for users to attend.

Analysis of design activity, mark allocation and the impetus requirement:

1 mark –

- The participant makes mention of a software application or product that is to be used by the Holistic Persona – it is not relevant to issues Katie faces but the designer thought the application is useful for Katie:
 - *Music listening/recommendation software*
 - Motivating requirement: music listening

3 marks –

- It does have feature to deposit and retrieve information:

- *Based on the bands she currently listens to, this software will recommend similar artists. Also may work with individual songs*

- Motivating requirement: music calendar/forum/recommender

4 marks –

- The application is connected on line and is mobile:
 - *There may also be features which alert her to bands playing locally, and upcoming events such as new releases.*
 - *Would also provide or take into account review scores from online sources (e.g. Pitchfork).*
 - *This software may be on her phone or another portable device, so she can easily carry it around with her at all times*
- Motivating requirement: music calendar/forum
- The design provides for connectedness with other systems and applications:
 - *Would also allow for easy recommendation of albums from the user to other users.*
 - *Would also allow for events to be created by users, for users to attend.*
- Motivating requirement: music recommender; share events with friends

Example 2

Participant Id: 1020

Holistic Persona: Minty

Consent to quote: Yes

Design activity marks: 2

Design Activity entries:

Software -The software needs to be able to cater for her allergies to peanut butter

-The software needs to also remind her about her glasses Minty will use my software when she goes out with her friends to eat or driving.

Analysis of design activity and mark allocation:

1 mark –

- The participant makes mention of a software application or product that is to be used by the Holistic Persona:
 - *Minty will use my software when she goes out with her friends to eat or driving*

2 marks –

- A participant has provided a description of what the software application or product is expected to do, but the description does not demonstrate how the software application or product functions:
 - *The software needs to be able to cater for her allergies to peanut butter*

Example 3

Participant Id: 1021

Holistic Persona: Doris

Consent to quote: Yes

Design activity marks: 2

Design Activity entries:

Doris is an amazing person with an interest in helping others. I can respect her choices in clubs and activities. She should probably make a reminder list for before she leaves the house and in case she forgets important allergies. Unless Doria actually reduces her weight, the thinking is not proactive enough to create any kind of positive end result.

Analysis of design activity and mark allocation:

1 mark –

- The participant makes mention of a software application or product that is to be used by the Holistic Persona:
 - *Doris ... should probably make a reminder list*

2 marks –

- The participant has provided a description of the software application or product, but the description does not demonstrate how the software application or product functions:
 - *She should probably make a reminder list for before she leaves the house and in case she forgets important allergies. Unless Doria actually reduces her weight, the thinking is not proactive enough to create any kind of positive end result.*
 - Motivating requirement: reduce weight - willingness and mental attitude

Example 4

Participant Id: 1026

Holistic Persona: Doris

Consent to quote: Yes

Design activity marks: 5

Design Activity entry:

Doris seems forgetful with some important things so she should potentially have a software application that automatically reminds her of these things at the required times. This software may be on her phone or another portable device, so she can easily carry it around with her at all times. It will notify her (with a noise or vibration) at slightly before meal times, to mention that she is allergic to food, while ordering food. It will also have a small device attached to her glasses case, and she gets notified by the software once she is more than a certain distance away from her glasses (if she forgets them when leaving home). This same device can be attached to Doris' sun-screen lotion container. The sensor is only a very small size and does not add much weight or size to whatever it is attached to (glasses case, sun-screen lotion, etc).

Analysis of design activity and mark allocation:

3 marks –

- Reminder application:
 - *reminds her of these things at the required times*
- It does have a database to deposit and retrieve information:
 - *software application that automatically reminds her*
 - Motivating requirement: reminder application; single user application

4 marks –

- It can be deducted that the application is connected on line:
 - *This software may be on her phone or another portable device, so she can easily carry it around with her at all times*
 - Motivating requirement: mobile application
- It is not clear if the design is to provides information or reminder by detecting location or is only based on meal time; but as it is on mobile phone it can be assumed that the application detects location and time:
 - *It will notify her (with a noise or vibration) at slightly before meal times*

5 marks –

- It has features that can act as automated reminder. The implementation of the reminder features are clever concept:
 - *It will also have a small device attached to her glasses case, and she gets notified by the software once she is more than a certain distance away from her glasses (if she forgets them when leaving home).*
 - *This same device can be attached to Doris' sun-screen lotion container. The sensor is only a very small size and does not add much weight or size to whatever it is attached to (glasses case, sun-screen lotion, etc).*

Example 5

Participant Id: 1048

Holistic Persona: Katie

Consent to quote: Yes

Scored mark for this part: 5

Design Activity entries:

Reminder application. Have a location-aware feature that reminds her when she is leaving the house to: take her glasses, and take sunscreen. Also, analyse her calendar for dinner events so the app can remind her to tell everyone about her peanut allergy. When she is getting ready to leave for a day out with her friends, she is just about to head out the door when her phone buzzes with a notification on the screen: "Take glasses and sunscreen!" or any other predetermined message she chooses. Or, as she arrives at a dinner events, just as the menus are passed around, her phone buzzes again with a reminder: "Peanut allergy!". She is then able to pass along that information to the people ordering the food.

Analysis of design activity and mark allocation:

3 marks –

- The design is for a reminder application:
 - *Reminder application*
- It does have a database to deposit and retrieve information:
 - *analyse her calendar for dinner events so the app can remind her to tell everyone about her peanut allergy.*
 - *she is just about to head out the door when her phone buzzes with a notification on the screen*
 - *or any other predetermined message she chooses*

4 marks –

- It can be deducted that the application is connected:
 - *Have a location-aware feature that reminds her when she is leaving the house*
 - *as she arrives at a dinner events, just as the menus are passed around .*

5 marks -

- It has features that can analyse and advise:
 - *Also, analyse her calendar for dinner events*
 - *app can remind her to tell everyone about her peanut allergy*

Example 6

Participant Id: 1029

Holistic Persona: Doris

Consent to quote: Yes

Design mark: 5

Design Activity entries:

A Virtual Diary / Reminder Application. The virtual diary allows for entries based on various user designed topics or sub topics, weather that be health food ideas or new music that they enjoyed, or information relating to her social activities. The reminder application will utilize multiple parts of a phones system (assuming that such a social girl would have a relatively advanced phone). First it would sync and use a calender to keep track of her activities past and future and send periodic reminders based on these entries. It would also use the GPS to track if she is leaving her 'home' and to remind her to take her glasses and sunscreen or anything else she may wish to remind herself of. The various features of this suggested software could also include things within the virtual diary about her peanut allergy, guitar chords, good local restaurants, etc.

