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Multimodal Social Media Product Reviews and Ratings in E-commerce*: *An Empirical Approach

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PhD IN INTERACTIVE INFORMATION SYSTEM

Supervised by Professor Dimitrios Rigas.

2017

Dedication

This research is dedicated to my parents for their support and motivation, my wife for being next to me during this hard journey and being patient throughout the years.

Acknowledgement

I would like to thank my sincere Prof.Rigas for his support to my research and PhD; for his motivation and patience. His presence during difficult times and his guidance helped me in completing this research. For this, I am grateful for not just being my supervisor but also for being my mentor.

List of Publications and Conferences

- Communicating Product User Reviews and Ratings in Interfaces for e-Commerce: A Multimodal Approach- International Conference on HCI in Business, Government and Organizations-Vol. 9751-pp 82-93- Springer International Publishing-2016.
- Best Paper Award -Track: E-business systems and Social Media-MBA- Business and Management Academy International Journal- Brunel University 2015.
- Relationship between Service Quality, Customer Retention and the role of Social Media- Case study Premier Inn Hotel (UK)- Journal of Organization Studies and Innovation-2015.
- Social media influence on the holiday decision making process in the UK (Generation Y) - Journal of Organization Studies and Innovation – 2014.

Abstract

Since the booming of the internet and the ".com" (e-commerce) in the 1990's, everything has changed. This improvement created different areas for researchers to investigate and examine, especially in the fields of human computer interaction and social media. This technological revolution has dramatically changed the way we interact with computers, buy, communicate and share information. This thesis investigates multimodal presentations of social media review and rating messages within an e-commerce interface. Multimodality refers to the communication pattern that goes beyond text to include images, audio and media. Multimodality provides a new way of communication, as images, for example, can deliver an additional information which might be difficult or impossible to communicate using text only. Social media can be defined as a two-way interaction using the internet as the communication medium.The overall hypothesis is that the use of multimodal metaphors (sound and avatars) to present social media product reviews will improve the usability of the e-commerce interface and increase the user understanding, reduce the time needed to make a decision when compared to non-multimodal presentations. E-commerce usability refers to the presentation, accessibility and clarity of information. An experimental e-commerce platform was developed to investigate the particular interactive circumstances that multimodal metaphors may benefit the social media communication of reviews of products to users. The first experiment using three conditions (text with emoji's, earcons and facially expressive avatars) measured the user comprehension, understanding information, user satisfaction with the way in which information was communicated and social media preference in e-commerce. The second experiment investigated the time taken by users to understand information, understanding information correctly, user satisfaction and user enjoyment using three conditions (emoji's, facially expressive avatar and animation clips) in e-commerce platform. The results of the first set experiments of the showed that the text with emoji's and the use of facially expressive avatar conditions had improved the users' performance through understanding information effectively and making decisions quicker compared to the earcons condition. In the second experiment, the results showed that the users performed better (understanding information, understating information faster) using the emoji's and the facially expressive avatar presentations compared to the use of the animation clip condition. A set of empirically derived guidelines to implement these metaphors to communicate social media product reviews in e-commerce interface have been presented.

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Acronyms

HCI	Human Computer Interface.
WUI	Web User Interface.
GUI	Graphical User Interface.
UI	User Interface.
B2B	Business to Business.
B2C	Business to Consumer.
C2C	Consumer to Consumer.
TRP	Textual Rating Presentation.
FRP	Facial Rating Presentation.
ERP	Earcon Rating Presentation.
SUS	System Usability Scale.
LSD	Least Significance Difference.
EMP	Emoji’s Presentation.
AVP	Avatar Presentation.
AMP	Animation Presentation.
UGC	User Generated Content.
WOM	Word of Mouth.
eWOM	Electronic Word of Mouth.

Chapter 1: Introduction

1.1 Introduction

E-commerce can be defined as "*the use of the Internet and other networking technologies for conducting business transactions*" (Turban, E., et al., 2004). E-commerce nowadays is an essential tool for firms to achieve competitive advantage and to survive in the current competitive environment. There were 1.92 trillion US dollars worth of sales globally in 2016 (Statista, 2017). The current modern society has driven most of firms to have e-commerce as a model of survival.

Providing the user interface as a major influence for users to go online, other features, such as previews from previous users' feedback, also play an important part in the users' actions, choices and loyalty when using e-commerce. Information and application design affect the usability perception of users (Balapour and Sabherwal, 2017). Firms across the world have implemented e-commerce and have gained the benefits within business strategy. Just creating a website or simply redesigning it will not bring e-business success. The user interface plays an important part in the success or failure of an e-commerce site. One dramatic achievement stands out in this young field of human-computer interaction -- the use of graphics as a standard and powerful component of the interface (Meera M., Ephraim P., 1996). Previous studies in the human-computer interface and designs suggested that providing more graphics to the users make them perform tasks faster and also that such an approach would enhance the user experience when interfacing with a system. This field has changed the way humans use computers, leaping from a command driven interface to a graphical user interface. In human-computer interaction, the term "modality" usually

refers to the human senses — vision, hearing, touch, smell and taste (Meera M., Ephraim P., 1996). Hence, researchers now are considering these human senses for use in the computer interface. The metamodels' main concept is that an HCI (human-computer interface) modality engages human capabilities to produce an effect in users (Obrenovic Z. and Starcevic D., 2004).

Web 2.0 has provided a new approach and a new type of website where the users can easily make opinions, beliefs and thoughts globally accessible via social media. Sharing information on line is now possible due to Web 2.0 (Scott and Orlikowski, 2012). Social media has changed the way users communicate and interact over the internet. Social media became the platform that allowed the users to create content online, known as user-generated-content. Users are influenced by the people surrounding them (Solomon et al., 2010); which makes social media a powerful tool to share information and product related feedback. Moreover, users mainly rely on online product reviews and ratings before making a purchase; these reviews provided by users are considered to be vital during the purchase decision making process.

Social media is proving to be an important tool for communication as more users are joining or using the platform which gave them a platform for sharing and communicating. In addition to that, the online purchasing is on a rise as shown by Statistica (2017); users are actively engaging on both social media and online purchases more than ever. Moreover, the development in technology has helped in creating and improving the human user interface that helped the users with the computer interaction. Hence, the author research work will focus on "*Multimodal Social Media Product Reviews and Ratings in E-Commerce*".

1.2 Aims

The overall aim of this research is to investigate the impact of the multimodal presentation of social media product reviews on usability, users' perceived enjoyment of e-commerce platforms and to produce a set of empirically derived guidelines for the implementation and design of multimodal social media enriched e-commerce sites. In particular, it will evaluate the usability in terms of effectiveness, efficiency and user satisfaction of the presentation modes. In addition to that, it aims to collect the users' perceived enjoyment while using the interfaces. An experimental e-commerce platform will be developed that will be the basis of this investigation. The multimodal metaphors that will be investigated consist of both visual and auditory metaphors. The visual metaphor that will be tested consists of facial expression avatars, emojis and animation clips; while the auditory metaphors will consist of earcons. Both metaphors will be tested in the context of communicating information to the end user. In addition, social media platforms, as a review source, will be investigated to determine their impact and the users' preferences. Subsequently, investigating social media as a review source and the users' preference in e-commerce. Investigating the use of multimodal metaphors (audio, facial expression avatars, emoji's, animation clips) for enhancing usability of e-commerce and impacting users' enjoyment. Finally, producing a set of empirically derived rules for designing e-commerce, rich with multimodality and social media.

1.3 Objectives

An experimental e-commerce platform was developed to act as a basis for this empirical investigation. This platform was used to perform two experiments with the output of the first experiment used to influence the design the second experiment.

The first experiment will be used to evaluate three conditions:

1. Text with emoji's review presentation (TPR): a presentation condition that illustrates the use of emojis in product review messages.
2. Earcon review presentation (ERP): this is an experimental condition that illustrates the use of short musical files to communicate ratings in product review messages.
3. Facial expression avatar (FRP): this is an experimental condition that illustrates the use of human facial expressions through the implantation of facial expression avatars to communicate ratings in product review messages.

The second experiment evaluated three conditions:

1. Emoji message presentation (EMP): this condition illustrated the use of emojis to communicate product reviews and ratings in an e-commerce interface.
2. Facial expression avatar presentation (AVP): this condition illustrated the use of facial expression avatars to communicate product reviews and messages in an e-commerce interface.
3. Animation clips presentation (AMP): this condition illustrated the use of animation through the use of different avatar characters to communicate reviews and ratings in an e-commerce interface.

The experiments studied the impact of the conditions on the systems' ease of use through measuring efficiency (time needed to complete a task), effectiveness (execute the tasks correctly) and user satisfaction. In addition to that, the first experiment studied the social media preference of the users; and in the second experiment measured the users' perceived enjoyment of the different conditions.

1.4 Overall Hypothesis

The overall hypothesis is that the multimodal metaphors presentation of social media based product reviews enhances the usability of an e-commerce site which in turn improves the effectiveness (in terms of browsing and understanding information), efficiency (understanding the information faster) and user perceived satisfaction and enjoyment when compared to a textual presentation.

1.5 Research Method

The method that was used to carry out this research included a literature survey, an initial experimental study and a further experiment. The data collection process was based on surveys. The experimental approach helped in gathering data related to the impact of social media. Keeping in mind that people usually tend to not use things that they are not familiar with and employ them differently, the second experiment was utilised to explore how acceptable it would be to complete all steps by using multimodal metaphors (audio, facial expressive avatar). This would give an indication of how usable it would be. The final stage was validation for the generated guidelines on using multimodal metaphors to communicate social media reviews and ratings in e-commerce platform.

The experimental e-commerce platform was used to carry a multimodality experiment to measure e-commerce usability. As the researcher is a certified Microsoft professional with development experience, the platform was developed using Microsoft Visual VB.Net 2010. In addition to the researcher's experience in the Microsoft development environment, VB.Net is an efficient web development language. This platform was implemented according to the experimental phases of this research study.

An attempt was made to gather existing information from journal articles, books, e-books and online resources, such as online newspapers and other library databases. Information were also obtained from e-commerce websites, blogs, reports and previous similar studies.

The researcher used a positivistic paradigm which is defined by Bryman & Bell (2007) as an “epistemological position that advocates the application of the methods of the natural sciences to the study of social reality and beyond”. Primary data is the information retrieved directly from sources by means of surveys or experimentation. According to Creswell (1994: 1-2) a quantitative study is “an inquiry into a social or human problem, based on testing a theory composed of variables, measured with numbers, and analysed with statistical procedures, in order to determine whether the predictive generalisations of theory hold true”. With reference to Creswell’s definition of qualitative and quantitative studies this research will be adopting the positivistic method. Here it will allow the study to conclude the impact of multimodality and social media review messages on the e-commerce interface. Figure 1.1 presents the thesis structure.

1.6 Ethical Consideration

Any researcher has a moral and ethical obligation to safeguard information gathered during studies (Veal 2011). In this research has applied and followed ethical guidelines of social research which provides safety of the interests of participants. An ethical approach is of high importance as it assures accurate data collection and analysis. It will be possible to overcome any ethical considerations and points of concern from the users’ or participants’ perspective. There will be a duty to protect the rights of people in the study as well as their privacy.

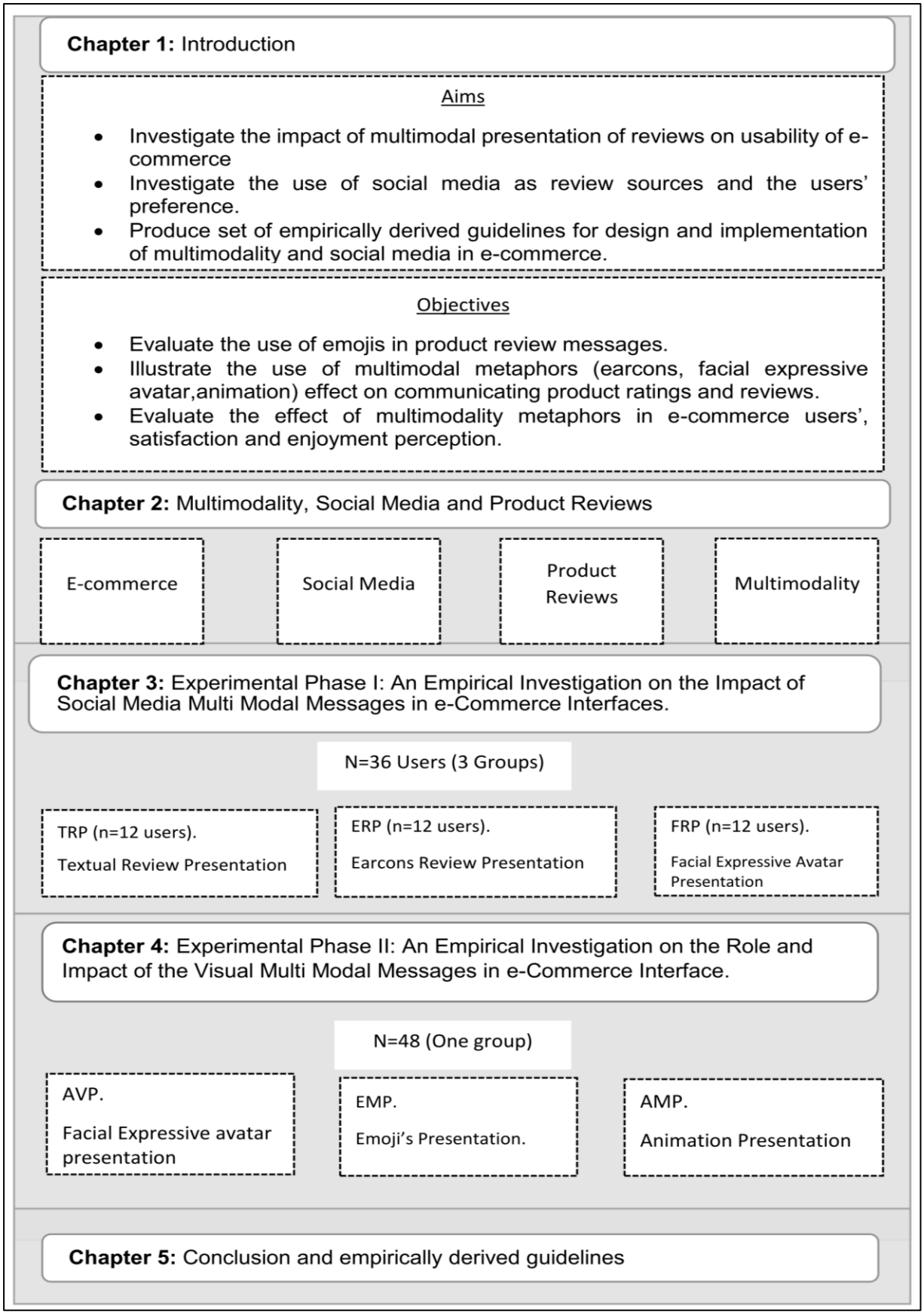


Figure 1.1: Thesis Structure.

The research followed the guide lines of Research Ethics Framework presented by ESRC (2015):

Research should be designed, reviewed and undertaken to ensure integrity and quality.

The confidentiality of information supplied by research subjects and the anonymity of respondents must be respected.

- Research participants must participate in a voluntary way, free from any coercion.
- Harm to research participants must be avoided.
- The independence of research must be clear, and any conflicts of interest or partiality must be explicit.

The research has respected the interest of all participants whatever their gender, age, disability, ethnicity, race, religion or culture. In addition to that the research has avoided any harm to the participant or their families or kin and their communities. The confidentiality of those involved in the study, keeping their anonymity and privacy secure was considered vital. Data obtained and analysed was kept and stored by the University of West London as part of the research, this data can be accessed by the participants when required.

1.7 Contribution

This thesis contributes to the literature of multimodality and social media in e-commerce platforms. The thesis presents an innovative multimodal social media review messages presentation in an e-commerce interface that can be used and

implemented on any e-commerce models. The design combined the use of social media platforms (Facebook, Twitter) as review sources with the multimodal communication metaphors (visual, auditory). The visual multimodal metaphors (emojis, facial expressive avatars, animation) improved the effectiveness, efficiency and user satisfaction when compared to the auditory metaphor (earcons). The thesis gives empirically derived guidelines for the design and implementation of multimodal social media e-commerce platforms. In addition to that, the thesis contributes to the possible development of customisable multimodal review presentation e-commerce pages by allowing users to choose, create and edit the presentation metaphor. The contribution can be summarised in the following:

- The use of emoji's in review messages has improved the user's performance during the tasks' execution and completion. The users managed to finish the tasks faster (efficiency), execute the tasks correctly (effectiveness) and showed higher satisfaction when compared to the use of an audio multimodal metaphor (earcons).
- Employing facial expression avatars in product ratings helped the user to have better performance when compared to another multimodal metaphor (earcons). The users with the aid of the facial expression avatar managed to have better efficiency (less time understanding the information), effectiveness (tasks completed successfully) and user satisfaction when compared to the earcon presentation. Also, the facial expression avatar showed no significant difference in the measurement variables (efficiency, effectiveness, user satisfaction) when compared to the use of text with emoji's.

- The preferred social media source for the product reviews and ratings was Facebook. The users showed a preference for selecting products with reviews sourced from Facebook over products with reviews sourced from Twitter.
- The use of visual multimodal metaphors, emojis, facial expression avatars and animation clips, showed that users could benefit from different review presentation interfaces. The use of emoji's or facial expression avatars facilitated communication of a high number of reviews and messages at the same time starting with 100 messages for a one-product presentation to 50 review messages for four-product comparisons. Animation clips proved to have the lowest impact on the users.
- A set of derived guidelines for the implementation of multimodal social media review messages in an e-commerce interface that could offer the users a better review communication experience.

1.8 Thesis Outline

The thesis is structured into five chapters and appendices. Below is a description of these chapters and appendices.

Chapter 1: Introduction- Provides an overall introduction to the thesis. The chapter briefly presents research aims, objectives, method, ethical considerations, contribution and thesis structure.

Chapter 2: Literature Survey- The chapter reviews previous work related to e-commerce, social media, user interfaces and multimodality. The first section provides background information about e-commerce such as types, structures, benefit and technologies. Then social media is presented with information on the emergence of social media and its use. The next section introduces the user interface and web

designs and the importance of the user interface in an e-commerce site. The multimodality section provides the general context of multimodality and its importance in different computer applications. The last section of the chapter provides a critical conclusion on multimodal social media e-commerce.

Chapter 3 Experiment I: An Empirical Investigation into the Impact of Social Media Multimodal Product Ratings in E-Commerce- The chapter presents the experimental platform used to investigate the usability of different multimodal metaphors in communicating social media product reviews. This experiment is conducted by assigning three independent groups to test three different versions of the experimental platform: textual with emoji's (TRP), earcon ratings presentation (ERP) and facial expression ratings presentation (FRP). The data analysis is presented in the chapter.

Chapter 4 Experiment II: The Role of Visual Multimodality in Communicating Product Reviews and Empirical Ratings Investigation- This chapter presents the second experiment that evaluates empirically the performance of different visual multimodal presentation platforms: emoji presentation (EMP), facial expression avatar presentation (AVP) and animation presentation (AMP). The investigation has one group of 48 users. The chapter presents and analyses the data collected from this experiment.

Chapter 5 Conclusion and Empirically Driven Guidelines- The final chapter presents a set of derived guidelines for the design and implementation of multimodal social media e-commerce sites. In addition to that, the chapter includes validation for some of these guidelines, limitations, future work, epilogue and lessons learned. There are also three appendices.

Appendix A: The first appendix presents the pre-platform design tasks questionnaire. The appendix also contains the data collected along with tables and graphs presenting the data.

Appendix B: This presents the questionnaire used in the first experiment. It also provides the data collected in this experiment from the three groups presented in the form of frequency tables. Tables contain users' answers regarding satisfaction, number of correct of tasks per group and time to perform the tasks.

Appendix C: This presents the second experiment data and questionnaires used for data collection. It contains the data for 48 users including the correctness, time, satisfaction and enjoyment. The frequency tables are used to present these sets of data.

Appendix D: This last appendix contains the questionnaire used for the validation of the empirically driven guidelines. The data collected for the validation is presented using tables and charts.