Analysis of design activity and mark allocation:

3 marks –

- The design is for an internet based application:
 - *A Virtual Diary / Reminder Application*
- It does have a database to deposit and retrieve information:
 - *or information relating to her social activities*
 - *First it would sync and use a calender to keep track of her activities past and future*

4 marks –

- It can be deducted that the application utilises GPS and other connectedness:
 - *The reminder application will utilize multiple parts of a phones system*
 - *It would also use the GPS to track if she is leaving her 'home'*

5 marks -

- It has features that can act as advisory function:
 - *The virtual diary allows for entries based on various user designed topics or sub topics, weather that be health food ideas or new music that they enjoyed*
 - *track if she is leaving her 'home' and to remind her to take her glasses and sunscreen or anything else she may wish to remind herself of*

Example 7

Participant Id: 1042

Holistic Persona: Eliza

Consent to quote: Yes

Design mark: 5

Design Activity entries:

I recommend a software program that is heavily user input based, as this will give her something to escape to in certain social situations. It should be suggestive rather than informative, and give her clear instructions as to what to eat next.

The program should also give her goals (realistic) as to improve her self esteem. Could possibly opt in to contact other people who need to go to the gym, as it is often a very socially intimidating place for overweight people. Situation she could use it would be when she is out at a restaurant and needs something to distract her when she does not wish to continue speaking to her friends or anyone else.

Analysis of design activity and mark allocation:

3 marks –

- The design does have a database to deposit and retrieve information:
 - *user input based*
 - *give her clear instructions as to what to eat next*

4 marks –

- It can be deducted that the application utilises GPS and other connectedness:
 - *heavily user input based, as this will give her something to escape to in certain social situations*
 - *Situation she could use it would be when she is out at a restaurant*

5 marks -

- It has features that can act as advisory function:
 - *It should be suggestive rather than informative, and give her clear instructions as to what to eat next*
 - *The program should also give her goals (realistic) as to improve her self esteem.*
 - *Could possibly opt in to contact other people who need to go to the gym, as it is often a very socially intimidating place for overweight people.*

Scenario - examples of the assessment

In the examples below, marks are assigned progressively as details of each design are evaluated.

Participant Id: 1020

Holistic Persona: Minty

Consent to quote: Yes

Scenario mark: 1

Design Activity entries:

Software -The software needs to be able to cater for her allergies to peanut butter
-The software needs to also remind her about her glasses Minty will use my software when she goes out with her friends to eat or driving.

Analysis of design activity / scenario writing and mark allocation:

1 mark – The designer demonstrated that the application is to be used by Minty however in the following two statements very little information is given about how to use the application:

- *The software needs to be able to cater for her allergies to peanut butter*
- *Minty will use my software when she goes out with her friends to eat or driving*

Participant Id: 1021

Holistic Persona: Doris

Consent to quote: Yes

Scenario mark: 2

Design Activity entries:

Doris is an amazing person with an interest in helping others. I can respect her choices in clubs and activities. She should probably make a reminder list for before she leaves the house and in case she forgets important allergies. Unless Doria actually reduces her weight, the thinking is not proactive enough to create any kind of positive end result.

Analysis of design activity / scenario writing and mark allocation:

2 marks – An interaction with the design is given which clarifies the conceptual design is prepare a list of items to remind the Holistic Persona Doris:

- *make a reminder list for before she leaves the house*

Participant Id: 1026

Holistic Persona: Doris

Consent to quote: Yes

Scenario mark: 3**Design Activity entries:**

Doris seems forgetful with some important things so she should potentially have a software application that automatically reminds her of these things at the required times. This software may be on her phone or another portable device, so she can easily carry it around with her at all times. It will notify her (with a noise or vibration) at slightly before meal times, to mention that she is allergic to food, while ordering food. It will also have a small device attached to her glasses case, and she gets notified by the software once she is more than a certain distance away from her glasses (if she forgets them when leaving home). This same device can be attached to Doris' sun-screen lotion container. The sensor is only a very small size and does not add much weight or size to whatever it is attached to (glasses case, sun-screen lotion, etc).

Analysis of design activity / scenario writing and mark allocation:

3 mark –

- The design is for Holistic Persona Doris:
 - *Doris seems forgetful with some important things*
- The scenarios are detailed out in design notes; the scenarios clarifies the design:
 - *It will notify her (with a noise or vibration) at slightly before meal times*
 - *she gets notified by the software once she is more than a certain distance away from her glasses (if she forgets them when leaving home)*

Examples of the mark allocation due to factual information:

In the examples below, marks are assigned cumulatively as details of each design are evaluated.

Participant Id: 1020

Holistic Persona: Minty

Consent to quote: Yes

Factual Information marks: 1.5

Design Activity entries:

Software -The software needs to be able to cater for her allergies to peanut butter

-The software needs to also remind her about her glasses Minty will use my software when she goes out with her friends to eat or driving.

Analysis of design activity / scenario writing and mark allocation for factual information:

0.5 marks –

- The designer refers to Holistic Persona by name:
 - *Minty will use my software when she goes out with her friends to eat or driving*

0.5 marks –

- The designer refers to Holistic Persona allergy:
 - *The software needs to be able to cater for her allergies to peanut butter*

0.5 marks –

- The designer refers to Holistic Persona short sightedness:
 - *The software needs to also remind her about her glasses*

Participant Id: 1021

Holistic Persona: Doris

Consent to quote: Yes

Factual Information marks: 1.5

Design Activity entries:

Doris is an amazing person with an interest in helping others. I can respect her choices in clubs and activities. She should probably make a reminder list for before she leaves the house and in case she forgets important allergies. Unless Doris actually reduces her weight, the thinking is not proactive enough to create any kind of positive end result.

Analysis of design activity / scenario writing and mark allocation for factual information:

0.5 marks –

- The designer refers to Holistic Persona by name:
 - *Doris is an amazing person*
 - *Unless Doris actually reduces ...*

0.5 marks –

- The designer refers to Holistic Persona allergy:
 - *in case she forgets important allergies*

0.5 marks –

- The designer implicitly refers to Holistic Persona short sightedness and skin lotion by referring to them collectively as a reminder list; hence 0.5 mark given:
 - *make a reminder list for before she leaves the house*

Participant Id: 1026

Holistic Persona: Doris

Consent to quote: Yes

Factual Information marks: 2

Design Activity entries:

Doris seems forgetful with some important things so she should potentially have a software application that automatically reminds her of these things at the required times. This software may be on her phone or another portable device, so she can easily carry it around with her at all times. It will notify her (with a noise or vibration) at slightly before meal times, to mention that she is allergic to food, while ordering food. It will also have a small device attached to her glasses case, and she gets notified by the software once she is more than a certain distance away from her glasses (if she forgets them when leaving home). This same device can be attached to Doris' sun-screen lotion container. The sensor is only a very small size and does not add much weight or size to whatever it is attached to (glasses case, sun-screen lotion, etc).

Analysis of design activity / scenario writing and mark allocation for factual information:

0.5 marks

- The designer refers to Holistic Persona by name:
 - *Doris seems forgetful*

0.5 marks

- The designer refers to Holistic Persona allergy:
 - *to mention that she is allergic to food, while ordering food*

0.5 marks

- The designer refers to Holistic Persona short sightedness:
 - *It will also have a small device attached to her glasses case, and she gets notified by the software*

0.5 marks –

- The designer refers to Holistic Persona skin lotion:
 - *This same device can be attached to Doris' sun-screen lotion container*

Examples of the mark allocation due to weight issue:

Participant Id: 1020

Holistic Persona: Minty

Consent to quote: Yes

Marks for addressing weight issue: 0

Design Activity entries:

*Software -The software needs to be able to cater for her allergies to peanut butter
-The software needs to also remind her about her glasses Minty will use my software
when she goes out with her friends to eat or driving.*

Analysis of design activity and mark allocation to weight issue:

0 mark –

- Food has been mentioned but in relation to allergy:
 - *Minty will use my software when she goes out with her friends to eat or driving*

Participant Id: 1021

Holistic Persona: Doris

Consent to quote: Yes

Marks for addressing weight issue: 0.5

Design Activity entries:

*Doris is an amazing person with an interest in helping others. I can respect her choices
in clubs and activities. She should probably make a reminder list for before she leaves the
house and in case she forgets important allergies. Unless Doria actually reduces her
weight, the thinking is not proactive enough to create any kind of positive end result.*

Analysis of design activity and mark allocation to weight issue:

0.5 mark –

- Weight is mentioned in context of personality:
 - *Unless Doria actually reduces her weight, the thinking is not proactive enough to
create any kind of positive end result.*

Participant Id: 1025

Holistic Persona: Minty

Consent to quote: Yes

Marks for addressing weight issue: 2

Design Activity entries:

*A product that will allow Minty to keep track of what she eats--both for allergies and
taking care of weight. An app that will allow Minty to plan her meals a week at a time,*

keep track of her exercise, and tell her if she is eating too much based upon her exercise regime. Minty sits down and plans her week of eating and exercising, and how much she will eat vs/ exercise. As the week goes on, she will keep track of how she sticks to her plan. The app will send off an alarm if she goes over her carb to exercise ratio.

Analysis of design activity and mark allocation to weight issue:

0.5 mark –

- In the design weight is considered:
 - *A product that will allow Minty to keep track of what she eats--both for allergies and taking care of weight.*

2 mark –

- Providing feature to address the weight issue by planning both food intake and exercise:
 - *to plan her meals a week at a time, keep track of her exercise*
 - *tell her if she is eating too much based upon her exercise regime*
- Providing planning and warning features:
 - *Minty sits down and plans her week of eating and exercising, and how much she will eat vs/ exercise.*
 - *As the week goes on, she will keep track of how she sticks to her plan*
 - *The app will send off an alarm if she goes over her carb to exercise ratio*

Participant Id: 1026

Holistic Persona: Doris

Consent to quote: Yes

Marks for addressing weight issue: 0

Design Activity entry:

Doris seems forgetful with some important things so she should potentially have a software application that automatically reminds her of these things at the required times. This software may be on her phone or another portable device, so she can easily carry it around with her at all times. It will notify her (with a noise or vibration) at slightly before meal times, to mention that she is allergic to food, while ordering food. It will also have a small device attached to her glasses case, and she gets notified by the software once she is more than a certain distance away from her glasses (if she forgets them when leaving home). This same device can be attached to Doris' sun-screen lotion container. The sensor is only a very small size and does not add much weight or size to whatever it is attached to (glasses case, sun-screen lotion, etc).

Analysis of design activity and mark allocation to weight issue:

0 mark –

- Food has been mentioned but in relation to allergy:

- *It will notify her (with a noise or vibration) at slightly before meal times, to mention that she is allergic to food, while ordering food.*

Participant Id: 1048

Holistic Persona: Katie

Consent to quote: Yes

Marks for addressing weight issue: 0

Design Activity entries:

Reminder application. Have a location-aware feature that reminds her when she is leaving the house to: take her glasses, and take sunscreen. Also, analyse her calendar for dinner events so the app can remind her to tell everyone about her peanut allergy. When she is getting ready to leave for a day out with her friends, she is just about to head out the door when her phone buzzes with a notification on the screen: "Take glasses and sunscreen!" or any other predetermined message she chooses. Or, as she arrives at a dinner events, just as the menus are passed around, her phone buzzes again with a reminder: "Peanut allergy!". She is then able to pass along that information to the people ordering the food.