Chapter 2: Multimodality, Social Media and Reviews of Products

2.1 Introduction

According to Internet World Stats (2017), there are around 3.7 billion internet users. The number of people accessing the internet to buy or to shop or to conduct business is increasing at a fast tempo. As more people are eager to connect, becoming online has opened a new era in terms of business; the internet today has become a commercial medium that has produced a dramatic new economy and new way of running a business. The internet and e-business (including e-commerce) have become an essential and a necessity to improve the business, compete or even to survive. E-commerce has created a completely new way for running a business and founded a new business model in the sense of communicating or performing processes with other firms.

E-commerce has changed the focus of the internet from an information repository containing only data to using that data to conduct business and commerce. The number of internet users has increased to 3.7 billion by 2017, an increase of 936% between the years 2000 and 2017 (Internet World Stats, 2017). Any businesses located in rural areas and small towns can compete more effectively in the global economy if they take advantage of the "worldwide" markets for customers, information, inputs, and services provided for them over the internet (David et al., 2007). More people engage in online communities and social networking in addition to more businesses eager to have e-commerce in order to compete and achieve an advantage.

Different models exist under e-commerce that support both consumers and businesses, such as: B2C (business to consumer), B2B (business-to Business) and C2C (consumer-to-consumer).

The improvement of internet technology has changed the way users communicate over the internet. The Web 2.0 standard is considered as the major shift from a static type of user interface into a more dynamic one which allows users to interact in two-way communication. This has allowed more input from the users' side and linked them to more social interaction. This new web gave the users the ability to not just read the text or content but the option to write, which is the interaction. The result of such improvement was what is currently known as social media. Social media has changed the way people communicate as it became easy to share and digest information (Williams and Williams,2008). The improvement from Web 2.0 to Web 3.0 has increased the interaction of the users resulting in new advances for the social media platform. Users now use social media to fulfil different aspects of their daily life by posting pictures, videos, sharing aspects of their life and providing feedback for products and services. For instance, users go to social networking sites checking pictures and feedback when planning a holiday (Mintel, 2013). Users value information from both offline (word-of-mouth) and online (electronic-word-of mouth) which helps in purchasing decisions.

The user interface in e-commerce is considered as important as the product the company is selling. The human-computer interface aspect of an e-commerce site impacts the user's action and shopping experience. The aspect of a website that helps the users to access different sections is referred to as ease of use (Cyr, 2008). The user interface goes beyond the ease of use of the application or the site to serve a

greater objective which is consumer trust or retention. Researchers in the human-computer interface field have showed that the use of graphics would improve the users' trust. A study by Pengnate and Sarathy (2017) showed that both visual appeal and ease of use are contributing factors in developing online trust among male customers, with visual appeal dominating trust formation among female customers. Multimodality is a concept that focuses on the use of the human senses to improve the human-computer interface. Studies showed that use of multimodality improved the performance of the users.

2.2 The Internet and e-Commerce Preview

2.2.1 The Internet

The 1970s and 1980s saw a merger of the fields of computer science and data communications that profoundly changed the technology, products, and companies of the now combined computer-communications industry (William S., 2007). This has led to the discovery of the network with its various types. The internet evolved from the ARPANET, which was developed in 1969 by the Advanced Research Projects Agency (ARPA) of the U.S. Department of Defense (William S., 2007). The internet is a global, interconnected computer network in which every computer connected to it can exchange data with any other connected computer (Catherine L., 2006). The main success of the internet is the interoperability which allows different types of computers to communicate with each other regardless of brand and type of operating system being run. At that time, the internet contained millions of potentially useful files and documents, but the network was unfathomable (Martin C., et al., 2013). The need for a tool or application arose in order to reach and navigate files over the internet.

Between 1991 and 1995, the means for navigating the internet was heavily contested by both public and private actors (Martin C., et al., 2013).

The internet's success is not just as a result of its global network but due to the applications that can be used over it. Tim Berners-Lee, the inventor of the World Wide Web, has stated (W3C) that a page, which is a document, can be linked to another document. Once a user found one document, it was possible to navigate the information space without a directory (Martin C., et al., 2013). The WEB contains billions of documents that use the internet as means of transportation (Catherine L., 2011).

The first web browser was MOSAIC that was considered as a turning point in web improvement. The MOSAIC browser was a textbook example of user-friendly, point-and-click software (Martin C., et al., 2013). In the last two decades, the web has witnessed many developments and improvements. Many will read about different versions of the web, such as Web 1.0, Web 2.0, Web 3.0 and Web 4.0. Berners-Lee has said that Web 1.0 can be considered as a "read-only web and also as a system of cognition". The early web provided limited user interactions or content contributions and only allowed users to search the information and read it (Sareh A., et al., 2012). The pages then were just static text content. Users and visitors of the websites could only visit the sites without any impact or contributions and the linking structure was too weak (Sareh A., et al., 2012). As the development of a better web, which considered the need in terms of usage and interaction, Web 2.0 was founded. Web 2.0 has revolutionised the use of the internet and social media has emerged as a result. The development of web technology carried on to the next web version, Web 3.0. Web 3.0 provided support for mobile internet connectivity, improved data management, and

provided better customer satisfaction in the current social web. The semantic web (Web 3.0) is a web that can demonstrate things in an approach which a computer can understand (Sareh A., et al. 2012). It is considered as repositories of data that can be linked to each other as in Figure 2.1. Table 2.1 provides direct comparison between Web 2.0 and Web 3.0. Figure 2.2 presents the web history.

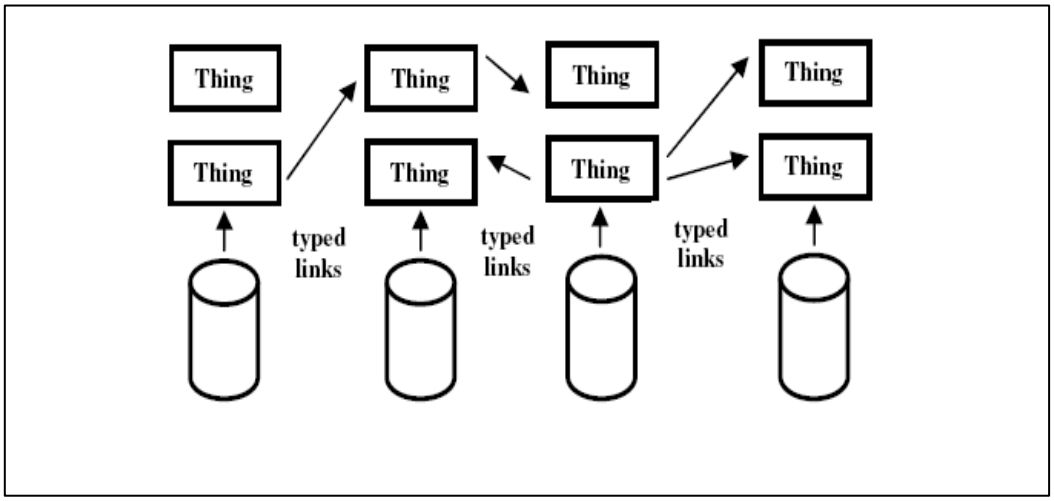


Figure 2.1: Web of data (Sareh A., et al. 2012).

Web 2.0	Web 3.0
Read/Write Web	Portable Personal Web
Communities Individuals	Communities Individuals
Sharing Content	Consolidating Dynamic Content
Blogs	Lifestream
Wikipedia, google	Dbpedia, igoogle
Tagging	User engagement

Table 2.1: A Comparison of Web 2.0 and Web 3.0 (Sareh A., et al. 2012).

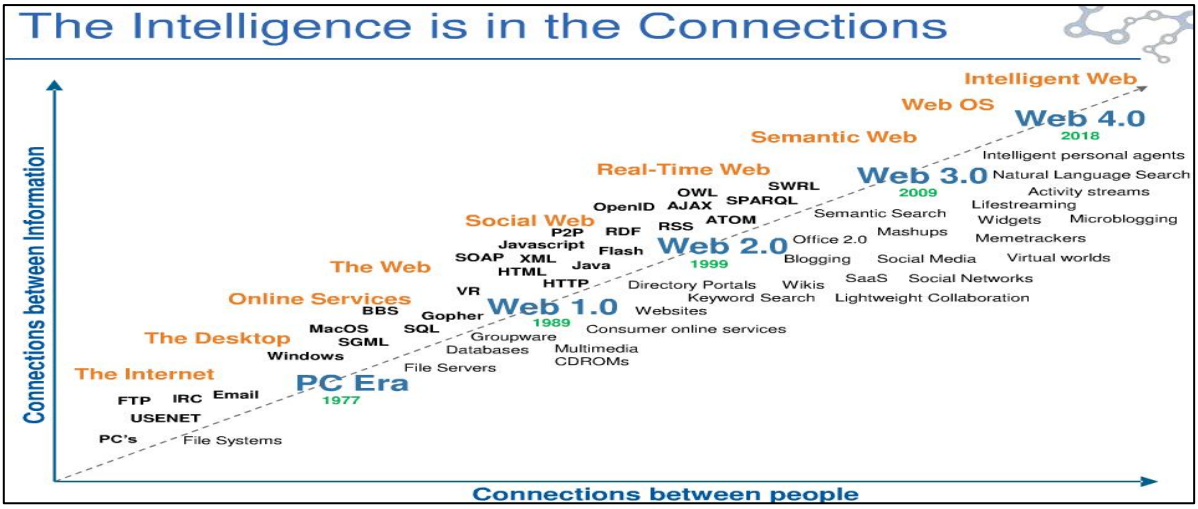


Figure 2.2: Web History (Radar Networks and Nova Spivak, 2007).

2.2.2 e-Business

A firm or organisation is said to have\be an e-business when most of its main business functions are delivered electronically. Hence any firm that is looking for an e-business environment an investment in information technology (IT) is essential; as IT has proved to be the infrastructure for an e-business approach. Exchanging information is often enabled through the use of IT (Skipper et al., 2008). IT spans the boundaries between firms and has been noted for its role in lowering the cost of exchanging information (Clemons et al., 1993). According to transaction cost theory firms seek inputs from external suppliers or the market for items they can't produce and to minimise transaction cost. IT (especially the internet) is the main tool in reducing transaction and communication costs. If firms must transact with outside suppliers, they will seek the most efficient governance mechanism to organise their external transactions and minimise transaction costs (Grover and Malhotra, 2003). In all different business sectors e-business has been adopted or used to gain competitive advantage. Some organisations invested in e-business but without achieving the hoped-for return, either because the execution of the plan was flawed or the planned approaches for their market were inappropriate (Chaffey D., 2009). Just creating a

website or simply redesigning it will not bring success as an e-business. It is about redefining how you do business. It requires new strategies and new business models (Edward P., 2001).

2.2.3 e-Commerce

E-commerce (EC) can be defined as “the use of the Internet and other networking technologies for conducting business transactions” (Turban E., et al. 2004). A firm or organisation is said to have an e-business when most of its main business functions are delivered electronically. Exchanging information is often enabled through the use of IT (Skipper et al., 2008). E-commerce does not involve just selling or buying products online but it has extended to most of a firm’s business processes like handling customer queries online, integrating payment from customers, promotion of product/services on the web, and secure transactions. E-commerce is an umbrella concept to integrate a wide range of existing and new applications (Zwass V., 1996). E-commerce is trading by means of new communication technology. It includes all aspects of trading including commercial market making, ordering, supply chain management, and the transfer of money (Simon Garret, and Skevington, P.J. 1999). Kalakota and Whinstone (2007) presented a wider definition of e-commerce that covered all usage aspects:

- From a communications perspective, e-commerce (EC) is the delivery of information, products/services, or payments via telephone lines, computer networks, or any other means.
- From a business process perspective, EC is the application of technology toward the automation of business transactions and workflow.

- From a service perspective, EC is a tool that addresses the desire of firms, consumers, and management to cut service costs while improving the quality of goods and increasing the speed of service delivery.
- From an online perspective, EC provides the capability of buying and selling products and information on the internet and other online services.

Some benefits include:

- 24 /7accessibility (Lin, B., and Hsieh, C. T., 2000).
- Improvements in operational efficiency and revenue generation by integrating e-commerce into their value chain activities (Rynjolfsson, E., and Kahin, B., 2000).
- Improved customer services (Bakos J. Y., 1998).
- Greater potential for partnership with suppliers and vendors (Koch, H., 2002).
- Lower transaction costs (Tumolo, M., 2001).
- Flexibility in administration and partnership (Brunn, P., et al 2002).
- Access to a wider range of markets (Senn J. A., 2004).

E-commerce can be used to support business networks and help rural firms overcome the challenges of small size and geographic remoteness (Henderson J.R., 2001). It is important to measure the strategic impact of the e-commerce and its impact on the buy and sell sides. Buy-Side-e-commerce refers to transactions to procure resources needed by any organisation from its suppliers (Chaffey D., 2009, p:360). E-commerce is commonly used to sell products online and to reach the largest number of customers possible; this is Sell-Side-e-commerce. Sell-Side-e-commerce refers to transactions involved with selling products to an organisation’s customers (Chaffey D., 2009, p:561). Figure 2.3 illustrates the e-commerce selling and buying terminology.

Some organisations invested in e-business but without achieving the hoped-for return, either because the execution of the plan was flawed or the planned approaches for their market were inappropriate (Chaffey D., 2009, p:35).

Any e-commerce has a certain structure or framework. Successful e-commerce has a three level framework (Nanehkaran Y., 2013):

1. **Infrastructure:** This is composed of hardware and software. It is responsible for connecting to the internet.
2. **Services:** This provides support in terms of searching for goods and trading partners. Also, provides the negotiations and agreement services.
3. **Products and structures:** Consists of goods, products and services that are linked to the customers or trading partner(s). In addition to sharing information inside and outside the firm.

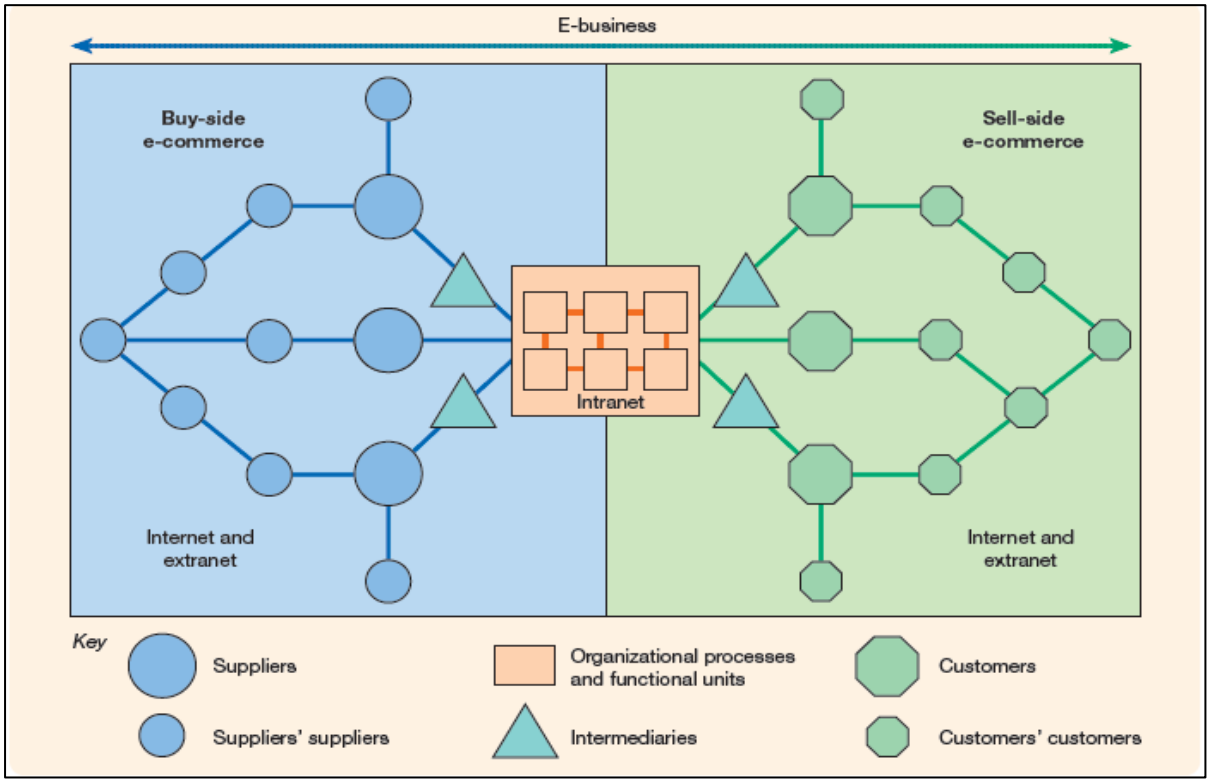


Figure 2.3: Distinction between Buy and Sell side e-commerce (Chaffey D., 2009, p:11).

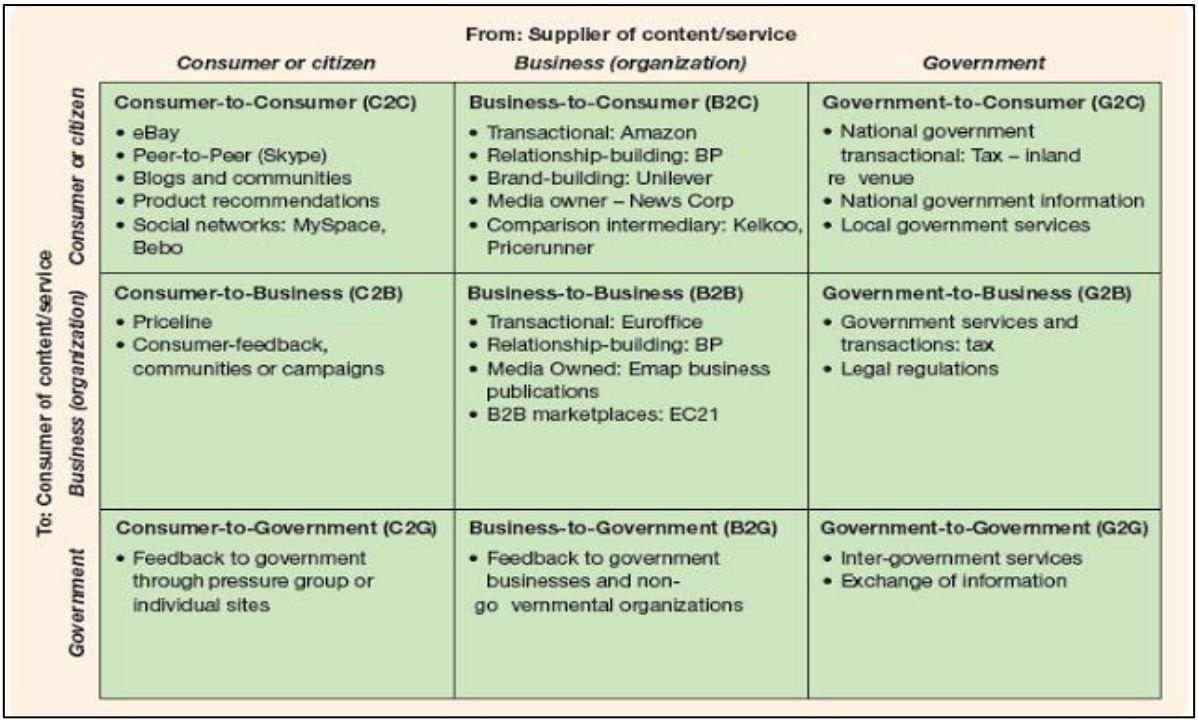


Figure 2.4: E-commerce transaction models (Chaffey D., 2009, p:25).

Many models were formed as a result of e-commerce; these models are categorised according to the operation between the organisation and its stakeholders. As Figure 2.4 shows, different types of e-commerce models can be used within firms like B2B (business to business), B2C (business to consumer), and even C2C (consumer to consumer).

2.2.3.1 B2B e-Commerce

According to Gebauer and Shaw (2002) B2B is defined as "systems and processes that support the flow of information between organisations as it occurs in procurement; manufacturing; research and development; sales; and distribution of goods, information and services". Hence, B2B is used to describe the process or transactions taking place between one commerce firm and another firm. As such, B2B e-commerce relies on relationship-specific resources in two or more organisations that create the capability for inter-organisation electronic information exchange (Tanewski, G. et al., 2003). Through using e-commerce, companies are able to connect with their trading

partners for ‘‘just in time production’’ and ‘‘just in time delivery’’ (EWT Ngai.; FKT Wat., 2002).