Analysis of design activity and mark allocation to weight issue:

0 mark –

- The design is for reminder application only. No mention of weight or exercise was made.

Participant Id: 1029

Holistic Persona: Doris

Consent to quote: Yes

Marks for addressing weight issue: 0.5

Design Activity entries:

A Virtual Diary / Reminder Application. The virtual diary allows for entries based on various user designed topics or sub topics, weather that be health food ideas or new music that they enjoyed, or information relating to her social activities. The reminder application will utilize multiple parts of a phones system (assuming that such a social girl would have a relatively advanced phone). First it would sync and use a calender to keep track of her activities past and future and send periodic reminders based on these entries. It would also use the GPS to track if she is leaving her 'home' and to remind her to take her glasses and sunscreen or anything else she may wish to remind herself of. The various features of this suggested software could also include things within the virtual diary about her peanut allergy, guitar chords, good local restaurants, etc.

Analysis of design activity and mark allocation to weight issue:

0.5 mark –

- Mentions food in context of managing weight issue:

- *The virtual diary allows for entries based on various user designed topics or sub topics, weather that be health food ideas*

1 mark –

- The health food topics suggested are educational and builds Doris' knowledge and hence motivation. Also the application suggested is a reminder application that can be set by Doris. Hence she will set it to remind herself about food and exercise:
 - *The virtual diary allows for entries based on various user designed topics or sub topics, weather that be health food ideas*

Participant Id: 1035

Holistic Persona: Doris

Consent to quote: Yes

Marks for addressing weight issue: 2

Design Activity entries:

A software product that can help a user lose weight. By entering all the food they eat in a day, users will be able to keep track of how much they have eaten to ensure that they do not overeat. They can see graphical information about what they eat, and hints for how to improve their diet, such as reducing the foods with high fat, or having more protein etc. The product will provide information on how much the user should eat per day to ensure that they keep losing weight until they are within a good weight range. Doris is out for lunch at a cafe with some of her friends. She orders a coffee with a slice of cake, and records this information down in the application so that it can track her food consumption. The application tells her that she is only allowed a very healthy dinner due to her eating cake for lunch.

Analysis of design activity and mark allocation to weight issue:

0.5 mark –

- In the design weight is considered:
 - *A software product that can help a user lose weight*

1 mark –

- Providing feature to address the weight issue by food intake:
 - *By entering all the food they eat in a day, users will be able to keep track of how much they have eaten to ensure that they do not overeat.*

2 mark –

- Providing feature to address the weight issue by planning exercise:
 - *to plan her meals a week at a time, keep track of her exercise*
 - *tell her if she is eating too much based upon her exercise regime*
- Providing planning and warning features:
 - *They can see graphical information about what they eat*

- *hints for how to improve their diet, such as reducing the foods with high fat, or having more protein etc.*
- *The product will provide information on how much the user should eat per day to ensure that they keep losing weight until they are within a good weight range.*
- *Doris is out for lunch at a cafe with some of her friends. She orders a coffee with a slice of cake, and records this information down in the application so that it can track her food consumption. The application tells her that she is only allowed a very healthy dinner due to her eating cake for lunch.*

Participant Id: 1042

Holistic Persona: Eliza

Consent to quote: Yes

Marks for addressing weight issue: 2

Design Activity entries:

I recommend a software program that is heavily user input based, as this will give her something to escape to in certain social situations. It should be suggestive rather than informative, and give her clear instructions as to what to eat next.

The program should also give her goals (realistic) as to improve her self esteem. Could possibly opt in to contact other people who need to go to the gym, as it is often a very socially intimidating place for overweight people. Situation she could use it would be when she is out at a restaurant and needs something to distract her when she does not wish to continue speaking to her friends or anyone else.

Analysis of design activity and mark allocation to weight issue:

0.5 mark –

- In the design weight is considered:
 - *need to go to the gym*

2 mark –

- Providing advanced feature to address the weight issue by suggesting building confidence for visiting gym. Building confidence has longer lasting and stronger affect:
 - *The program should also give her goals (realistic) as to improve her self esteem.*
 - *Could possibly opt in to contact other people who need to go to the gym, as it is often a very socially intimidating place for overweight people*

Examples of the mark allocation to suitability of design to Holistic Persona:

Participant Id: 1019

Holistic Persona: Katie

Consent to quote: Yes

Mark allocation to suitability of design to Holistic Persona: 2

Design Activity entries:

Music listening/recommendation software: Based on the bands she currently listens to, this software will recommend similar artists. Also may work with individual songs, maybe like last. fm. There may also be features which alert her to bands playing locally, and upcoming events such as new releases. Would also provide or take into account review scores from online sources (e.g. Pitchfork). There would also be a community centered around the discussion of music. Would also allow for easy recommendation of albums from the user to other users. Would also allow for events to be created by users, for users to attend.

Other entries: The answers provided to post design questionnaire is as follows:

- S 1. My scenario writing / design activity was with Holistic Persona: *Katie*
- S 2. I found that the scenario writing / design activity was easy: *Neither agree nor disagree*
- S 3. I was totally engaged with the Holistic Persona's personality while carrying out the scenario writing / design activity: *Neither agree nor disagree*
- S 4. The personality of the Holistic Persona positively influenced the scenario writing / design activity: *Agree moderately*
- S 5. To meet the Holistic Persona's needs, I added features to the design which otherwise I would not have added: *No*
- S 6. Comments on the features added:
- S 7. I would like to do another scenario writing / design activity with the same Holistic Persona or a persona that has similar personality again: *Yes*
- S 8. I was thinking of a real person that I know when I was conducting the design: *No*
- S 9. The person I was thinking had same personality as the Holistic Persona: *No*
- S 10. For my future design activity, if I have to choose only one Holistic Persona I would choose: *I cannot remember the name*
- S 11. Comments on my choice of Holistic Persona: *I mainly focused on the music side of Katie's personality. Didn't really relate to most of the rest of it.*