As part of an e-business approach B2B will help in reducing the cost of transactions. The Porter competitive forces model (Figure 2.5) reflects the importance of the supplier (another firm) to the firm in terms of achieving competitive advantage. For example, the more a firm engages its supplier the more the supplier will provide vital input, thus lowering cost (Lauden and Lauden, 2013). The Porter model reflects the forces, especially the supplier, that affect the firm’s performance in the environment and its competitiveness; the firms can engage other than suppliers to achieve competitive advantage or lower cost and increase profit. As mentioned above, the internet was the main tool that initiated e-business and e-commerce; it is also used to implement further B2B concepts and approaches. The B2B concept has promoted business processes and is the way to run business in a completely digitised world that has made the internet and e-commerce essential for business continuity and competitiveness.

B2B and the need to improve the supply chain have led to a new, emerging, more efficient supply chain.

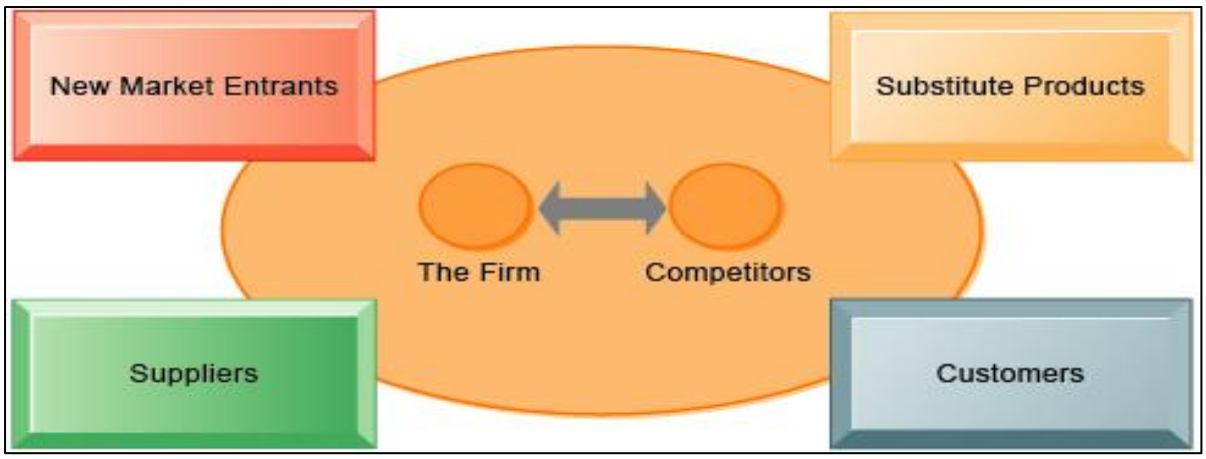


Figure 2.5: Porter Forces Model (Presby,2015).

The benefit of the web was actually presented as a result of the firm's business need to add value to whatever it's delivering to its customers.

2.2.3.2 B2C e-Commerce

B2C refers to transactions between a business and its end consumer and so it creates electronic storefronts that offer information, goods, and services between business and consumers in a retailing transaction (Yaser N., 2013). As the internet has created a new way to exchange data and to communicate it gave a new concept for business which is B2C. According to the Porter model to achieve competitive advantage the firm needs to have\implement customer intimacy. Strong linkage to customers and suppliers increases the switching cost (Laudon and Laudon, 2013). The potential for B2C e-commerce is to conduct the business 24/7 which is one of its greatest benefits.

Figure 2.6 represents the number of sales and it shows how e-commerce sales have been increasing every year. Sales reached 134 million pounds in June 2017 (ONS, 2017). Giving customers the ability to purchase products or services through the web is a tool to gain customer satisfaction and loyalty. Users can easily choose goods from various producers without moving location (Yasser N., 2013). One of the most important features is giving the user or the customer the ability to look at many products at the same time without the need to leave their physical location. Everyone can easily compare fees among various web sites (Yasser N., 2013). Some companies also provide discounts when prices are compared with shop fees. The customer nowadays has the ability and the power to quickly switch from one site to another (from one B2C to another B2C) to reach the item looked for, which makes it hard for firms to maintain or retain customers.

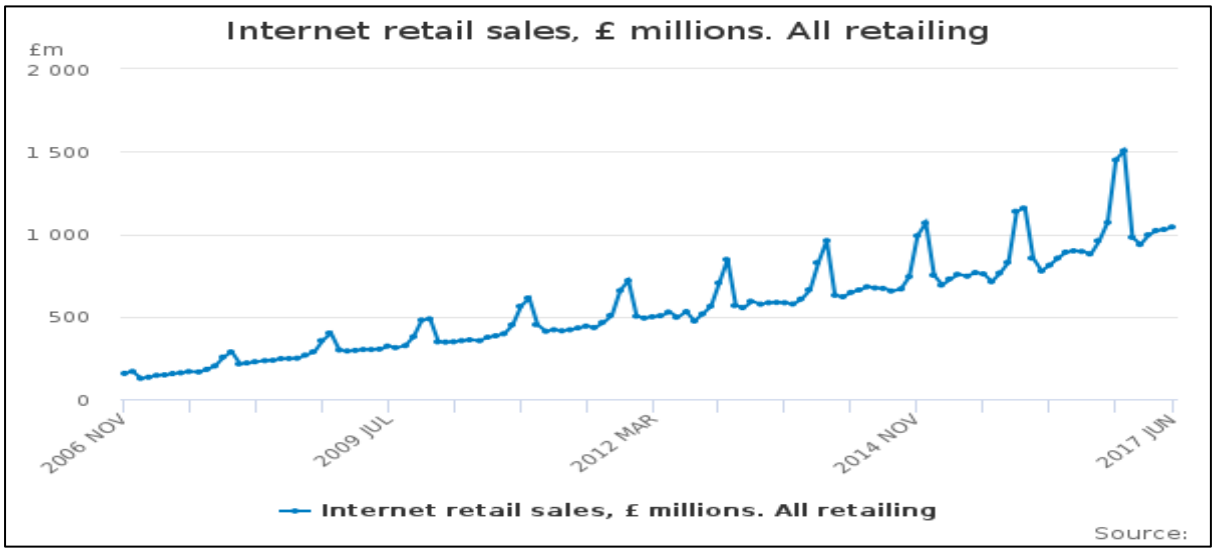


Figure 2.6: Internet Sales (ONS,2017).

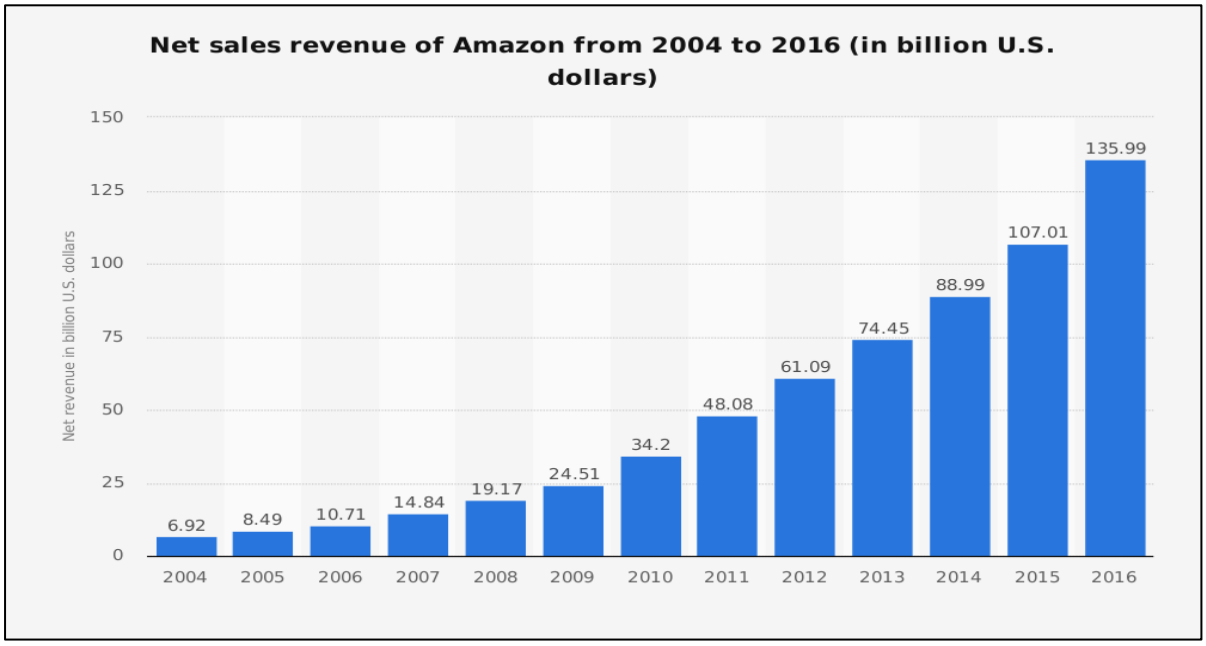


Figure 2.7: Amazon Annual reports (Statista, 2017).

Figure 2.7 shows that the latest Amazon sales figures increased *from $107 billion in 2015 to $135 billion in 2016 (Statista, 2017), which is in correspondence with the increase of users accessing the internet.* The successful use of electronic commerce in B2C relations depends on how well businesses track and react to consumer behaviour and how they maintain their customer relationships (Stephen B. and Stan K., 2008). Tracking how customers behave on the internet and how they interact with

the B2C e-commerce of the firm helps the firm to study and to determine the most profitable customers.

With the current internet users' accessibility increasing (World Stats, 2017) it is a business necessity for the firms to have a B2C e-commerce capability in order to compete and achieve advantage. The data in Figure 2.7 of Amazon's annual reports show an increase in online sales that reflects the customers' satisfaction of buying online. Having a good well-presented B2C application to reach customers is not enough to make the business successful. In the B2C world, if you don't have the right e-commerce infrastructure you can find yourself quickly running out of capital and from there out of business (Leslie L., 2002). A strategy should be implemented to make the provision of e-commerce (B2C) in the business successful. It is very important to have a strong brand or product, but it is not enough. Customer growth is not adequate. Availability of inventories is not enough. Delivery of the items is not enough. What is more important is the customers' expectation.

Paul Evanko said (2002) "To do that you have to have the right mix of capabilities". Capabilities are a mix of firms' management skills and brand availability. "The right balance of good management of capital, fundamental management leadership skills, scale and yes, branding. But this balance varies by industry". As Paul pointed that the balance varies from industry to industry and also it changes from time to time. Thus, successful companies focus on flexibility (Leslie L., 2002). Most B2C companies concentrate on the delivery (investing) of the item as part of the customer expectation. All firms send an email confirmation to the customer with tracking number to track the shipment of the items. Having the execution, the operational excellence to be able to do what the firm promise is an important part of delivery (Leslie L., 2002). From the customers' perspective, what matters the most is receiving the shipment on time and

damage free and this is the minimum customer expectation. Meeting customer expectation repeatedly will lead to customer loyalty.

2.4.3 C2C e-Commerce

Consumer-to-Consumer (C2C) is another application of e-commerce. Online users have a common interest in terms of selling and buying. The most successful example of C2C ecommerce is eBay. Having an account on eBay makes the user able to purchase directly from another user who has interest in selling. Moreover, such a site can make users into sellers with no need to have a physical location to conduct business. In C2C communication, all necessary information must be collected promptly when a buyer and a seller communicate (Chih-Chin,Wen-Yau, 2013). The networking platform or networking is provided to both seller and buyer through a fee or by charging a cost per transaction. For example, eBay has three types of fees (eBay, 2017):

- **Insertion fees:** This fee is paid whenever you list an item on eBay, even if it doesn't sell.
- **Final value fees:** When your item sells, you'll be charged a final value fee that's based on a percentage of the total cost to the buyer, including postage, packaging and any other related costs and only paid when the item is sold.
- **Feature fees:** This fee is only paid if you select optional features to increase your chances of a successful sale, e.g. international site visibility, subtitle or picture pack.

An online auction is another service provided by the C2C platform that will boost the seller’s sales figures. When bidding on an online auction for a certain item the buyer wants to analyse the item regarding the price, discount, item’s description, delivery and reviews before bidding or completing the transaction. However, the amount of

information and analysis provided is time consuming for both the seller and the buyer. Another service or feature that might be provided by a C2C platform is the smart agent. Agents are intelligent, autonomous software components capable of interacting with others within an application, attaining a common goal and thereby contributing to the resolution of some given problem (Pratik Biswas, 2008). In C2C, a smart agent can analyse data information and even can bid and operate on the user's behalf (seller or buyer).

Some properties of an agent (Michael W., Nicholas J., 1995):

- Autonomy: agents operate without the direct interventions from humans.
- Social ability: agents interact with other agents.
- Reactivity: agents perceive their environments and respond in timely fashion to changes that occur.
- Pro-activeness: agents do not simply act in response to their environment they are able to exhibit goal-directed behaviour.

The agents' characteristics help both the sellers and the buyers to communicate, interact and do business with less time spent on communication or information analysis. The existence of agents in the C2C world has created another term C2CIA (Consumer to Consumer Intelligent Agent) that perform similarly in the C2C trade. The C2CIA features the following criteria for C2C trades (Chih-Chin, Wen-Yau, 2013):

- **Intelligence:** A C2CIA automatically customises itself to suit user preferences, based on previous experiences and imprecise information obtained via interaction with users. The agent also automatically exchanges transaction information with other agents.
- **Automation**: A C2CIA must take the initiative and exercise significant control over its own actions through service agreements.

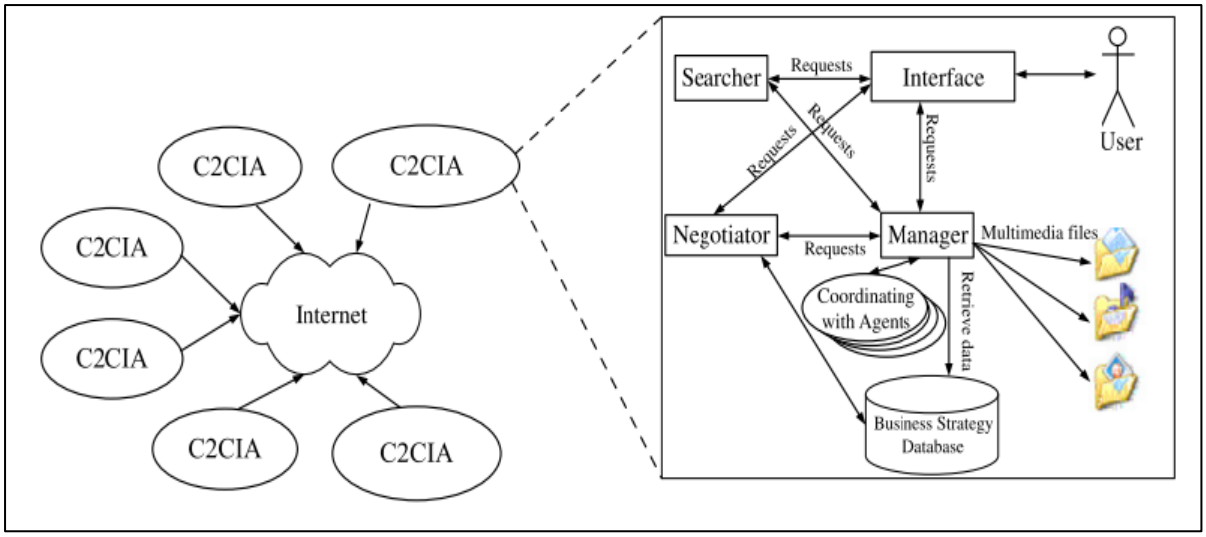


Figure 2.8: The architecture of C2C Intelligent Agent (Chih-Chin, Wen-Yau., 2013).

- **Cooperation**: A C2CIA does not simply respond to commands but makes suggestions to modify requests or questions users to seek clarification. A C2CIA also cooperates with other agents to query the needed modules.

Figure 2.8 presents the architecture of the C2CIA that is considered as another dimension for C2C that could improve the performance of both the seller and the buyer. This helps both parties to conduct business or transactions with less time and with more precise purchase decisions and transactions.

2.3 User Interface and Usability

The web increases accessibility and defies geographical barriers (Jakob N., Marie T., 2001). As the web gives a new dimension for firms and users in terms of communicating outside their limited physical boundaries, hence it is important to pay attention to providing a proper web design that is easy to use. Creating an effective web design began by the time the web started to become more popular and browsers' use spread. As more people are connecting to the internet the need to have a proper interface for web layout has become a major issue when presenting or implementing an e-commerce site regardless of the application (B2B, B2C or C2C). According to

Costabile (2001), usability is defined as one of the six characteristics of software quality. It is the “capability of the software product to be understood, learned, used and attractive to the user, when used under specified conditions". It is further subdivided into five sub characteristics: understandability, i.e., the capability of the software product to show the users its appropriateness to the tasks to be accomplished and to the context of use; learnability, i.e., the capability of the software product to help users to easily learn its functionality; operability, i.e., the capability of the software product to make possible for the users the execution and the control of its functionality; attractiveness, i.e., the capability of the software product to be pleasant for users; compliance, i.e., the capability of the software product to adhere to standards, conventions, and style guides about usability (Costabile M.F., 2001, pp.179-192).

When referring to computer systems or the web there are two terms for defining user interfaces, the GUI (Graphical User Interface) and WUI (Web User Interface). With the GUI, the design and the implementation are undertaken with the user at the centre of the design.

Graphical user interface (GUI) broadly involves (Uttara N., 2001):

- Set up user types.
- Define tasks, for each user type.
- Design the user interface by specifying presentation elements to complete these tasks.

While whenever building or designing a web interface the users are undefined and the page is globally accessed. Web design techniques include (Rosenfeld L., Morville P., 1998):

- Define the site’s mission and vision. Also, envision the intended audience.

- Determine the site's content and functionality.
- Define the organisation of information on the site, including navigation, labelling, and search systems. Specify these in terms of web page hierarchy diagrams, or information architecture blueprints.
- Build and test. Preferably, test the site's usability by observing members of the intended audience perform specific tasks on the site.

Major differences between them (GUI and WUI) include the following (Uttara N., 2001):

- User characterisation is more difficult on the web because it typically addresses an unknown audience. For applications, however, the user community is usually well defined.
- Applications are typically task centric, whereas the web is still largely information centric.
- Customers are not stuck with a web site the way they might be with an application or product they have purchased. At the slightest difficulty, the surfer tends to move on to another site, maybe never to return again. Navigation between web pages is much more flexible than that between forms (or screens) of an application. Thus, user can reach a particular web page by any number of navigation paths provided on the site. In contrast, in the GUI application, the routes to a particular screen are extremely limited. Indeed, most screens have only one path to them.

One of the most commonly used techniques in usability evaluation is heuristic evaluation (Nielson, J., 1993). In this technique, the evaluator looks at the interface and then tries to frame an opinion about what is good and bad about the interface. In heuristic evaluation, a small set of evaluators test the interface against the following usability principles:

1. Simple and natural dialogue.

2. Speak the users' language
3. Minimise user memory load.
4. Consistency.
5. Feedback.
6. Clearly marked exit.
7. Shortcuts.
8. Good error messages.
9. Prevent errors.
10. Help and documentation.

Providing good design along with simplicity is the core of a successful interface. A good design of the user interface results when designers understand people as well as technology (Costabile M.F., 2001, pp.179-192). Moreover, the impact of the design affects the actions of the users especially when it comes to searching for or comparing a product.

2.3.1 Web Design

The web interface is the part the user will interact with whenever accessing or using any page regardless of the usage. As the web gives a new dimension for firms and users in terms of communication outside their limited physical boundaries, it is important to pay attention to provide an efficient web design that is easy to use. As more people are getting connected to the internet, the need to have a useable interface for the web layout has become a major issue when presenting or implementing an e-commerce site. For firms, the main target is converting an unknown web surfer into a regular visitor. With the increasing number of companies taking

advantage of the internet, it is important to understand what drives utilisation of one site over another (Deborah E. and Elizabeth P., 2004). The easier the web page is to use the more the user will come and visit or purchase as they tend not to like pages that are not easy to surf or to go through. Another important feature is the content, as mentioned earlier, web pages are content centric. According to Hong et al.,(2014), the use of a matrix product presentation format supports searching while the list view product presentation format supports browsing. The clearer the content and the more up-to-date the page is, the more frequent the user will come and visit. The content composes the largest portion of the web page, and in order to improve the quality value of the user on the web, the quality of the content should be considered. Since content is king on the web, the only way to increase the ultimate value of the web to users is to enhance the quality of the content (Jakob N., 1999). Web evolution (Web 1.0, Web 2.0 and Web 3.0) is a continuous approach that will keep moving forward to enhance the web experience and implement richer content for the user.

As mentioned above the content is the king of the web page, still it is difficult to know who the users are and what their requirements are. This invariably leads to an almost imperceptible shift in the focus from what the user would like to find on the site to what the owner would like to display (Uttara N., 2001). The content then is the display of what the owner wants to present, and having that as a poor layout will lead to fewer users or visitors to that page that then could lead to business losses. In many ways, designing effective web content is very similar to designing a physical landscape (Deborah E., et al., 2004). It is not just about having the right content for the users and it’s more than using the right number of spaces; images, videos, layout and structure, etc. all play a major part in implementing the web page content.

The Web is all about choice; the range of places available for users to transact business is astounding, the options almost endless (Jakob N, Marie T., 2002). This reflects the need to have an effective and efficient design with ease of access. Hypermedia provides an untraditional way to access content through simple navigation among the pages. This linking capability makes hypermedia very powerful in terms of its ability to organise, store and present large amounts of complex information (Perera S., et al., 1999). Finding the right way to present the information within the website is almost as important as the information itself. The simplicity of the page in presenting the content will make the user more comfortable and less confused and will surf pages with fewer clicks. The underlying structure of hypermedia provides for storage of information in atomic nodes in the form of different multimedia elements such as text, graphics, animation, audio and video, thereby allowing a multidimensional association of information (Davies, et al., 1991). A node is presented to the user as a set of information and each node is linked to another node (information to other information) in the form of a network that makes it easier for the user to navigate. The nodes are typically interconnected in a semantic network and each node's information is made available to the user via one or more links (Perera S., et al., 1999).

Checking and analysing the web, a few gaps are presented in terms of page designs where there is still an effort to take the user to a new level of web experience through applying and providing more freedom for the user through different techniques and approaches like multimodality and social media.

2.4 Multimodality

Multimodal computer systems are those that use more than one of our senses in their user interfaces. Most user interfaces heavily use visual stimuli to communicate information and this could result in overloading the user's visual channel (Brewster, S., 1998, 1997). The use of human senses in the computer field has been area researchers are interested in. Within the human-computer interface field, where its mission is studying how users use computers, developers try to provide designs and layouts for people that are easy to use. Multimodal interaction is part of every-day human discourse: we speak, move, gesture, and shift our gaze in an effective flow of communication (Zeliko, O and Dusan, S., 2004). Multimodal applications may use non-speech sound, text and hypertext, animation and video, speech, handwriting, gestures and computer vision. Each of the human senses provides different information that can be used in the day to day interaction with each other and with the surroundings. Including visual metaphors with auditory ones will enhance the user experience when interfacing with a system or an e-commerce site as these metaphors could deliver the idea and the required information within the least amount of time. These systems can be used in many applications, like virtual reality, and to provide an interface for those who are without one or more of the human senses (Dix A., 1993; Dix A., et al., 2004). A study conducted by Rigas and Hopwood (2003) showed that in intermediate and complex tasks, multimedia metaphors helped users to make fewer mistakes and in some cases reduced the time taken to complete them. This shows the importance of multimedia or multimodality in making the execution of tasks easier. Another study by Rigas and Memery (2003) showed that multimedia helped users to learn more material than text-and-graphics only media, and assisted them in performing different tasks more successfully. In e-learning interfaces, multimodality has shown to be useful in

enhancing usability and users' learning performance (Leonard A, Shawn H.,1996). This shows the importance of multimodality when it comes to creating a better user interface which increases usability. Hence, applying multimodality in e-commerce might have the same influence as in the e-learning area.

2.4.1 Sound

Some computer applications are already using sound; for example, the beep warning and composed speech. The use of sound and vision in presenting information provides universal design of the product (Dix, A., et al., 2004). Sound does not occupy the screen of the user as a graphical interface or icons do. The most commonly used communication channel is the visual one. However, the visual channel has drawbacks since the user has to focus on the visual aspects which might already be loaded with many visual channels. The effective use of sound can be beneficial to overcome these drawbacks (Dix A., et al., 2004)**.** The auditory metaphors consist of recorded speech, earcons and auditory icons whereas the audio-visual metaphors incorporate the use of speaking avatars with human-like animated facial expressions and body gestures (Al-Seid M., 2009). There are two types of sounds that can be used: speech and non-speech metaphors.

2.4.1.1 Speech Metaphor

There are many spoken languages across the globe each of which has its own punctuation, grammar and syntax. There have been many attempts to implement systems that are able to understand human speech (Speech Recognition Systems). However, these systems struggle with the complexity of languages, automatic recognition of the spoken word, background noise interference with speech input, differences in human voices and accents, and the limitation of single-user input (Al-

Seid M., 2009). Thus, the success of these systems is still low. A spontaneous and free-flowing speech style is critical to its success (Deng L., 2004). Even with the challenges facing this area to have a higher influence in our lives it has been used and implemented in some products, such as mobile phones. Speech recognition can be used to input information into computer-based systems like mobile, telephone-based and airline booking systems (Dix A., et al., 2004). Systems face limitations in determining the spoken words; Morario (2009) emphasises that to reduce the error rate more samples of the spoken word are needed. “For learning (words) we need to extract cepstral coefficients from several audio samples of the same word.” (Morario A., 2009). The industry has yet to bridge the gap between what people want from speech recognition, typically in a multimodal environment, and what the technology can deliver (Dong L., 2009).

The development in technology has lead researchers to look at different ways that would improve this field using different techniques and models such as machine learning. Recent advances in algorithms and computer hardware have made it possible to train neural networks in an end-to-end fashion for tasks that previously required significant human expertise (Graves A and Jaitly N,2014). Speech recognition is improving especially with wide implementation of it in mobile devices. The use of machine learning and neural network is proving to be vital in different fields such as speech recognition, but that development still not considered to be an easy task or approach. According to Graves and Jaitly (2014), the networks are at present only a single component in a complex pipeline. Within the speech recognition system implementation the challenge proving to be not just the development or the implementation of the system but the learning functionality of the system. The network must not only learn how to recognise speech sounds, but how to transform them into

letters (Graves A and Jaitly N,2014). In addition to that, the researchers in the field found that there are other difficulties or challenges for the speech recognition system which includes various the surroundings or the environment of the users using the system. There are many technological hurdles yet to reach flexible solutions that satisfy the user. This is because of many factors such as environmental noise, paucity of robustness to speech variations (foreign accents, sociolinguistics, gender, and speaking rate), spontaneous, or freestyle speech (Sahu P. et al.,2017). The area is improving constantly and also becoming increasingly usable and useful; however, it is still not widely adopted in e-commerce.

2.4.1.2 Non-Speech Metaphor

Non-speech is another multimodal interaction in the human-computer interface that is part of the audio metaphors interaction process. Non-speech sounds, compared to speech sounds, are language-independent, provide faster communication and can be understood quicker with the presence of sufficient training (Brewster S., et al., 1998). Research has proven that the audio existence is as important as the visual in any system or application. The combination of visual and auditory information at the human-computer interface is a powerful tool for interaction (Sears A and Julie J., 2003). The combination of two human senses together leads to better or improved decisions and judgement. In daily life audio/sounds surround the environment people live in which makes such interaction unavoidable. Within non-speech the researcher will focus on two groups: earcons and auditory icons.

2.4.1.3 Earcons

Most of the information in the computer age has been presented using the visual channel. However, sometimes information is missed as the user’s attention might be

somewhere else. Focusing on one task using the visual channel will reduce the ability to engage in another visual task but using sound for monitoring the state of the other task can be effective. While directing our visual attention to one task, such as editing a document, using sound we can still monitor the state of the other tasks on our machine (Sears A., Julie J., 2003). Earcons are short sounds of a musical nature used in Human-Computer Interaction for the communication of information about objects, operations and interaction in or with computer interfaces (Blattner M., et al., 1989). These earcons, that are defined as short musical sounds, can be used to deliver complex information or communication. These non-speech sounds are constructed from short sequences of musical notes (Rigas D., et al., 2000) that can be combined to convey more complex information (Brewster S., 1993). An earcon that is a single note and a single pitch are examples of one-element earcons (Al-Seid M., 2009). As Blattner et al., (1989) highlighted, earcons can be one-element (simple) or a compound. Thus, compound earcons can be made up of many simple earcons. In order to discriminate different earcons within these combinations, sound attributes such as timbre, register, pitch, rhythm, duration, tempo, intensity and spatial location can be used (Brewster S., et al., 1995). With the presence of earcons which present or communicate a piece of information the user will need to adapt to various earcons and what each of those earcons resembles. The use of earcons in user interfaces is based on the linkage between the incorporated earcons and the information to be communicated and therefore the user has to rely only on his/her memory to interpret the delivered auditory message (Alotaibi M., 2009). Earcons have improved the HCI (human-computer interaction) by not just having one channel of information communication (visual). Earcons have been implemented to enhance users‘ interaction along with visual components used in user interfaces such as scrollbars

(Brewster S., et al., 1994), buttons (Brewster S., et al., 1995); menus (Brewster S., et al., 1997; Brewster S., et al.,1999), progress bars (Crease M. and Brewster S., 1998), and tool palettes (Brewster S., and Clark C. V., 2005). Mobile devices have embedded various earcons that users familiarise themselves with and that are deployed to provide different types of information. Earcons have been shown to be beneficial to enhance users' interaction with mobile devices where the inclusion of structured musical sounds helped the users to overcome the lack of visual feedback due to the small screen size in these devices (Brewster S., et al., 1998; Brewster S., 1999; Walker A. and Brewster S., 2000).

2.4.1.4 Auditory Icons

Multimodal interaction involves more than one human sense in human-computer interaction and could be utilised to enhance the usability of user interfaces (Alseid M., et al., 2014). Auditory icons can be described as modified versions or comics of naturally occurring sound. Auditory icons are non-speech sounds from the surrounding everyday life used to communicate different objects and actions in computer interfaces (Gaver W. W, 1986). They can include sounds from the environment like a doorbell, breaking glass, fire alarm, etc. For example, the sound of glass breaking can be used to deliver a certain message, or a fire alarm sound can be used to deliver a different message with critical condition or high importance. This approach has been used in mobile phones allowing users to put different sounds for different functions; a ringtone for a phone call can be different from the ringtone for a message which allows the user to quickly determine which he/she is receiving. Auditory icons also can be successfully combined with other multimodal metaphors, such as speech and earcons, to communicate information for mobile telephony users (Rigas D., et al., 2000).

Event to Sound Mappings for the SonicFinder	
Computer Finder Event	**Auditory Icon**
Objects	
Selection *Type (file, application, folder, disk, trash)* *Size*	*Hitting Sound* *Sound Source (wood, metal, etc.)* *Pitch*
Opening *Size of opened object*	*Whooshing Sound* *Pitch*
Dragging *Size* *Location (window or desk)* *Possible Drop-In?*	*Scraping Sound* *Pitch* *Sound type (bandwidth)* *Disk, folder, or trashcan selection sound*
Drop-In *Amount in destination*	*Noise of object landing* *Pitch*
Copying *Amount completed*	*Pouring sound* *Pitch*
Windows	
Selection	*Clink*
Dragging	*Scraping*
Growing *Window size*	*Clink* *Pitch*
Scrolling *Underlying surface size*	*Tick sound* *Rate*
Trashcan	
Drop-in	*Crash*
Empty	*Crunch*

Table 2.2: Mapping used in SonicFinder (Gaver W. W., 1998).

Another example, in a messaging system, is that a weighty sound can be played to indicate both the arrival and the size of the received message (Graver W., 1986). An experimental study by Rigas and Alseid (2009) investigated non-speech sounds when used along with the speech of a full-body, animated virtual lecturer during the presentation of learning content and found that earcons and auditory icons could be used beneficially in communicating auditory messages related to important parts of the content.

Auditory icons have been used to deliver pieces of information or a message and its usage provided a great contribution in facilitating the user interface as the result of the experiment mentioned earlier has shown. Auditory icons aim to provide an intuitive linkage between the metaphorical model worlds of computer applications by sonically representing objects and events in applications, using sounds that are likely to be familiar to users from their everyday life (Brazil E. and Fernstrom M., 2011).

SonicFinder (Gaver W., 1989) is an example of a system in which auditory icons have been developed and used. SonicFinder used digitised recordings of sounds that were played when the system was used. Most of the user's actions were represented by auditory icons (Brazil E. and Fernstrom M., 2011). The complete list of mappings for the SonicFinder is shown in Table 2.2**.** These sounds are part of our daily life environment or surrounding interaction and they are well known to users and provide the mapping to the information or data. A good advantage of using auditory icons is the ability to convey different information using a single sound (Brewster S., 2008, p.247). Auditory icons can be generated and stored in a file to be used in an application and processed when a certain event occurs. These sounds are known to users and can be mapped to information, message or data and can be easily remembered.

However, these mappings are sometimes difficult to establish (Grazonis S., et al., 2009).

2.4.2 Avatars

Multimodal input systems have been developed to support functions such as increased system accessibility for diverse users (Sarter N., 2006). An avatar is a computer-based character that has been utilised to virtually represent one party in an interactive context (Bartneck, et al., 2004; Dickey M., 2003). In addition to the visual presence of the avatar it also can provide communication. According to Beskow J.(1997), verbal communication is the use of speech or written massages while the nonverbal is the use of facial expression or body language (gestures). As multimodality refers to the use of different communication channels, an avatar is considered another important tool to improve the visibility and communication aspects of any system. The improvement in technology, especially in social media and video gaming, has improved the presence of avatars. An avatar may be a static picture or image that users employ to present himself/herself in a social networking setting (Kang and Yang, 2006). Avatars can be classified into three groups: abstract, realistic and naturalistic (Salem B. and Earl N., 2000).

- Abstract avatars are cartoon-like interactive characters with limited animation (Gazepidis N., 2008).
- Realistic avatars offer a real representation of humans having been generated based on captured static or video images and they are used in several applications such as games, movies and teleconferences (Villa M., et al., 2003).

- Naturalistic avatars are humanoid in appearance and widely utilised in collaborative virtual environments to represent the interacting users (Burford D. and Blake E., 1999).

2.4.2.1 Avatars Use

Virtual environments are implemented in web-based applications such as entertainment, edutainment, e-learning, simulation and e-commerce (Thalmann D., 1997). Avatars have been used as a tool to support the e-learning environment, as they create a cognitive residue where students believe they are in an actual environment (Anneta L and Holmes S, 2006). A virtual environment (VE) is a virtual representation of a real (or imaginary) environment where users can exist virtually, interacting with it or with other participants (Fabri M., et al., 2002). The employment of avatars in VEs allows users in physically-separated locations to interact with each other (Krenn B et al., 2004; Prasolova E. and Divitini M., 2002) in a virtual world where in everyday human expressions can be used to demonstrate users‘ feelings and emotions (Dickey M., 2003). A study conducted by Theonas G. et al. (2008) showed that the presence of an avatar had a positive influence on students; the facial expressions of the virtual lecturer had positively affected the performance of the students. In addition to that, studies showed the impact of avatars not just in e-learning systems but also in e-government. A previous study conducted by Almutairi and Rigas (2014) showed that the presence of the avatars had a positive impact on system usability and users trust when implemented in an e-government interface. Body gestures are used by humans to communicate non-verbally where the movements of body, head and hands can be used as an illustration tool to supplement our speech when we feel that it is unable to express what we would like to say (N. Gazepidis., 2008; Cowell and Stanney, 2005). Two studies by Gazepidis and Rigas (2006, 2007)

showed that incorporating talking virtual salesman with facial expressions and body gestures in e-commerce interfaces was more appealing to users compared to the textual presentation of products. The use of avatars has been studied across different platforms, such as e-learning, e-government and e-commerce, with results indicating the positive impact of avatars on users. Implementing avatars in the interface of different applications (e-learning, e-government and e-commerce) showed a positive impact on improving users experience through understanding the information communicated and executing tasks faster. The implementation of avatars has been used to improve users' trust as well. A study conducted by Bente G. et al., (2014), showed that avatars can help to reduce uncertainty and to improve trust building in e-commerce settings. The success of an avatar in a user interface hugely depends on the user perception of the avatar and the type of avatar being used. The use of a human avatar has been perceived as the most credible and attractive and was regarded as having the highest impact on intention to interact (Mull I., et al., 2015). Furthermore, users' trust in e-commerce depends on the presence of pictures or avatars; seller depictions (photos, avatars) have been shown to reduce buyer uncertainty and to foster trust in online trading (Bente G., et al, 2014).

2.4.2.2 Facial Expressive

Researchers have been studying human expressions and how these expressions can be implemented and communicated digitally. An advantage of using 3D animated human avatars is the possibility of expressing human emotions through the facial and body animation of the avatar (Theonas, G., et al., 2008). Users communicate over the internet more than ever before and the success of an e-commerce interface relies on their trust of the service. The presence of a human face, even in the form of a photo, can serve as an indicator of honesty (Dion, K., et al., 19272). Furthermore, facial

expressions are considered an important feature of people's daily life. For successful social interaction accurate face perception is critical (Oosterhof and Todorov, 2009). Facial expressions are used to present an emotional state that others would understand. For example, if a user observes a happy facial expression he or she would perceive a happy emotional state and similarly with an angry facial expression. Facial expressions are considered an essential element for interpersonal communication and social interaction (Hickson S., et al., 2017). Moreover, facial expressions could communicate information that would not be easy to relay verbally; facial expressions provide a means for communicating emotions and thoughts through visual cues that may be hard to articulate (Hickson S., et al., 2017). The success of the avatar depends on the social cues being communicated or presented; these are considered to be facial expression, gazing behaviour, speech and motion dynamics (Ruijten P., et al., 2016). According to Fabri M., et al. (2002), there are seven universal human emotional categories: happiness, surprise, fear, sadness, anger and disgust, and the neutral aspect of the facial features.

A study conducted by Lee M et al. (2013) to determine how the facial expression of a reviewer's avatar interacts with the content of their consumer review to influence prospective customer purchase decisions showed that customers tended to react according to users review used avatars when the consumer review was positive. Participants exposed to the reviewer's angry-looking avatar were more likely to attribute the review to the product's performance than those exposed to a happy-looking avatar. Furthermore, another study by Fagerstrom A., et al., (2017) conducted to check the impact of the sellers' facial expression image on consumer's buying behaviour on the accommodation rental service Airbnb showed that the consumers were significantly affected by the facial expression of the seller.

According to Pease (1988), facial expressions and body gestures were mainly used to present attitude communication, and in some cases, it could replace spoken and written messages. Facial expression can be correctly recognised by users even when communicated with limited facial features (Fabri, et al., 2002). Facial expression presentation or appearance has an influence on the users of e-commerce websites. As Cowell and Stanny (2005) suggested facial expressions could promote users' feelings of credibility and trust towards interface agents. Therefore, an avatar can be used as a tool of communication among e-commerce consumers. The facial expressive avatar is the type of avatar considered through this research.