Analysis of design activity and mark allocation to suitability of the design to Holistic Persona:

2 mark –

- The designer has put forward music ideas or added music related features to make the design suitable to Katie.
 - *Based on the bands she currently listens to, this software will recommend similar artists.*
- The design notes show that the designer added features that are related to social aspect of Katie's personality traits, hence the Holistic Persona might use the product:
 - *There would also be a community centered around the discussion of music.*
 - *Would also allow for easy recommendation of albums from the user to other users.*
 - *Would also allow for events to be created by users, for users to attend*
- Analysis of post design questionnaire indicate the designer was aware of the Katie's personality and connected with musical aspect of Katie:
 - Answer to Q 3 indicates that the designer's engagement with the personality of Holistic Persona was neutral.
 - Answer to Q 4 indicates that the personality of the Holistic Persona moderately positively influenced the scenario writing / design activity. However the designer does not elaborate what this effect has been. There was no answer to Q 6.
 - Answer to Q 7 indicates that the designer wishes to do more design with the same Katie and from answer to Q 10 and Q 11 it is evident that the designer would prefer musical aspect of the Holistic Personas.

Participant Id: 1020

Holistic Persona: Minty

Consent to quote: Yes

Mark allocation to suitability of design to Holistic Persona: 0

Design Activity entries:

Software -The software needs to be able to cater for her allergies to peanut butter

-The software needs to also remind her about her glasses Minty will use my software when she goes out with her friends to eat or driving.

Other entries: The answers provided to post design questionnaire is as follows:

- Q 1. My scenario writing / design activity was with Holistic Persona: *Minty*
- Q 2. I found that the scenario writing / design activity was easy: *Neither agree nor disagree*
- Q 3. I was totally engaged with the Holistic Persona's personality while carrying out the scenario writing / design activity: *Neither agree nor disagree*
- Q 4. The personality of the Holistic Persona positively influenced the scenario writing / design activity: *Agree moderately*
- Q 5. To meet the Holistic Persona's needs, I added features to the design which otherwise I would not have added: *Yes*
- Q 6. Comments on the features added:

- Q 7. I would like to do another scenario writing / design activity with the same Holistic Persona or a persona that has similar personality again: *No*
- Q 8. I was thinking of a real person that I know when I was conducting the design: *Yes*
- Q 9. The person I was thinking had same personality as the Holistic Persona: *No*
- Q 10. For my future design activity, if I have to choose only one Holistic Persona I would choose: *I cannot remember the name*
- Q 11. Comments on my choice of Holistic Persona:

Analysis of design activity and mark allocation to suitability of the design to Holistic Persona:

o mark –

- The designer has not put forward any ideas or added any special features to make the design suitable to Minty:
- The design notes does not show that the designer has realised the effect the personality traits of the Holistic Persona might have on usability of the product. The designer has not put forward any ideas.
 - o Answer to Q 3 indicates that the designer's engagement with the personality of Holistic Persona was neutral.
 - o Answer to Q 4 indicates that the personality of the Holistic Persona moderately positively influenced the scenario writing / design activity. However the designer does not elaborate what this effect has been. There was no answer to Q 6.
 - o Answer to Q 7 indicates that the designer does not wish to do any design with the same Holistic Persona and from answer to Q 10, it is not known if the designer would prefer any of the Holistic Personas.

Participant Id: 1021

Holistic Persona: Doris

Consent to quote: Yes

Mark allocation to suitability of design to Holistic Persona: 1

Design Activity entries:

Doris is an amazing person with an interest in helping others. I can respect her choices in clubs and activities. She should probably make a reminder list for before she leaves the house and in case she forgets important allergies. Unless Doria actually reduces her weight, the thinking is not proactive enough to create any kind of positive end result.

Other entries: The answers provided to post design questionnaire is as follows:

- Q 1. My scenario writing / design activity was with Holistic Persona: *Doris*
- Q 2. I found that the scenario writing / design activity was easy: *Agree moderately*
- Q 3. I was totally engaged with the Holistic Persona's personality while carrying out the scenario writing / design activity: *Disagree moderately*

- Q 4. The personality of the Holistic Persona positively influenced the scenario writing / design activity: *Agree moderately*
- Q 5. To meet the Holistic Persona's needs, I added features to the design which otherwise I would not have added: *No*
- Q 6. Comments on the features added:
- Q 7. I would like to do another scenario writing / design activity with the same Holistic Persona or a persona that has similar personality again: *No*
- Q 8. I was thinking of a real person that I know when I was conducting the design: *Yes*
- Q 9. The person I was thinking had same personality as the Holistic Persona: *Yes*
- Q 10. For my future design activity, if I have to choose only one Holistic Persona I would choose: *Jade* [Note: Jade's personality is similar to Minty]
- Q 11. Comments on my choice of Holistic Persona:

Analysis of design activity and mark allocation to suitability of the design to Holistic Persona:

1 mark –

- The designer has shown an understanding of Doris personality but has not make any suggestions:
 - *Doris is an amazing person with an interest in helping others. I can respect her choices in clubs and activities.*
 - *Unless Doris actually reduces her weight, the thinking is not proactive enough to create any kind of positive end result.*
- Analysis of post design questionnaire indicate the designer was aware of the Doris's personality but did not have connectedness with Doris:
 - Answer to Q 3 indicates that the designer did not engage with the personality of Doris.
 - Answer to Q 4 indicates that the personality of Doris moderately positively influenced the scenario writing / design activity. However the designer does not elaborate what this effect has been.
 - Answer to Q 7 indicates that the designer does not wish to do any design with Doris. However from answer to Q 10, the designer would prefer Jade. Answers to Q 7 and Q 8 indicate that the designer was thinking of a real person who had same personality as Doris when s/he was conducting the design.

Participant Id: 1023

Holistic Persona: Eliza

Consent to quote: Yes

Marks for suitability of the design to Holistic Persona: 3

Design Activity entries:

An anonymous, public forum of message board where discussion is encouraged. -This would allow Eliza to find groups of people with similar interests, issues, and ideas to discuss and socialize with reduced pressure from her introverted personality (since the application is online and anonymous). -When she would otherwise be under too much social anxiety or has been previously rejected in face-to-face conversations, an online forum would allow group discussion and input from other users who are much more likely to empathize. This can also boost self-esteem from the support other users are likely to provide.

Other entries: The answers provided to post design questionnaire is as follows:

- Q 1. My scenario writing / design activity was with Holistic Persona: *Eliza*
- Q 2. I found that the scenario writing / design activity was easy: *Agree moderately*
- Q 3. I was totally engaged with the Holistic Persona's personality while carrying out the scenario writing / design activity: *Agree strongly*
- Q 4. The personality of the Holistic Persona positively influenced the scenario writing / design activity: *Agree moderately*
- Q 5. To meet the Holistic Persona's needs, I added features to the design which otherwise I would not have added: *Yes*
- Q 6. Comments on the features added: *A typical forum/image board/discussion board is kept under a single theme so that it's users will general share similar interests. The main theme or topic of the forum Eliza would use would be 'users who are introverted'. It would be ideal if the website had several 'sections' for different to pics so she could subscribe to topics such as 'music', 'guitar' as well etc.*
- Q 7. I would like to do another scenario writing / design activity with the same Holistic Persona or a persona that has similar personality again: *No*
- Q 8. I was thinking of a real person that I know when I was conducting the design: *Yes*
- Q 9. The person I was thinking had same personality as the Holistic Persona: *Yes*
- Q 10. For my future design activity, if I have to choose only one Holistic Persona I would choose: *Jade*
- Q 11. Comments on my choice of Holistic Persona: *The most similar to Eliza, easier to relate to.*

Analysis of design activity and mark allocation to suitability of the design to Holistic Persona:

3 mark –

- The design note indicates that the designer has shown an understanding of Eliza's personality. The forum is anonymous and there is no pressure or feeling of rejection.
 - *An anonymous, public forum of message board where discussion is encouraged.*
 -
- Eliza is emotionally not stable, the application does not direct Minty or have peer pressure on her.

- *This would allow Eliza to find groups of people with similar interests, issues, and ideas to discuss and socialize with reduced pressure from her introverted personality (since the application is online and anonymous).*
- *When she would otherwise be under too much social anxiety or has been previously rejected in face-to-face conversations, an online forum would allow group discussion and input from other users who are much more likely to empathize. This can also boost self-esteem from the support other users are likely to provide.*
- Analysis of post design questionnaire indicates the designer was aware of the Eliza's personality The designer has in-depth knowledge to handle personality:
 - Answer to Q 3 indicates that the designer did engage with the personality of Eliza.
 - Answer to Q 4 indicates that the personality of Eliza positively influenced the scenario writing / design activity.
 - Answers to Q 5 and Q 6 indicate that the designer made recommendations to according to Eliza's personality
 - Answer to Q 7 indicates that the designer does not wish to do any design with Eliza. However from answer to Q 10 and Q 11, the designer would prefer to design for Jade who as the designer states about her personality: [Jade] *the most similar to Eliza, easier to relate to*. This indicates the designer is aware that Jade has an introvert personality similar to Eliza but Jade is emotionally stable.
 - Answers to Q 7 and Q 8 indicate that the designer was thinking of a real person who had same personality as Eliza during the design activity. Perhaps the reason his design does not address the issues that Holistic Persona Eliza faces is that he is so engaged with the personality of the real person that he knows and that person may not have the problems the Holistic Persona Eliza has.

Participant Id: 1025

Holistic Persona: Minty

Consent to quote: Yes

Marks for suitability of the design to Holistic Persona: 2

Design Activity entries:

A product that will allow Minty to keep track of what she eats--both for allergies and taking care of weight. An app that will allow Minty to plan her meals a week at a time, keep track of her exercise, and tell her if she is eating too much based upon her exercise regime. Minty sits down and plans her week of eating and exercising, and how much she will eat vs/ exercise. As the week goes on, she will keep track of how she sticks to her plan. The app will send off an alarm if she goes over her carb to exercise ratio.

Other entries: The answers provided to post design questionnaire is as follows:

Q 12. My scenario writing / design activity was with Holistic Persona: *Minty*

- Q 13. I found that the scenario writing / design activity was easy: *Agree moderately*
- Q 14. I was totally engaged with the Holistic Persona's personality while carrying out the scenario writing / design activity: *Disagree moderately*
- Q 15. The personality of the Holistic Persona positively influenced the scenario writing / design activity: *Disagree moderately*
- Q 16. To meet the Holistic Persona's needs, I added features to the design which otherwise I would not have added: *Yes*
- Q 17. Comments on the features added:
- Q 18. I would like to do another scenario writing / design activity with the same Holistic Persona or a persona that has similar personality again: *No*
- Q 19. I was thinking of a real person that I know when I was conducting the design: *No*
- Q 20. The person I was thinking had same personality as the Holistic Persona: *No*
- Q 21. For my future design activity, if I have to choose only one Holistic Persona I would choose: *I cannot remember the name*
- Q 22. Comments on my choice of Holistic Persona: *The one who reminded me of myself.*

Analysis of design activity and mark allocation to suitability of the design to Holistic Persona:

2 mark –

- The design note indicates that the designer has shown an understanding of Minty personality.
 - The application is private. Minty being an introvert likes a private application.
 - Minty is a planner, the application allows Minty to plan.
 - Minty is emotionally stable, the application does not direct Minty or have peer pressure on her.
- One of the Holistic Persona reminds him of himself (see below). Hence he connects to a Holistic Persona.
- Analysis of post design questionnaire indicates the designer was aware of the Minty's personality but does not want to do more design activity with Minty. This is indicative that designer lacks in-depth knowledge to handle personality:
 - Answer to Q 3 indicates that the designer did not engage with the personality of Minty.
 - Answer to Q 4 indicates that the personality of Minty moderately negatively influenced the scenario writing / design activity. The designer does not elaborate what this effect has been.
 - Answer to Q 7 indicates that the designer does not wish to do any design with Minty. However from answer to Q 10 and Q 11, the designer would prefer *The one who reminded me of myself*. From the self-assessment of the personality questionnaire, the designer's personality matches Jean or Kate (Extraversion

80%, Agreeableness 83%, Conscientiousness 48%, Emotional stability 25%, Imagination 83%).