2.5 Social Media

As the web and internet technology improved it constantly gave new dimensions for users to communicate and share information. User behaviour has been completely changed by the introduction of Web 2.0 allowing users to interact with one another online. Web 2.0 has let people share information online (Scott O., 2012). For example, many online travel agencies started to operate as a result of the emergence of Web 2.0. Also, many social media platforms created applications and tools to make purchases available to users. As defined by previous authors social media is a web application that allows the creation and sharing or exchange of user generated content (UGC) (Jha, 2014; Mintel, 2013; Kaplan and Haenlein, 2010; Xiang and Gretzel, 2010;). The Oxford English Dictionary (2013) defines social media as "websites and applications that enable users to create and share content or to participate in social networking". Different forms and types of social media currently exist. Social media websites groups include: blogs, social networking sites, virtual social worlds, collaborative projects, content communities and virtual game worlds (Kaplan and

Haelein, 2010). Currently, the major social media sites include Facebook, Twitter, Instagram, YouTube, LinkedIn, and Google+ among others. Social media started mainly as a platform to communicate with friends and family members; now it is a place where consumers can learn more about their favourite companies and the products they sell (Paquette H., 2013). Moreover, the platform has evolved in such a way that it is considered to be a major tool for both businesses and users. According to Jones (2013), it is essentially a category of online media where people are talking, participating, sharing, networking and bookmarking online. This technology has a huge impact on how businesses communicate and how users purchase online. According to Hajli (2014), it is nearly impossible to find any information that is not available on the internet, and thus the platform provides a one-stop shop for access to information. Additionally, internet-related technologies have influenced and drastically changed how social and business interactions are undertaken. The popularity of social media network sites has increased in the last decade and has become a major platform for the marketing of products and services for businesses. Social media became an interactive environment with a global, open and transparent platform that has changed users' shopping attitudes (Dutta, 2012). On a daily basis, there are more than 500 million active users and more than 55 million user-generated contents through status updates and comments among others (Hajli, 2014). Social media sites have grown exponentially in the past ten years and this is evident through sites such as Facebook and Twitter, which have more than 2.4 billion users combined. Facebook alone has more than 2 billion active users. Currently, consumers have the desire to engage online and be influential users within online communities and groups, for information sharing or information searching.

2.5.1 User Generated Content

With the ability to create content online, known as user-generated content (UGC), users have been interacting and influencing one another over social media websites such as Facebook and Twitter. The use of web application by users to create online content is referred to user-generated content (UGC) (Lange-Faria and Elliot , 2012). Some examples of UGC include: blogs, photos, videos and reviews that users create online. A key business component of social media is that it now allows consumers to evaluate products, make recommendations to contacts or friends, and link current purchases to future purchases through status updates and twitter feeds (Forbes L., 2013). Social media is moving toward being the main source for product reviews and hence firms' e-commerce reviews. The advent of social media in forms similar to Twitter and Facebook are beginning to have large implications for business practices and academic literature alike (Forbes L., 2013). Social media makes it much easier and faster to share information. Social media websites, like Facebook and Twitter, enable users to share and spread information instantly. Customers or potential customers now rely on reviews provided by people or a friend within their social media network. Previous researchers have investigated the role of social media on business. Forbes (2013) conducted a study of the influence of social media in consumer buying behaviour in the USA that found that most of the participants purchased online based on social media previews. According to the study which had 249 participants, 59% were using Facebook and 34% using Twitter as social media tools to get peer reviews. In addition to that, 2/3rd of the participants purchased an item within 24 hours of having peer reviews. Moreover, this study showed that 42% of the participants purchased an item based on reviews from people they don't know. This study has presented the

influence of social media when buying products. With social media, most customers go to the web to seek advice or to have a look at peer reviews. For example, with Tripadvisor people make purchases based on previous experience of, and recommendations from, unknown people.

Many researchers were concerned with the influence of social media on business in general. Gary B. (2009) asked “How can social media help accelerate the business?” As the main concern for firms or businesses is to be competitive and gain profit it is important, based on the Porter model, to consider the customer as a main factor for competitive advantage. Additionally, the ability for people to interact with social media allows businesses to communicate and respond to their consumers and thus allow a new paradigm of marketing (Mir and Rehman, 2013). Businesses must change their strategies to ensure that their marketing approaches consider the impact of UGC on the success of their activities. According to Hajli (2014), social media platforms encourage what the author refers to as social media e-commerce. Social media e-commerce implies the interaction between consumers that is facilitated by social media sites. In this case, through interaction, users create a sense of community and gradually, trust, which has a significant influence on one's decision to purchase a product. UGC significantly influences the behaviour of consumers as other users are perceived as trustworthy (Cheong and Morris, 2008).

It will not take long for today's emerging social media to become critical in helping firms communicate with precision to clients and prospects (Gary B., 2009). Social media has changed consumer behaviour from pre-purchase to post-purchase interactions, where individuals seek information about a product on the social media platform then leave reviews and responses on their experiences. Such reviews may be positive or

negative, and this can, in turn, affect the decisions of future users. The power bestowed on the users is thus very high as they can generate content/reviews, which can positively or negatively affect a product or business (Jha, 2014).

2.6 Product Reviews

Social media appears to have become the platform users rely on to get reviews. When users are sharing reviews regarding a product or service they are directing or influencing other users' purchase decisions. According to Duan et al. (2008), consumers evaluate product information (e.g., product reviews) in order to help them fulfil their consumption goals. The high number of people on social media sites creates a large platform for increasing brand visibility and selling products and services to people across the world. The availability of social media has given information a new dimension as now users know the power of information that is communicated and shared. Electronic word-of-mouth (e-WOM) is likely to be much more powerful than ordinary word-of-mouth because it could reach an unlimited number of receivers (Ghandour and Bakalova, 2014). E -WOM is now a crucial product information source as communication technology improvements and social media facilitate information exchanges between more consumers (Kim and Gupta, 2012). The reviews being shared by the users are usually categorised as positive, neutral or negative. Positive product reviews provide information about satisfactory experiences with the product, and thus represent opportunities to attain positive outcomes (Duan, et al., 2009).

A study focused on tripadvisor.com conducted by Vermeulen and Seegers (2009) found that positive hotel reviews improve the hotel's perception among potential customers. They concluded that exposure to any (positive or negative) reviews increases hotel awareness, especially if it is less well known to the reader. A similar

study conducted by Ye et al. (2011), suggested that the growing number of positive reviews of a hotel can result in more bookings for that hotel. Reviews being shared among other users or groups have a different value to the receiver depending on the content of the review and whether the reviewee included his/her emotional context. If consumers attribute negative emotions to the reviewer's personal dispositions rather than the product, those emotions are unlikely to influence consumers' product evaluation directly (Vermeulen and Seegers, 2009). In article by the Penman A. (May 2017) presented a case were a mother was being legally challenged by a business owner because of a negative review was left on TripAdvisor and the article highlighted that she was not the first person to receive a legal challenge to change the reviews. This shows that users leaving reviews are not going un-noticed. The reviews left online by users have implications on users' decisions and business alike. Most of the reviews are generated by the anonymous users who are considered to be neutral users. As research showed that users heavily rely on such reviews before conducting or making a purchase. Similar to the case mentioned above business could pay users to leave a positive reviews regarding their services or products which would attract more customers.; because the reviews that directly reflect on the product are considered to have an influence on users when purchasing. Hence, such reviews are considered to be misleading the other users regarding a service or product. Therefore, having reviews from people the users know is considered to be more reliable.

2.6.1 e-WOM, Social Presence and Purchase Decision

Traditional word-of-mouth (WOM) can be a recommendation or discussion with friend or family member. Electronic-word-of-mouth (e-WOM) is created when users share information and their experiences online (Cox C., et al., 2009). Online travel agencies,

despite not being classified as social media, employ social tools, such as featured customers' reviews and links to travel review websites, to facilitate the holiday planning and booking process (Mintel, 2013). This use of a social tool in e-commerce is referred to as social presence. Social presence is the feature that allows a user/customer to interact with other users within the e-commerce application. For example, Amazon provides social presence to users to write feedback about a product or service they have acquired. In the case of businesses, such user-generated content through the responses of other users is very influential in the decision-making process for product purchase by a potential customer as well as on the brand awareness of a product or an organisation. As Forbes (2013) showed people's reviews that encouraged users to purchase items are considered e-WOM. Litvin et al (2008) summarised the main characteristics of WOM: face-to-face communication, informal nature and no commercial involvement. Cox et al. (2009) point out that when customers share online their own views and experience of a product or service they create e-WOM. Consumer-generated product reviews (hereafter consumer reviews) make it easier than ever before for consumers to learn more about products from other consumers (Lee M at el., 2013). And because e-WOM takes place on an e-commerce or social media platform it is more powerful and influential than WOM as it can reach an unlimited number of users. However, Litvin et al (2008) pointed out that e-WOM comes from unknown individuals; therefore, the credibility of the information is not guaranteed. To deal with the anonymity of consumer reviews some companies, such as Amazon, are allowing users to create their own profile. Consumers began to trust online blogger's opinions and experiences more than those of marketing professionals (Sandu and Abalaesei, 2015). In addition, the significance of trust in assessing the risk of buying a product has been studied (Hajli, 2014). The author identifies benevolence

and credibility-based trust, which influence consumer behaviour and perception about a product. Credibility-based trust relates to the belief that the other user is credible and thus his/her comment or review on a product is trustworthy and impartial (Hajli, 2014).

Users go through a set of processes before making a purchase known as decision making processes (DMP). According to Mir and Rehman (2013), the number of reviews or the amount of UGC has a significant influence on consumers' behaviour about a product or service. Mir and Zaheer (2012), argued that when users share related information about a product or service, it increases its perceived credibility. Further, it strengthens the usefulness of the information that is shared on social media sites. Most users trust the UGC, product reviews, and ratings more than company generated information (Liu-Thompkins and Rogerson, 2012). Understanding the social media of users can allow organisations to influence the perception of their brand on social media and ensure that users are satisfied and have a favourable view of a company. According to Heinonen (2011), the marketing field is changing drastically where consumers are increasingly creating content, which is a shift from the past where companies solely controlled the content. In a study regarding UGC, Jonas (2010) found that it is considered an important, useful aid in the decision-making process of consumers. Users seeking UGC to inform their purchase decisions are interested in the number of reviews regarding shares, likes, comments, and ratings among others. However, it is worth noting that the actual content of the UGC is also an influential factor in the decision-making process (Cheong and Morris, 2008). If the reviews are positive, then an individual is more likely to purchase or have a positive perception of the product. On the other hand, significant amounts of negative reviews weaken the brand or trust of a product and thus reduce the likelihood of an individual purchasing it.

Product reviews and rating play a major role in the marketing of goods and services. Social media sites, such as Facebook among others, have introduced the ability to rate and review products easily. Additionally, consumers can also easily rate individual brand pages by expressing satisfaction or dissatisfaction with the business or specific products. A report by Power Review (2011) argued that product reviews and ratings are highly trusted and used by shoppers in making purchasing decisions. Indeed, Power Reviews (2014) found that 95% of online consumers actively seek for reviews before purchasing a product. Additionally, 24% of online users consult product reviews and ratings in every purchase that they make (Power Reviews, 2014). Thus, it is evident that organisations cannot ignore the influence of consumer generated product reviews and ratings about their services or business. According to Liu-Thompkins and Rogerson (2012), some of the ways through which product reviews influence consumer decision-making are based on their credibility and trust. Just like UGC, consumers view product reviews and ratings as more credible than company produced content. Since users find product reviews and ratings more trustworthy, businesses have to find ways through which they can maximise this capability by actively engaging consumers and addressing their concerns or responding to compliments where necessary (Sparks and Browning, 2011). Such an approach allows businesses to engage their consumers at a more personal level, which creates a perception of trustworthiness for the business and thus increases its credibility, which can then translate to more sales and success.

According to Solomon M. (2014, p.146), consumer behaviour is the process individuals or groups go through to select, purchase and use a product or a service. Many models have been developed to reflect on the stages the consumers go through before making a purchase. The stages include: problem recognition, information

search, evaluation of alternatives, product choice and post purchase evaluation (Solomon M., 2014, pp.146-148). Figure 2.9 shows the stages of the DMP and the link among the processes. The information search stage is considered as the main stage for the users to collect as much information as possible regarding a product or a service. Customers currently look for online or offline information sources that can be trusted to reduce the risk of the purchase (Parra-Lopez, 2010). Offline sources the consumer mainly relies on are WOM from friends and families. However, online information sources currently considered as e-WOM could include input from anonymous users in addition to friends and families. This has given rise to new shopping techniques and technology which improves social shopping with known or new friends (Ashman R., et al., 2015).

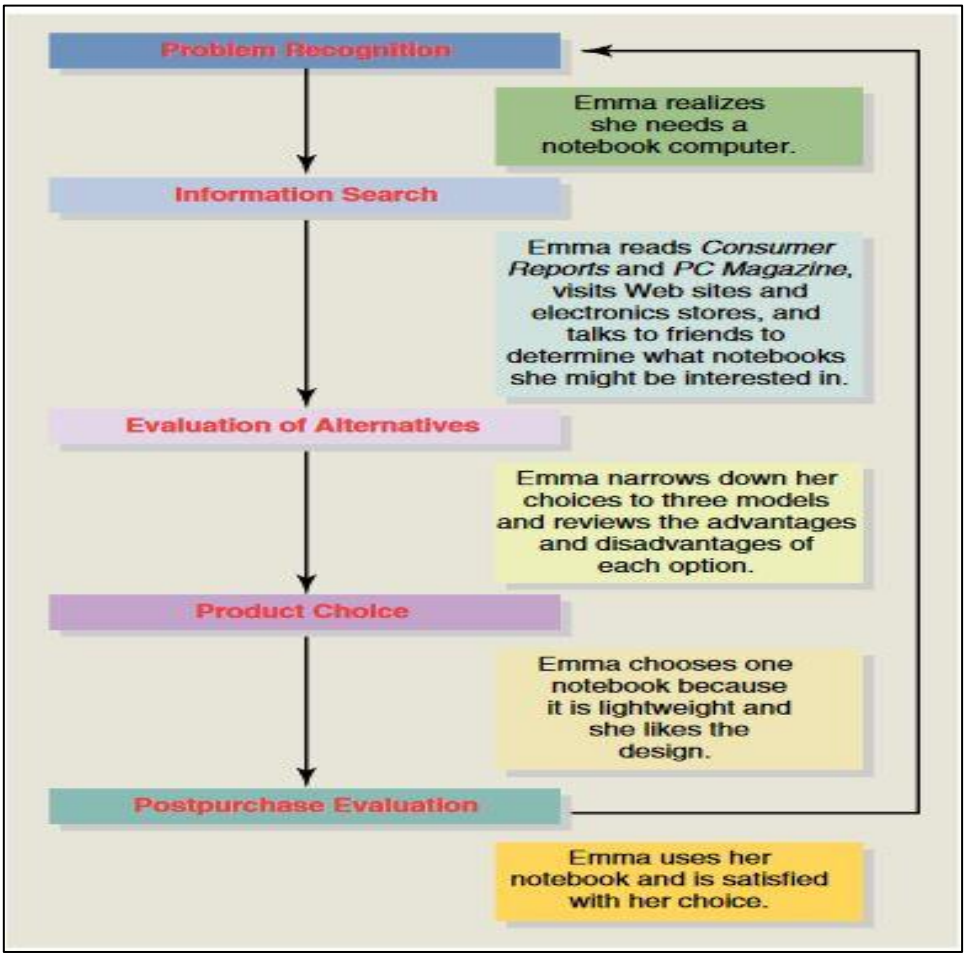


Figure 2.9: Consumer purchase decision process (Solomon M., 2014, pp:147).

E-WOM has delivered social shopping which has changed the online shopping behaviour of users as now they can engage and interact, through the virtual environment, to provide valuable feedback on their purchases which could impact the decisions of other users or consumers. Social shopping allows online shoppers to simulate the experience of a brick-and-mortar store by accessing feedback from other people, either before or after deciding on the purchase (Ashman R., et al., 2015). The use of e-WOM has become highly popular as it is fast, saveable, and sometimes anonymous, which gives users more flexibility to comment and respond to a product or service (Cheong and Morris, 2008). Consumers are in a position to easily respond to and engage with sellers in an interactive process in commenting, positively or negatively, about the products or services, and organisations cannot ignore this power of the social media user-consumer (Chu, 2011). Therefore, product reviews through e-commerce or social media sites are considered a vital piece of information for the user before making a purchase and considered another vital tool to provide a feedback to others after the purchase.

2.7 Critical Conclusion

The use of the environment of sounds in user interfaces has proven that it can effectively be applied to present simple or complicated information. Multimodality, as showed through previous studies, improves the users' performance. Social media has been employed by companies to produce marketing or promotion campaigns as it (social media) has shown to be the cheapest platform for such activities. Creating customer loyalty in the online environment is not a simple process which has urged companies to turn to social media features, such as social presence, which could play a role in influencing loyalty and trust. Users are likely to be influenced by other

customers through the comments, reviews, and ratings that are posted on social media. Hence the researcher will examine social media influence (without considering the social presence) as a resource of product reviews, as usually the user's social media networks include people who he/she knows and those people (friends, family) do not have an interest in highly rating an e-commerce site to another person.

Chapter 3

Experimental Phase I:

An Empirical Investigation on the Impact of Multi-modal Social Media Messages in e-Commerce Interfaces

3.1 Introduction

This chapter describes the experiments (first experimental phase) investigating the usability and impact on users of multimodal social media review messages in e-commerce. The multimodal messages used incorporated presentations of different metaphors such as text with the presence or absence of emojis, non-speech sounds (earcons) and avatars with facial expression. The main aim was to identify empirically the suitability of multimodal presentations when used as part of social media based review messages. The experiments also aimed to identify whether the inclusion of such metaphors can improve the user experience and usability of e-commerce interfaces. An e-commerce experimental platform was developed to act as a basis for these experiments. Three conditions were implemented and investigated. These were (1) text with emoji's and on its own, (2) earcons and (3) an avatar with facial expressions. The study involved three groups (one group for each review presentation) in which the usability performance of the groups in terms of efficiency, effectiveness and user satisfaction was measured and compared.

3.2Aims

The aim was to obtain an overall overview of whether the multimodal presentation of social media product reviews can outperform the traditional textual presentation. The aim was to examine the association of employing multimodal presentations of social media reviews and techniques in product reviews. In addition to that, to evaluate multimodal review messages in terms of effectiveness and efficiency of review presentations. Also, to Identify the impact of different multimodal presentations on the user performance. More specifically to evaluate the impact of multimodal metaphor e-commerce product reviews and assess the usefulness of earcons (short musical stimuli) and facially expressive avatars in in the context of review presentations and to identify usability when users received these messages during different task circumstances and difficulty. The additional aim considered was to examine the link between social media as review source and the purchase decision.

3.3Objectives

To achieve the aims stated the objectives needed were to provide the experimental hypotheses based on the aims. Also, to develop the experimental platform examining the three experimental conditions textual review presentation (TRP), earcon review presentation (ERP) and facially expressive avatar review presentation (FRP). In addition to that, objective needed to evaluate the experimental conditions with tasks that reflect a variety of review presentations (using different social media resources) and difficulty in order to gather product reviews particularly when a comparison of two, three and four products was presented with usability measurements presented in efficiency of task completion (time taken by user to complete all tasks),effectiveness of multimodal metaphors (correct task completion) and post experimental user

viewpoint (including social media reviews source) and satisfaction of the review metaphor presentations.

3.4 Hypotheses

The main experimental hypothesis was that the impact of multimodal metaphor presentations of social media based product reviews in an e-commerce site will outperform the traditional and typical textual e-commerce based reviews using parameters such as effectiveness, efficiency and user satisfaction. Sub-hypotheses were specifically related to the experimental platform. These sub-hypotheses were:

H1: (a) ERP (Earcon review presentation) in single product reviews will be more efficient than in comparisons of two, three or four products.

(b) FRP (Facially expressive avatar review presentation) will have the same efficiency in comparisons of one, two, three or four products.

(c) FRP (Facially expressive avatar review presentation) will have more efficiency than TRP (Textual review presentation) and ERP(Earcon review presentation) in product comparisons.

H2: (a) FRP (Facially expressive avatar review presentation) will be more effective than TRP (Textual review presentation) and ERP (Earcon review presentation) in terms of tasks completed successfully.

(b) ERP (Earcon review presentation) will be more effective than TRP (Textual review presentation) in terms of tasks completed successfully.

H3: One social media review source (Facebook) has more efficiency than another (Twitter).

H4: Users will be more satisfied with TRP (Textual review presentation) than ERP (Earcon review presentation) and FRP (Facially expressive avatar review presentation) in product comparisons.

3.5 Experimental Platform

A special e-commerce platform was developed by the author in order to be used in this empirical examination. The platform was developed using Microsoft Visual VB.Net 2010, VB.Net is an efficient web development language. Figure 3.1 represents the structure (conceptual framework) of the implementation of the experimental platform. This platform was implemented according to the experimental phases of this research study. This section explains the design and implementation of the experimental platform for each of the conditions.

The platform provided three different review presentations; text (with/without emoji's) presentation, earcon review presentation and a facial expression avatar presentation. All the review presentations of the platform were designed to have the reviews sourced from social media, in particular from Facebook and Twitter. In addition to that, the review presentations were designed to deliver the same information about the products being displayed. The presented content included three sections: the product, product specification and the reviews. The product and the product specification were the same for all the different review presentations, while the reviews were presented differently based on the review presentation being examined.

Prior to the development of the experiment and the platform the researcher conducted a pre-platform-design study (see Appendix A) that included 20 users to indicate the tasks' difficulty level according to how many products were displayed. The study showed that the users considered single-product display and two-product

comparisons to be an easy interface, three-product comparisons to be moderate while four-product comparisons to be complex or difficult. The complexity of these tasks was increased with every task and each task was presented separately from its previous task with the use of the same review presentation. This study considered evaluating social media reviews using different presentation layouts according to three keys: one is the traditional textual presentation, TRP, which is the current review with additional emojis; secondly using multimodal metaphor earcons (music files) to present reviews, ERP; and finally using another multimodal metaphor of a facial expression avatar.

In each condition, the user will have to finish four tasks: the first a presentation for a single product and then presentations that compare two, three and four products respectively. Table 3.1 shows the mapping between content and the multimodal metaphor. It can be noticed that customer reviews use text only in presenting the information. On the other hand, the review ratings are presented using text and a multimodal approach using different metaphors to support the delivery of the different ratings. In addition to that the social media source is presented using only text to reflect the source of the reviews/rating being presented.

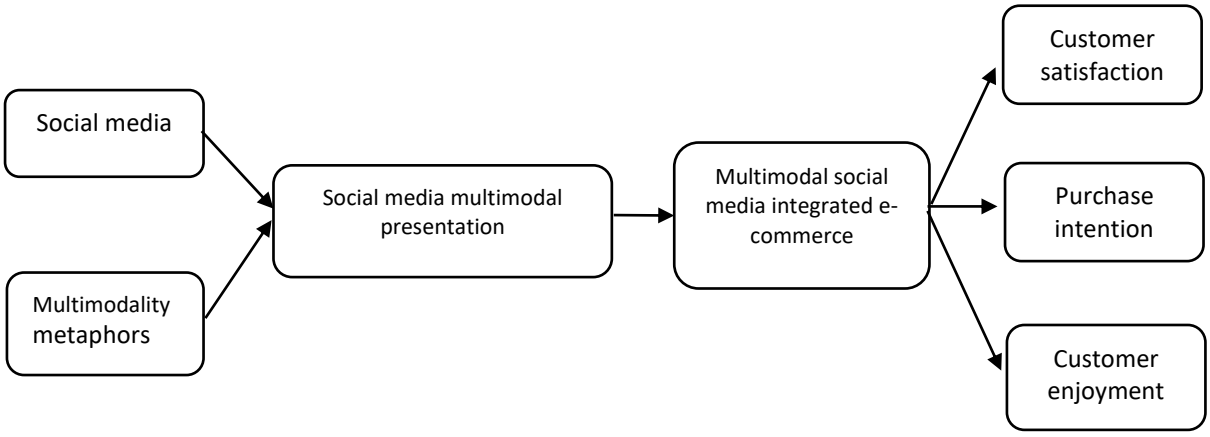


Figure 3.1: Conceptual model for the relationship between social media review messages, with multimodal metaphors for multimodal social media integrated e-commerce and customer satisfaction, purchase intention and enjoyment.

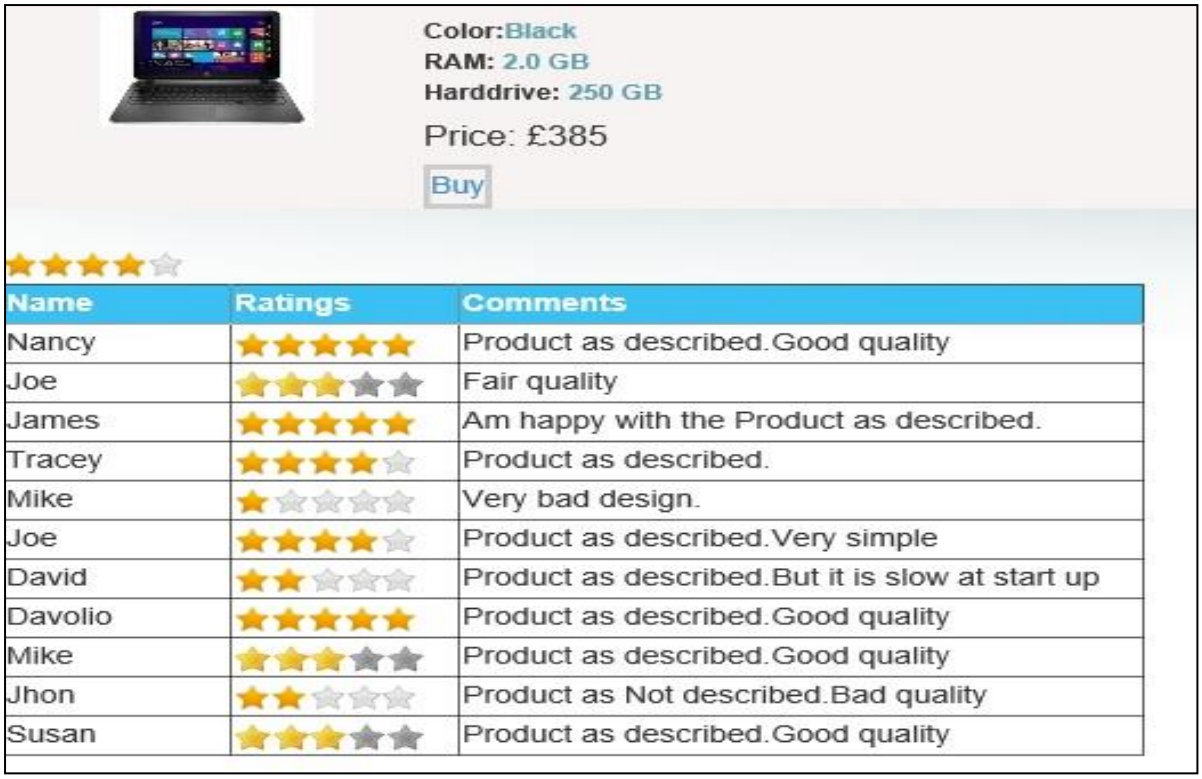
Experiment	Multimodal Social messages interaction				
Interaction Metaphor / Content	Text	Graphics	Colours	Earcons	Facial Expression Avatar
Product Description	✓				
Price	✓		✓		
Customer Reviews	✓				
Reviews Ratings	✓	✓		✓	✓
Social Media Source	✓				

Table3.1: The allocation of metaphors to the information communicated.

In summary, the TPR involved the use of text only (with the use of emojis) whereas the multimodal review presentations used two multimodal metaphors the EPR and the FRP. The ERP is categorised by the use of different musical notes while the FRP presented the reviews using human facial expressions presented by an avatar.

3.5.1 Textual Reviews Presentation E-Commerce (TRP)

Figure 3.2 shows an example screenshot of the textual review presentation e-commerce interface in which the reviews were presented using text for a single product, while Figure 3.3 presents reviews using text and emojis for a two-product comparison without the use of any other communication channel. Only the visual channel of the human senses was used to deliver the review rating. This presentation was designed to include overall rating and the rating's review text from the social media network (Facebook or Twitter).



Name	Ratings	Comments
Nancy	★★★★★	Product as described.Good quality
Joe	★★★☆☆	Fair quality
James	★★★★★	Am happy with the Product as described.
Tracey	★★★★☆	Product as described.
Mike	★☆☆☆☆	Very bad design.
Joe	★★★★☆	Product as described.Very simple
David	★★☆☆☆	Product as described.But it is slow at start up
Davolio	★★★★★	Product as described.Good quality
Mike	★★★☆☆	Product as described.Good quality
Jhon	★★☆☆☆	Product as Not described.Bad quality
Susan	★★★☆☆	Product as described.Good quality

Figure 3.2: One-product textual review presentation.

In the experimental build, the user reads the task requirement regarding the product for selection. This is the traditional e-commerce review presentation that is currently applied and used by most of the e-commerce sites with added emojis in the review text to examine their impact on the users. The review page gives a list of related product reviews that will help the user in making the right selection. The users will need to read the task description and the product reviews being presented. Users will go through the list of available products trying to find the required product (specified in the task requirement). The assumption is that the users will be able to successfully match the selection with the task requirement.

3.5.2 Review Messages with Multimodal Presentations

Figure 3.4 shows an example screenshot of a multimodal review presentation interface. The implementation of the multimodal metaphor interfaces involved in the experiment was based on the connection between the social media product rating

reviews to be communicated and the interaction metaphors. These connections were built upon previous findings that showed the use of multimodality in other problem domains (see Section 2.4). Additionally, guidelines for multimodal information presentation (Sarter N., 2006) were followed. For instance, to extend the amount of information transfer multimodality was used as an output medium (Oviatt S., 2003; Sarter N., 2006); some of these modalities may be capable of expressing semantically rich information and creating new content (Oviatt S., 2015). The use of specific facial expression avatars is due to their positive influence (Rigas and Almutairi, 2013). Moreover, speech and non-speech along with graphical displays were used and combined to acquire more effective (than the text and graphs) presentation (Reeves L., et al., 2004); speech can be used as auditory displays to present varying messages (Baber and Noyes, 2003); while non-speech can be used to facilitate communication and interpretation of other data content (Krammer G., et al., 2010); and the use of timbre, rhythms and short notes to communicate information (Rigas et al., 2005).

Description	Product 1	Product 2
Image		
Hard Drive	500 GB	500 GB
RAM	2.0 GB	2.0 GB
Price	£450	£450
Review Source	Facebook	Twitter
Overall Ratings	★★☆☆☆	★★☆☆☆

Reviews

Name	Ratings	Comments
Jack	★★★★★	Product as described.Fair quality 👍
Mike	★★★★★	The specs more than the design -- even though the design is nice. 😃
Ann	★★★★★	Product as described.Fair quality 👍
Joe	★★★★★	That is precisely what I was expecting.Product as described.Fair quality 👍

Reviews

Name	Ratings	Comments
Nancy	★☆☆☆☆	Product not as described.
Nancy	★☆☆☆☆	Product not as described.
Jack	★★★☆☆	Product as described.Fair quality
Mike	★★★★☆	The specs more than the design -- even though the design is nice.

Figure 3.3: Two-product comparison textual reviews with emoji's.

The reviews' text content along with the social media network sources that were used in the textual presentation were replicated in the multimodal review presentation interface. The review ratings were removed and replaced with earcons and facial expression avatars. This different approach of rating information presentation was offered where the user can read reviews and listen to the earcons (or just listen to the earcons to determine the rating score) or the user can determine the rating through the facial expression avatar.

3.5.2.1 Implementation of Earcon Review Presentation (ERP)

The implementation of the earcons to create this presentation, (ERP), involved using various technologies. Previous studies showed that earcons can be used to successfully communicate information, especially numerical (Ciuffreda A., 2008; Bonbright T et al., 2001; Upson R., 2002; Alty J. and D. Rigas, 2005; Rigas D. et al., 2000; Rigas D. and Alty J., 1998). Hence, earcons were used to deliver and communicate the review rating in the ERP (earcon review presentation). The earcon design followed the guidelines presented in previous studies (Rigas D. 1996; Brewster S. et al., 1995; Rigas D. et al., 2005). The ERP interface had the required information of the review ratings communicated using the earcons in addition to the use of text and graphics in the interface. Musical notes were created to communicate the different review ratings from one to five; five musical notes were utilised to communicate the different rating scores (from 1 to 5). Each rating review had a musical note associated to it. Earcon creation guidelines suggested using different timbres, pitch and rhythm (Brewster S., et al., 1994). Based on Brewster et al., guidelines (1995) different timbres were used to communicate different ratings in two-, three- and four-product comparisons. Figure 3.4 shows the tree structure design for the earcons with top down instrument usage approach. For example, starting from the top, one instrument (Piano)

was used for the one-product review presentation; the next branch (two-product comparison) would use the first branch (Piano) for one product along with the second branch instrument (Guitar) for the second-product comparison, and so on for all other ones. Table 3.2 shows the design structure of these earcons along with the used musical instrument to deliver the required timbre. Each musical file (that demonstrated a certain ranking score) was played for 4 seconds. According to the rank to be communicated the pitch changed from rising to declining pitch. The use of different timbres would help the user in recognising the ranking to be communicated where there were two or more product comparisons. As Edworthy et al., (1989) showed, attention-grabbing sounds can be created by varying sound parameters; as in this experiment (timbre and intensity).

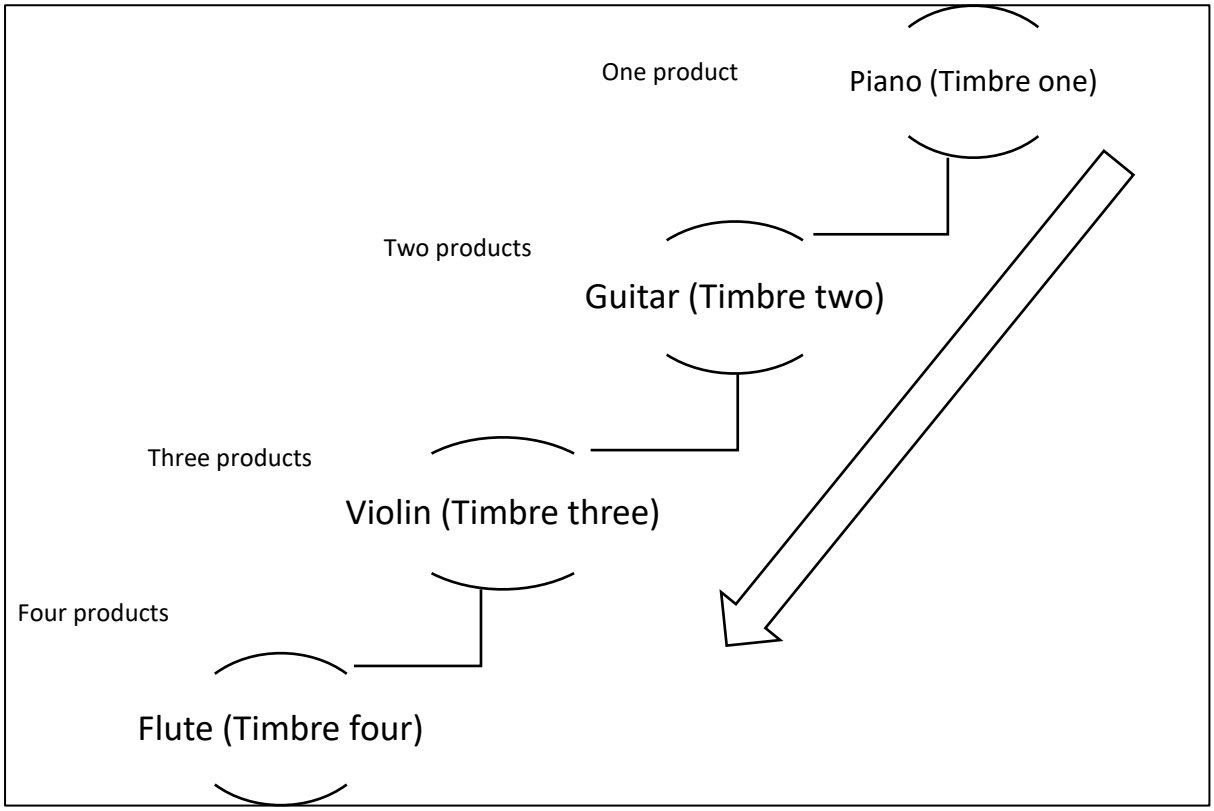


Figure 3.4: Earcons' tree structure used in the experiment.

Timbre / Ranking		Piano	Guitar	Violin	Flute
1	**Notes**	A	D	E6	A3
	Rhythm	Fading	Fading	Fading	Fading
2	**Notes**	C	A	C4	G4
	Rhythm	Single	Single	Single	Single
3	**Notes**	E	G	A4	B4
	Rhythm	Rising	Rising	Rising	Rising
4	**Notes**	G	High E	F4	C5
	Rhythm	Rising	Rising	Rising	Rising
5	**Notes**	Sharp F	C	C5	E4
	Rhythm	Rising	Rising	Rising	Rising

Table 3.2: Structure of earcons to communicate the different ratings in ERP.

Figure 3.5: Earcon product review presentation.

Also, as Rigas et al., (2005) suggested, the use of different timbre and notes was important to communicate information and to aid any disambiguation. Hence, different notes for every musical instrument were applied which aimed to help the users understand the information being communicated. When one or more parameters of the non-speech sound are altered, acoustic changes may occur in other parameters that characterise that particular non-speech sound (Rigas and Memery, 2003). Figure 3.5 presents a screenshot of the ERP interface where the files presented musical notes.

3.5.2.2 Implementation of Facially Expressive Avatar Presentation (FRP)

Figure 3.6 show an example screenshot of the facial expression avatar review presentation. The implementation of the facial expression avatars used in the experiment was based on the connection of the expressions used in our daily life and the review rating to be communicated or presented. Fabri M. et al., (2002) presented the facial expressions used in our daily life. In order to create the facially expressive avatar, the Poser tool was used to create the face with the implementation of the expression required for the experiment. Poser has a built-in collection of characters with the option of customisable facial expressions. The output file was stored as a picture format (JPG) to be inserted and used in the experiment. Figure 3.7 shows the facial expressions used in the FRP interface. Table 3.3 presents the mapping of the facial expressions with the rating value.

The rating 3 was considered to be presenting a neutral ranking ranging from 2.5 to 3; any value between 2 and 2.4 was considered to be sad. Moreover, any value less than 2 mapped to the angry expression. The smile and the happy facial expressions were mapped to ratings of 4 and 5 respectively.

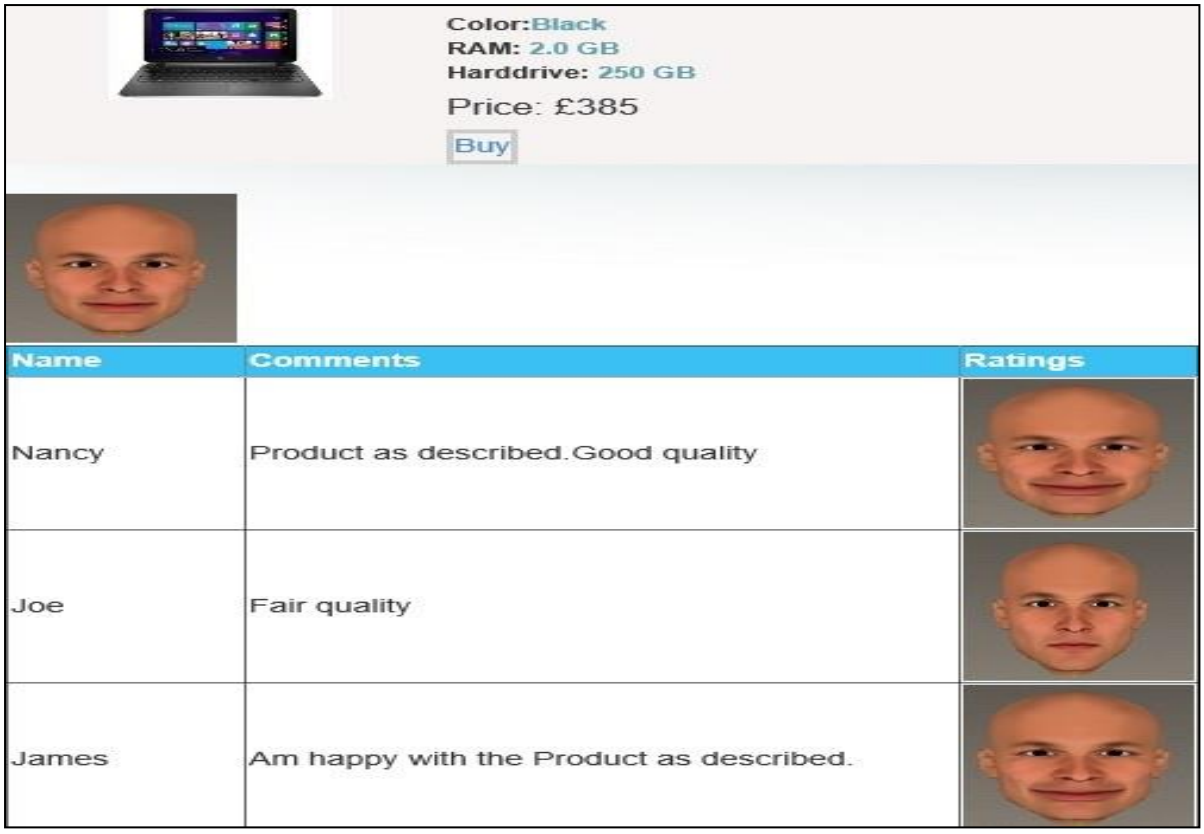


Figure 3.6: Facial expression product review presentation.