- Answers to Q 7 and Q 8 indicate that the designer was not thinking of a real person who had same personality as Minty during the design activity.

Participant Id: 1026

Holistic Persona: Doris

Consent to quote: Yes

Marks for suitability of the design to Holistic Persona: 2

Design Activity entry:

Doris seems forgetful with some important things so she should potentially have a software application that automatically reminds her of these things at the required times. This software may be on her phone or another portable device, so she can easily carry it around with her at all times. It will notify her (with a noise or vibration) at slightly before meal times, to mention that she is allergic to food, while ordering food. It will also have a small device attached to her glasses case, and she gets notified by the software once she is more than a certain distance away from her glasses (if she forgets them when leaving home). This same device can be attached to Doris' sun-screen lotion container. The sensor is only a very small size and does not add much weight or size to whatever it is attached to (glasses case, sun-screen lotion, etc).

Other entries: The answers provided to post design questionnaire is as follows:

- Q 1. My scenario writing / design activity was with Holistic Persona: *Doris*
- Q 2. I found that the scenario writing / design activity was easy: *Disagree moderately*
- Q 3. I was totally engaged with the Holistic Persona's personality while carrying out the scenario writing / design activity: *Agree strongly*
- Q 4. The personality of the Holistic Persona positively influenced the scenario writing / design activity: *Agree moderately*
- Q 5. To meet the Holistic Persona's needs, I added features to the design which otherwise I would not have added: *Yes*
- Q 6. Comments on the features added: *Features to address issues the character had been facing.*
- Q 7. I would like to do another scenario writing / design activity with the same Holistic Persona or a persona that has similar personality again: *Yes*
- Q 8. I was thinking of a real person that I know when I was conducting the design: *No*
- Q 9. The person I was thinking had same personality as the Holistic Persona: *No*
- Q 10. For my future design activity, if I have to choose only one Holistic Persona I would choose: *I cannot remember the name*
- Q 11. Comments on my choice of Holistic Persona:

Analysis of design activity and mark allocation to suitability of the design to Holistic Persona:

2 mark –

- The design notes shows a design that takes into account the personality of Doris.
 - The application is on mobile phone.
 - *The sensor is only a very small size and does not add much weight or size to whatever it is attached to (glasses case, sun-screen lotion, etc).* Doris like novel and dainty things.
- Analysis of post design questionnaire indicates the designer was aware of the Doris' personality and would like to do more design with Doris (Q 7). The designer connected with Doris and could produce good design but has not extended. This could be due to lack of in-depth knowledge:
 - Answer to Q 3 indicates that the designer did strongly engage with the personality of Doris.
 - Answer to Q 4 indicates that the personality of Doris moderately positively influenced the scenario writing / design activity. The designer in Q 5 and Q 6 mentions that he has added features *to address issues the character had been facing*.
 - Answer to Q 7 indicates that the designer does wish to do more design activity with Doris.
 - Answers to Q 7 and Q 8 indicate that the designer was not thinking of a real person that he knows who had same personality as Doris during the design activity.

Participant Id: 1029

Holistic Persona: Doris

Consent to quote: Yes

Marks for suitability of the design to Holistic Persona: 3

Design Activity entries:

A Virtual Diary / Reminder Application. The virtual diary allows for entries based on various user designed topics or sub topics, weather that be health food ideas or new music that they enjoyed, or information relating to her social activities. The reminder application will utilize multiple parts of a phones system (assuming that such a social girl would have a relatively advanced phone). First it would sync and use a calender to keep track of her activities past and future and send periodic reminders based on these entries. It would also use the GPS to track if she is leaving her 'home' and to remind her to take her glasses and sunscreen or anything else she may wish to remind herself of. The various features of this

suggested software could also include things within the virtual diary about her peanut allergy, guitar chords, good local restaurants, etc.

Other entries: The answers provided to post design questionnaire is as below:

1. My scenario writing / design activity was with Holistic Persona: *Doris*
2. I found that the scenario writing / design activity was easy: *Neither agree nor disagree*
3. I was totally engaged with the Holistic Persona's personality while carrying out the scenario writing / design activity: *Agree moderately*
4. The personality of the Holistic Persona positively influenced the scenario writing / design activity: *Agree moderately*
5. To meet the Holistic Persona's needs, I added features to the design which otherwise I would not have added: *No*
6. Comments on the features added:
7. I would like to do another scenario writing / design activity with the same Holistic Persona or a persona that has similar personality again: *No*
8. I was thinking of a real person that I know when I was conducting the design: *No*
9. The person I was thinking had same personality as the Holistic Persona: *No*
10. For my future design activity, if I have to choose only one Holistic Persona I would choose: *Jade*
11. Comments on my choice of Holistic Persona: *She is not perfect but has a good idea of what she wants, that imperfection yet determination allows for both error handling and specification building.*

Analysis of design activity and mark allocation to suitability of the design to Holistic Persona:

3 mark –

- The designer in the design notes has shown he has good understanding of the Doris personality. The designer connected with Doris and could produce good design which is extended. The designer uses features such as a suggestive design, use of mobile system and is aware that Doris has a busy social life:
 - *The reminder application will utilize multiple parts of a phone's system*
 - *First it would sync and use a calendar to keep track of her activities past and future and send periodic reminders based on these entries.*
 - *assuming that such a social girl would have a relatively advanced phone*
- Analysis of post design questionnaire indicates the designer was aware of the Doris' personality:
 - Answer to Q 3 indicates that the designer engaged with the personality of Doris.
 - Answer to Q 4 indicates that the personality of Doris moderately positively influenced the scenario writing / design activity. The designer in Q 5 and Q 6 does not think that he has added any features.