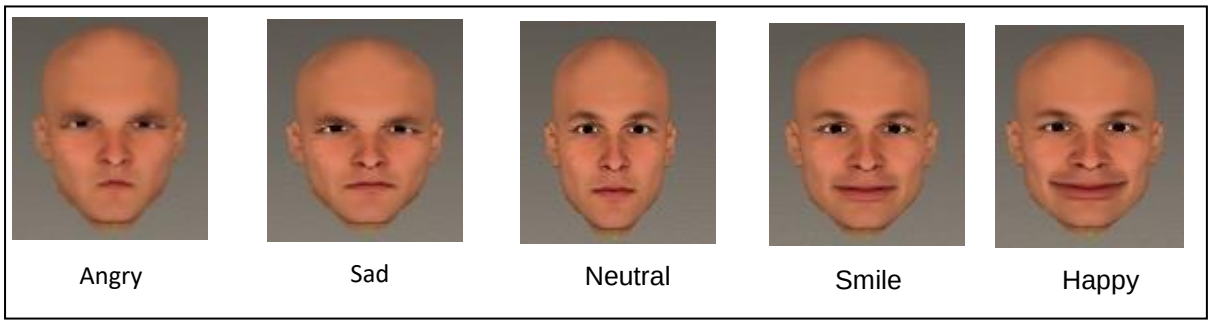


Figure 3.7: Facial expressions used in the FRP.

3.6 Experimental Design

In order to examine the effect of the multimodal metaphor review presentations against textual reviews to find out which presentation would provide better efficiency, effectiveness and user satisfaction for product and e-commerce reviews, both presentations, textual and multimodal, were empirically evaluated. The between-subject design methodology was applied.

Rating	Expression	Picture
1	Angry	
2	Sad	
3	Neutral	
4	Smile	
5	Happy	

Table 3.3: Facial expressions rating mapping.

Presentation / Groups	TRP	ERP	FRP
Group I (n=12)	✓		
Group II		✓	
Group III			✓

Table 3.4: Groups experiment mapping.

Each user was exposed to different rating presentations and four experimental tasks. The user sample consisted of 36 users evenly divided into three different groups. Each group consisting of 12 users examined only one mode of information presentation made up of fours tasks as in Table 3.4. The experiment consisted of four parts:

1. Pre-experiment questionnaire
2. Perform tasks

3. Post-task questions
4. Post-experiment questions.

3.6.1 Procedure

For consistency throughout the experiment, the same procedure was applied for the three groups. The experiment started by reading and answering the pre-experiment questions that presented the user's profile of personal information (e.g. age, gender and education). Also, the pre-experiment questionnaire required that the users declare their previous experience using computers, internet and online shopping. In addition to that, the users were also required to answer questions related to the social media and social media network they use. After finishing the pre-experiment questionnaire, users were presented with a video tutorial for five minutes. The tutorial presented an introduction to the e-commerce platform that the user was going to use. The tutorial was directed to each group; hence three tutorial videos were used presenting the three interfaces implemented. All the videos showed and explained the design of the platform. However, every group had a different review interface according to the interface to be tested. Group 1 had the textual review interface tutorial showing the textual reviews along with emojis. While Group 2 had the tutorial demonstrating the use of earcons in the product reviews. The earcon files played during the tutorial presented the ranking to be communicated with each file played twice. For Group 3 the facial expression interface tutorial was presented to demonstrate the link between facial expressions and the rating to be presented. Thereafter, the users were asked to start performing four common tasks.

On task completion, users were asked to give their satisfaction regarding the platform and the tested review interface through answering the questionnaires designed for the

post experiment experience. Refer to Appendix A for the questionnaires used to conduct the experiment. Figure 3.8 presents the experiment flow chart.

3.6.2 Tasks

Each group performed the same four common tasks but with a different presentation method for each group. Previous studies showed that the metaphors are affected by the level (Rigas D. and Hopwood D., 2003; Rigas D. and Ciuffreda A., 2007) and the type of task being examined (Rashid S. and Rigas D., 2008; Alotaibi M. and Rigas D., 2008). Hence, the tasks were designed to follow the same procedures as previous experiments by increasing the level of difficulty in each task. The tasks' difficulties were divided into easy (one-product presentation and two-product comparison presentation), moderate (three-product comparison presentation) and difficult (four-product comparison presentation). Each task had a set of requirements; the user had to choose the right product based on certain review criteria given to him\her and these reviews varied from one task to another. For instance, for Group 1 Task 1, the reviews were simply presented one-by-one (one product review interface), while Task 2 presented reviews and ratings of two compared products, Task 3 presented reviews and ratings of three compared products and Task 4 presented reviews and ratings of four compared products. The task complexity depends on two things: the task number (1, 2, 3, and 4) and the presentation. As the user proceeded from one task to another task the RP (review presentations) difficulty increased as more reviews were presented at the same time. The more complex the task the more requirements and the more reviews were presented. Therefore, the more difficult the task was the more information was communicated; hence the complex tasks contained a larger volume

of information compared to the easy and moderate tasks. Table 3.5 demonstrates the mapping of tasks and products compared (at the same time) with the complexity level.

Upon the completion of each task, users had to answer questions based on that task. Questions reflected the task difficulty through checking if it was easy to find the requested product based on the review presentation and to check if reviews were read, and the number of reviews read. Also, the post task questions helped to determine if users would choose a product according to certain reviews' source. The aim of these questions was to evaluate the performance of the user based on the information and the review interface presented by the task. The first group of users (Group 1) evaluated the TRP, all starting with easy difficulty level, checking one product at a time and comparing two products at a time. For every presentation, the user was requested to choose the right product. For the moderate level, the group was presented with a three-product comparison showing all the reviews textually from which the user needed to choose the right product. For the final Task 4, the comparison of four products at the same time as a textual presentation, the user had to select one and only one product.

Tasks	**Complexity level**	**Products comparison**
T1	Easy	One
T2		Two
T3	Moderate	Three
T4	Difficult	Four

Table 3.5: Mapping tasks complexity with product comparison.

As Group 1 tested the textual presentation, Group 2 tested the impact of earcons. For Group 2 earcons were used to communicate messages that reflect the review ratings for that product. Easy level contained two tasks (1 and 2). Task 1 presented a single musical file that demonstrated the product rating according to the reviews. Task 2 showed the grid of two products with their associated earcon presentation to demonstrate the reviews. Tasks 3 and 4 presented three- and four-product grids respectively where each product had an associated musical file review. The final Group 3 tested the presence of a facial expression avatar to communicate the reviews.

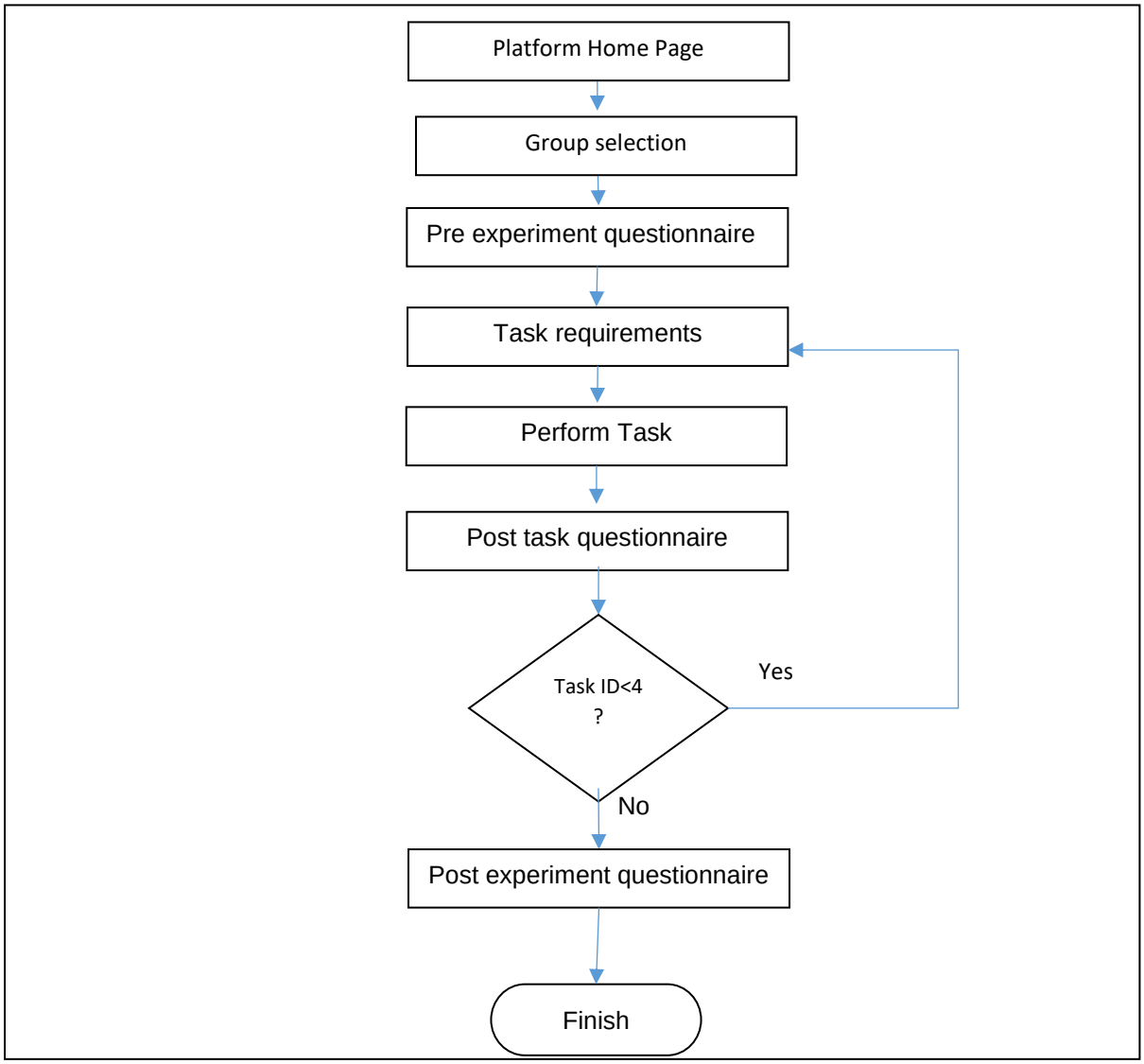


Figure 3.8: Experiment flow chart.

For Task 1, a single facial avatar was presented while for Task 2 two facial avatars were presented simultaneously. Tasks 3 and 4 presented grids of 3 and 4 products respectively where each had the metaphor review presentation of a facially expressive avatar. Table 3.4 demonstrates the experimental procedures of tasks, difficulty and groups.

3.6.3 Variables

The variables considered for the experimental design were classified into three types: dependant, independent and controlled variables (Field A, 2013, p: 430-484).

Groups-Test	**Allocation of tasks to the complexity level and groups**		
	Easy	**Moderate**	**Difficult**
Group I -Textual	T1 T2	T3	T4
Group II -Earcons	T1 T2	T3	T4
Group III -Avatar	T1 T2	T3	T4

Table 3.4: Experimental procedure tasks, complexity level and groups.

Variable code	**Variable name**	**Experimental Condition**
IV 1	Review presentation mode	Textual
		Earcons
		Facial expression avatar
IV 2	Complexity level	Easy
		Moderate
		Difficult
IV 3	Social media source	Facebook
		Twitter

Table 3.5: Independent variables considered for the experiment.

3.6.3.1 Independent

Independent variables were the factors manipulated in the experiment and considered to be the cause of the result (Kranzler J., 2003). These variables were:

IV 1: *Review presentation mode:* the experiment presented three review presentations: textual, earcons and facially expressive avatars.

IV 2: *Social media source:* the experiment used two social media as review sources which were Facebook and Twitter.

IV 3: *Task difficulty level:* the tasks' complexity level increased as the user proceeded from one task to another. Table 3.5 presents the independent variables with respect to the variable name in the experiment.

3.6.3.2 Dependent

The dependent variables are the ones being measured after manipulating the independent variable (Field A., 2013, p: 65-109). The dependant variables used were:

DV 1: *Task time:* duration taken by the user to complete each task.

DV 2: *Task successfulness:* to measure the task completion success by checking whether the correct product was chosen. Task was considered successfully completed if the selection choice was correct.

Variable code	Variable name	Measures
DV 1	Task time	Efficiency
DV 2	Task successfulness	Effectiveness
DV 3	User satisfaction	Satisfaction
DV 4	Social media preference source	Source preference

Table 3.6: Dependent variables considered for the experiment.

DV 3: *User satisfaction:* to measure user satisfaction by completing user satisfaction questionnaires. A user satisfaction questionnaire provided information on various aspects such as complexity, familiarity and help. Questionnaires were designed using a 6-point Likert scale. The system usability scale (SUS) scoring method (Brooke J., 1996, p:189-194) was used to calculate user satisfaction overall as well as for each presentation metaphor.

DV 4: *Preference of social media source:* on completion of the tasks, users answered questions to measure their preference of social media review source. Users scored their agreement/disagreement using a 6-point Likert scale.

Table 3.6 summarises the dependent variables used in the experiment.

3.6.3.3 Control

The controlled variables should be kept consistent throughout the experiment to avoid their influence on the dependent variables and so ascertain that the independent variables are the only cause of the experimental results (Field A, 2013, p: 269-308). The variables that were associated with this experiment are:

CV 1: *Required tasks:* the same tasks were required to be completed by the users but with different presentation used among the groups.

CV 2: *Experiment Consistency*: the experiment was conducted using the same procedure for all groups.

CV 3: *Familiarity:* all users had no training or introduction session before the experiment. All the users were first-time users of the tested platform with no prior knowledge of multimodal metaphors.

CV 4: *Task requirements:* the requirements of the tasks were the same between the groups.

3.6.4 Sampling

A total of 36 people volunteered to the study. All were first-time users of the experimental platform. The sample was opportunistic. The 36 users were randomly assigned to three groups (n=12) to test the review presentations' conditions: (1) textual presentation; (2) earcon presentation; and (3) facially expressive avatar presentation. This number of users in groups is sufficient to provide a usability evaluation (Nelson J., 1993). The users in groups had no prior knowledge of multimodal metaphors, which indicated that they only relied on their interaction with the platform to perform the tasks and answer the questionnaires.

3.7 Data Collection

The data collection involved questionnaires and experimental observations. The users were required to answer four questions after the completion of each task. In order to obtain the efficiency, the time taken by each user to answer the questions was observed. Moreover, to measure the effectiveness, the correctness of the user's selection was measured. The total number of successful selections was counted for each user. A pre-experiment questionnaire gathered user profile data such as age, gender, education level, users' prior experience with the internet, online e-commerce activity, writing or reading reviews, and the use of social media. The collected data were analysed using descriptive statistics. The descriptive statistics presented comparisons and summaries between the groups on the experimental observation.

The post-experiment questionnaire aimed to measure user satisfaction with the presentation methods. The user response was used to calculate an individual user satisfaction score. The satisfaction scores of all users within a group was used to calculate the overall satisfaction score of the group.

3.8 Sample Profile

Pre-experiment questionnaires were used to collect and to gather the profile of the sample. Users' information such as gender, age and education were collected and analysed. In addition to the users' personal information, data related to previous knowledge of using computers, internet and online shopping frequency were also collected and analysed. Figure 3.9 presents the profile of the sample used. It shows that the age range in Group 1 was 58.33% in the range of 25-34, 36.11% in range 18-24 and 5.56% in range of 35-44. Group 2 had the age range of 66.67% in 25-34, 25% in range 18-24 and 8.33% in the range 35-44. Group 3 had the age range of 58.33% in range of 25-34, 36.34% in the age range of 18-24 and 5.33% in the range 35-44. The majority of the participants were males with 75% in Group 1, 66.67% in Group 2 and 83.33% in Group 3. Females were 25% in Group-one, 33.33% in Group 2 and 16.67% in Group 3. The education level was dominantly undergraduates with 50% in all the three groups.

The groups had close figures for the second highest level of education to be Master's level with 36.33% in Group 1, 33.33% in Group 2 and 41.67% in Group 3.

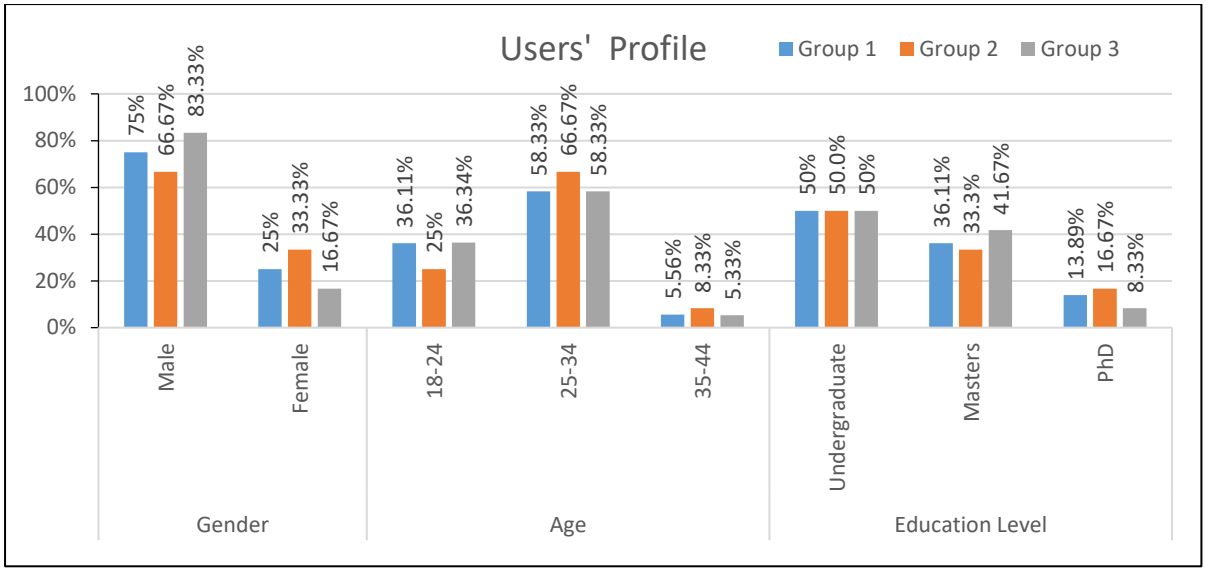


Figure 3.9: Users' profile in terms of age, gender, and education level in the three groups.

The level of PhD users was low with a presence of 13.89% in Group 1, 16.67% in Group 2 and 8.33% in Group 3.

Figure 3.10 presents users' knowledge with regards to the use of computers and the internet. The data presented shows that the users had a good knowledge of using computers for more than 10 hours a week with 75% in Group 1, 58.33% Group 2 and 66.67% in Group 3. While with respect to internet use for more than 10 hours a week Group 1 had 75% while Group 2 and Group 3 had 66.67% each. Also, Figure 3.10 presents data regarding users' online shopping frequency. Fifty percent of users moderately shop online in Groups 2 and 3 compared to 41.67% in Group 1. In another shopping frequency pattern, the figure reveals that 31.33% of users in Group 1 shop quite often online, while 25% in Group 3 compared to 16.67% in Group 2 do so. The last online shopping pattern revealed by the figure is the slightly often online shopping; Groups 1, 2 and 3 had 25%, 33.33% and 25% respectively.