- Answer to Q 7 indicates that the designer does not wish to do more design activity with Doris.
 - Answers to Q 8 and Q 9 indicate that the designer was not thinking of a real person that he knows who had same personality as Doris during the design activity.
- The designer would like to do more design with Jade or Minty as he find her more challenging Q10 and Q 1.

Examples of the qualitative assessment of the personality consideration in design

Participant Id: 1019

Holistic Persona: Katie

Consent to quote: Yes

personality consideration in design:

Design Activity entries:

Music listening/recommendation software: Based on the bands she currently listens to, this software will recommend similar artists. Also may work with individual songs, maybe like last. fm. There may also be features which alert her to bands playing locally, and upcoming events such as new releases. Would also provide or take into account review scores from online sources (e.g. Pitchfork). There would also be a community centered around the discussion of music. Would also allow for easy recommendation of albums from the user to other users. Would also allow for events to be created by users, for users to attend.

Other entries: The answers provided to post design questionnaire is as follows:

S 1. The personality of the Holistic Persona positively influenced the scenario writing / design activity: *Agree moderately*

S 2. To meet the Holistic Persona's needs, I added features to the design which otherwise I would not have added: *No*

S 3. Comments on the features added:

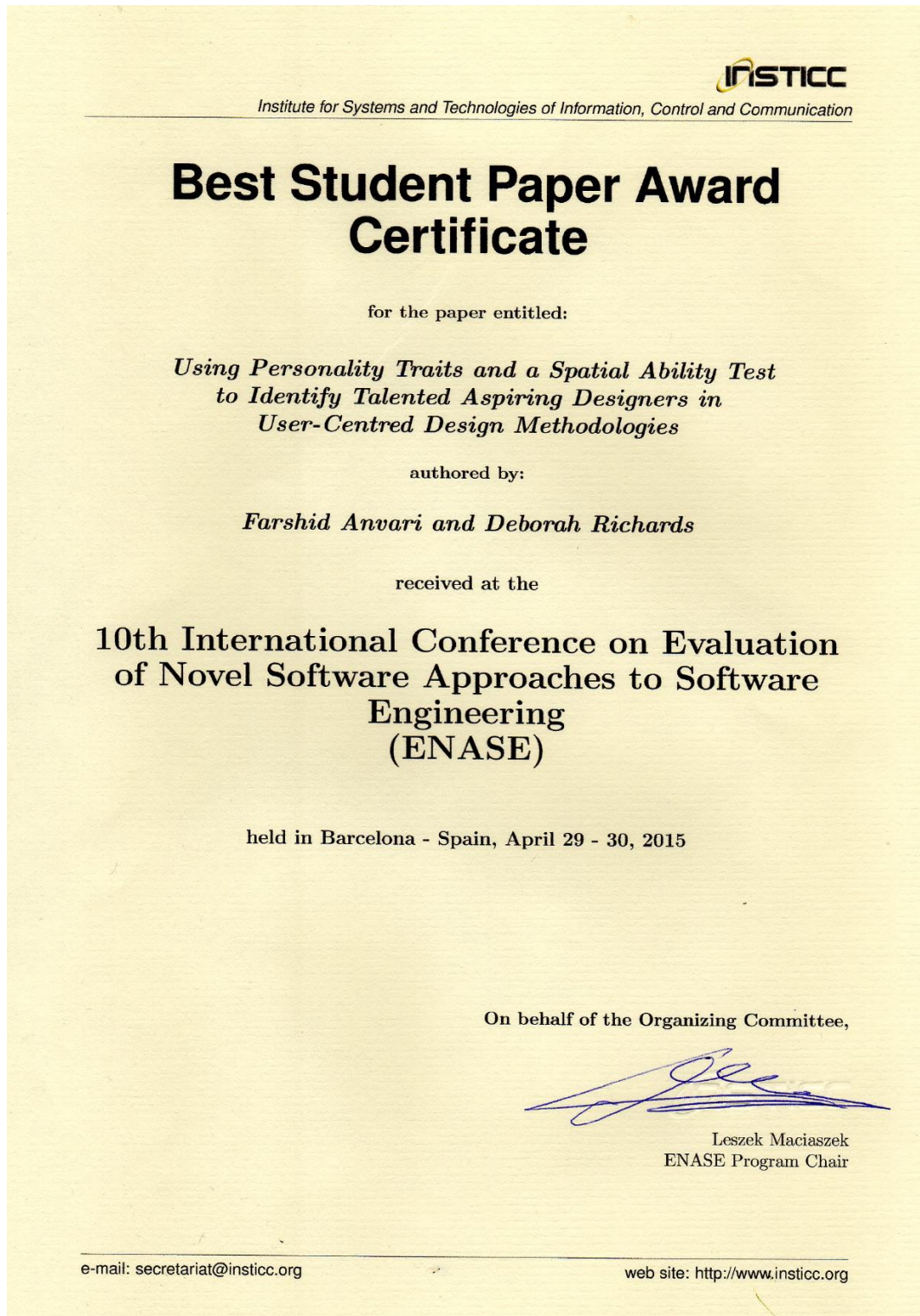
Analysis of design activity and allocation of category to personality consideration in design: C/I

C – Considered / In-depth

- The designer has put forward music ideas or added music related features to make the design suitable to Katie.
 - *Based on the bands she currently listens to, this software will recommend similar artists.*
- The design notes show that the designer added features that are related to social aspect of Katie's personality traits, hence the Holistic Persona might use the product:
 - *There would also be a community centered around the discussion of music.*
 - *Would also allow for easy recommendation of albums from the user to other users.*
 - *Would also allow for events to be created by users, for users to attend*

- Analysis of post design questionnaire indicate the designer was aware of the Katie's personality and connected with musical aspect of Katie:
 - Answer to Q 3 indicates that the designer's engagement with the personality of Holistic Persona was neutral.
 - Answer to Q 4 indicates that the personality of the Holistic Persona moderately positively influenced the scenario writing / design activity. However the designer does not elaborate what this effect has been. There was no answer to Q 6.

Appendix Q : The best student paper award



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