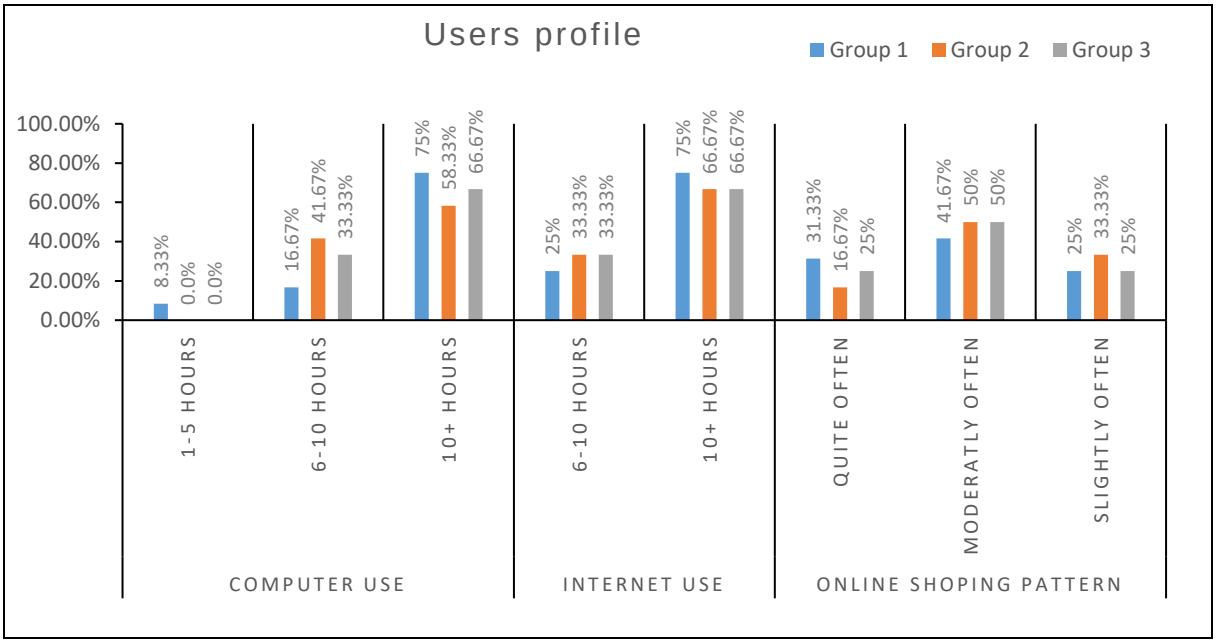


Figure 3.10: Users' knowledge in terms of using computers, internet and online shopping frequency.

These figures indicated that the users have a good education level (mainly Bachelor degree), good knowledge of using computers, good level of internet experience and familiarity with online shopping.The sample had a high education level which gave them the ability to understand the requirements better than lower level education users, such as high school users.

Other data related to product rating, reviews and social media were collected from the users in the pre-experiment questionnaires. Figure 3.11 presents the users' product rating approach with regards to reading and writing reviews. The three groups had a figure of 100% for reading reviews, while the figures varied for writing reviews, as Group 1 had 50%, with 41.67% for both Groups 2 and 3. Regarding the time spent reading reviews the groups showed slight differences in that area. Fifty percent of users usually spend 4 to 6 minutes reading reviews in both Groups 1 and 3 with only 41.67% of users in Group 2. Zero percent of users in Group 3 usually spend 1 to 3 minutes compared to 33.33% in Group 1 and 8.33% in Group 2. Moreover, 41.67% of

users usually spend 7 to 9 minutes reading reviews in Group 2, while 33.33% do in Group 3 and 8.33% in Group 1. Not many users among the groups actually spent more than 10 minutes with 8.33% in Group 1, 8.34% in Group 2 and 16.67% in Group 3.

Users' social media preference, as presented in Figure 3.12, shows that Facebook is the preferred social media network with 100% in all groups. Also, Figure 3.12 reveals that Twitter was considered as the second preferred and used social media network among the users with 58.3% in Groups 2 and 3 with 25% for Group 1.

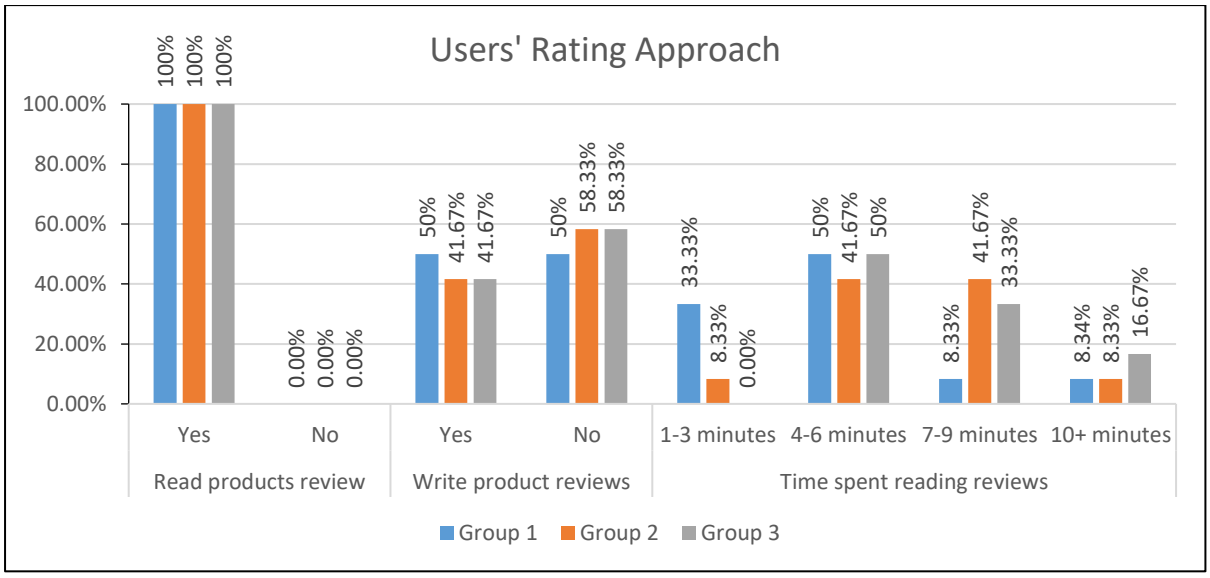


Figure 3.11: Users' rating approach in terms of reading, writing reviews and time spent reading reviews.

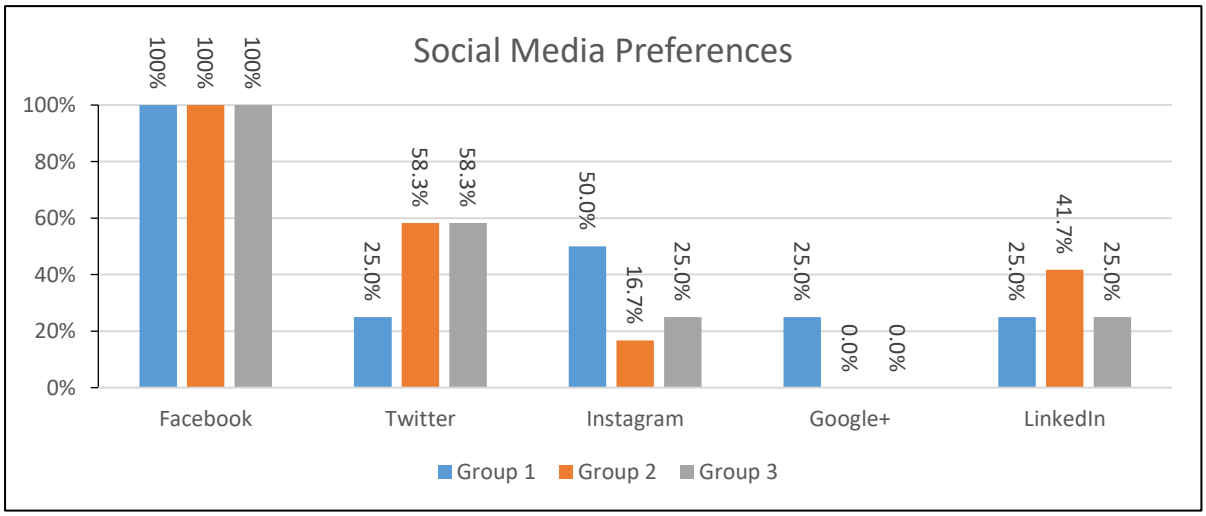


Figure 3.12: Users' social media network preferences.

Figure 3.13 represents the last data collected using the pre-experiment questionnaires which related to reviews' trust and recommendation when it comes to online shopping. Users answered questions related to online shopping principles using a Likert scale of 6 to demonstrate their level of agreement to the statements. These data demonstrated that 58.3% of users in Groups 1 and 2 don't trust online reviews while 50% in Group 1 trust the online reviews. Regarding buying products based on family and friend's recommendations, 75% of users in Group 3 agreed on buying products based on their recommendations, Group 2 users showed that only 50% did so while 41.7% in Group 1 agreed that usually they buy products based on the recommendations. The users' profile presented shows that the three groups presented with the textual, earcon and facially expressive avatar presentations were relevant to a large extent in terms of users' shopping characteristics, prior knowledge and social media use. Therefore, the differences among the three presentation groups obtained in the experimental study results could be linked to the interface condition applied to the participants.

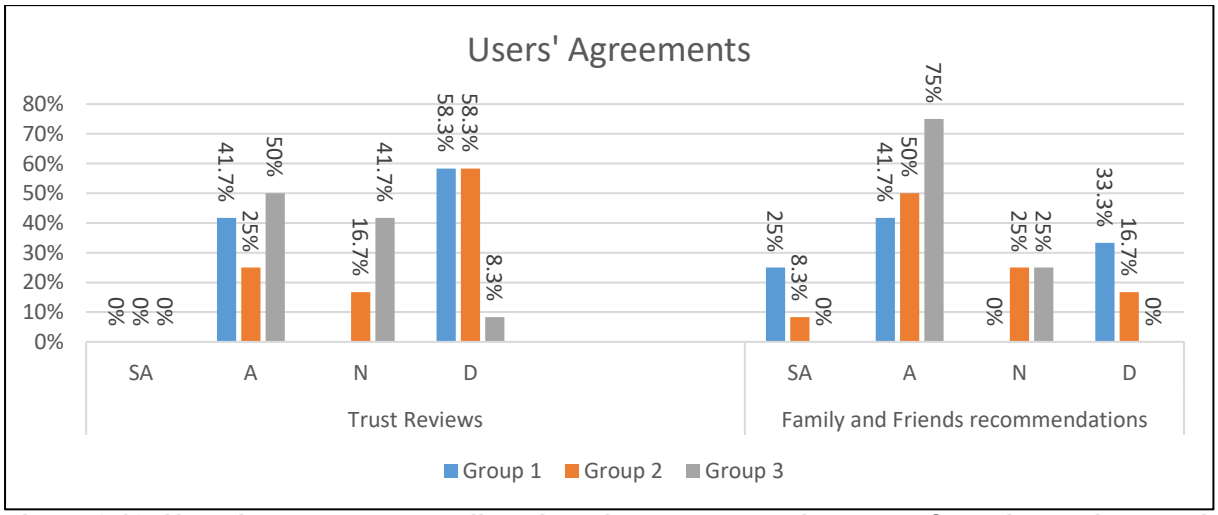


Figure 3.13: Users' agreement on online shopping statements in terms of trusting reviews and purchasing based on family and friend's recommendations.

3.9 Results and Analysis

The results of the three groups were analysed in terms of the time taken by users to finish the tasks (efficiency), number of correct choices or selections (effectiveness) and users' perception ratings (satisfaction). The analysis of the data was conducted using an advanced statistical analysis software the IBM SPSS. The data been entered to the SPSS files that were created reflecting the design of the study and presenting the variables (refer to section 3.6.3)

3.9.1 Statistical Methods

Descriptive statistical analysis was used to conduct the analysis of the conducted experiment. The mean, median and mode were calculated to perform the statistical analysis. Also, Kolmogorov-Smirnov test (Field A., 2013, p: 65-109) was used in the statistical analysis to test, calculate and present the normal distribution of experiment results. Experimental results in terms of time taken by users to answer, correctly chosen products and the users' perception' satisfaction were analysed. For the normal distributed data, an independent t-test was used to evaluate the parameters in the groups to determine the significance value of difference among the groups. It is important for the research design, depending on many factors like methodology, data type and variables, to have the correct selection of statistical tests. In the case where data were not normally distributed, the Mann-Whitney test was considered to examine the independent t-test (Kanzler J., 2003, p:160-165)**.** A repeated measure of variance is used to determine the statistical significance difference amongst population means of three or more groups (Levine G., 2013). Hence, ANOVA was used which is considered as an extension to a t-test. Post hoc analysis was also conducted to find the significance differences among the variables and groups. Also, a chi-squared test

was used for statistical analysis of categorical data (Field A., 2013, p: 65-109). The statistical analysis used α=.05 and the significance using p-value=.05 (which refers to be less than of 0.05). All the conditions been analysed and compared using these various statistical methods.

3.9.2 Efficiency

The time taken by users to complete tasks for each group (textual, earcons, and facial expression avatar) and task complexity (easy, moderate, and difficult) were used to measure the efficiency.

Figure 3.14 shows the mean value of time taken to complete all tasks for the three groups (A) and the mean value based on the tasks complexity for the three groups (B). It can be seen that the time taken completing all the tasks as well as for the complexity levels was lower for the textual group (Group 1). The data for the time taken can be found in Appendix A.

3.9.2.1 Tasks' Completion Time According to the Groups (Rating Interface Condition)

Each user in the different groups (textual, earcons, and facially expressive avatar) had to complete four tasks in total of different complexity levels. As shown in Figure 3.14(A) the mean time consumed to complete all the tasks in the textual condition group (Group 1) was lower than that in the earcons and the facial expression avatar groups. The mean value taken by the users to complete all the tasks in the textual group (Group 1) was 11.10 minutes considered to be the lowest average among the three groups. The result was very close to the facial expression avatar group (Group 3) in which the users had a mean of 11.38 minutes to complete all the tasks. In comparison, users in the earcons group spent an average of 20.09 minutes to complete the tasks.

It showed that the mean value or the average time taken by the users has nearly doubled comparing the textual group and the facial expression avatar group to that in the earcons group. The textual and the facial expression avatar groups were 9 minutes faster than their counterparts in the earcons group. Due to the nature of the interface design of Group 2 (earcons), which used musical files, it was expected that Group 2 users would take more time to complete the tasks as they would be relying on hearing musical notes rather than seeing a visual presence.

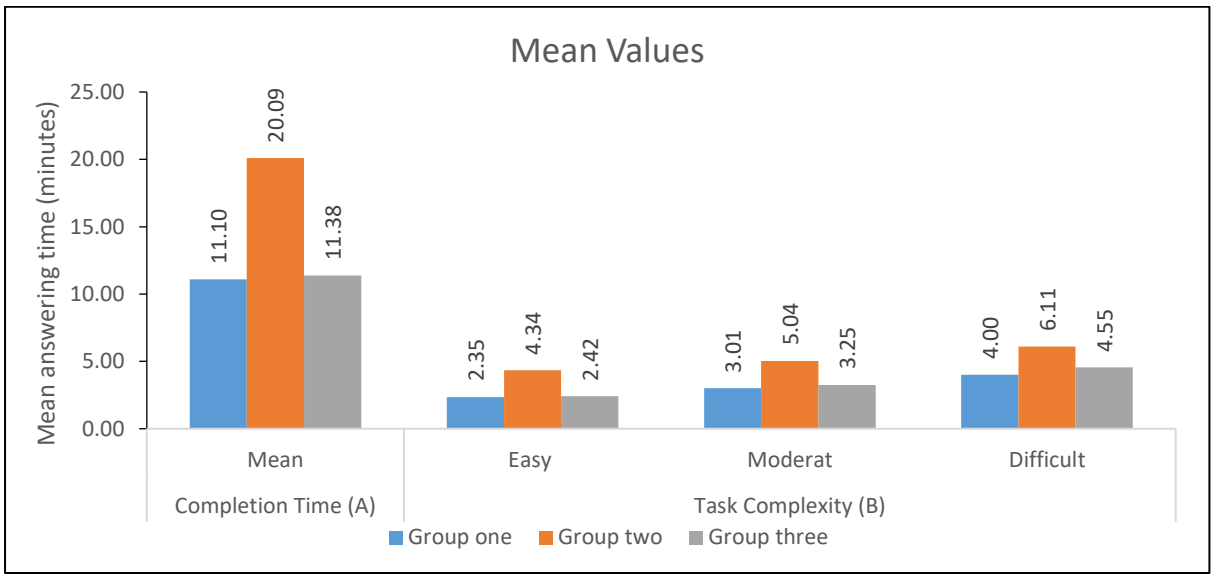


Figure 3.14: Mean values of time taken by users in the three groups to finish all the tasks (A) and grouped by task complexity (B).

A Levene test was conducted to check the homogeneity of variances among the group giving F=0.9, close to 1; in other words, the Levene test was not significant indicating that the data showed homogeneity of variance.

The one-way ANNOVA test showed that the time taken to complete all the tasks between the groups was significant with p=.001 (p<.05); however, ANOVA did not provide which groups were significant. Hence, Fisher's post hoc least significant difference (LSD) was used to determine the groups for which completion time was significant. The LSD showed that the difference in completion time between the textual

and the earcons groups was significant with p=.001 (p<.05) with mean difference -8.99. While the test showed there was no significant difference between the textual and the facial expression avatar groups with p=0.51 (p>.05) and mean difference of -0.28. Moreover, the calculation showed the difference in completing all the tasks between the earcons and facial expression groups was significant with p=.001 (p<0.05) and mean difference of 8.70. Table 3.7 presents the statistical descriptive data for the completion time of the three groups. The mean of each group was calculated in group 1 to be 10.7, in Group 2 19.6 and in Group 3 10.9. The table also shows that the lower bound (25%) of the users' completion time was 9.9 in Group 1, 18.9 in Group 2 and 12.3 in Group 3. Moreover, the table presents the lowest and the highest (minimum and maximum) completion time in each group.

The experimental observation revealed that users in Group 2 (earcons) had to have their attention focused on remembering the musical file being played and to link it to the rating that was being communicated, with most of them having played the file more than twice. This increased the required time for the user to finish the task which impacted the overall time of the experiment. However, the users of the other groups maintained their attention on the screen, on the visual presentation of the textual rating and the facial expression avatar, obtaining a quicker response to product selection and task completion.

In summary, the users in Group 1 (textual group) and Group 3 (facial expression avatar) were aided by the inclusion of emoji's and the visual multimodal metaphor which enabled them to spend less time in completing the tasks than the earcon group users. Also, the users in both groups (1 and 3) did not need to spend a lot of time recalling or mapping the requested ratings due to the use of a visual communication

metaphor. Therefore, it can be concluded that using visual multimodal metaphors, as facial expression avatars, text and emojis, was more efficient than just using earcons in presenting product review ratings. Figure 3.15 shows the mean plot of completion time for the groups.

3.9.2.2 Task Completion Time According to Task Complexity

Figure 3.14(B) shows the completion time based on the task complexity. The tasks were designed to increase in difficulty and were divided into two easy, one moderate and one difficult.

Descriptive

Task Completion Time per group

Group	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean		Minimum	Maximum
					Lower Bound	Upper Bound		
1	12	10.7000	1.16561	.33648	9.9594	11.4406	8.55	12.55
2	12	19.6942	1.19667	.34545	18.9338	20.4545	18.35	22.15
3	12	10.9875	.82713	.23877	10.4620	11.5130	10.05	12.45
Total	36	13.7939	4.36007	.72668	12.3187	15.2691	8.55	22.15

Table 3.7: Groups' task completion time estimates descriptive table.

Figure 3.14 shows that the completion time for the earcon group was higher for all the complexity levels. The variance time for completing task between the groups increased as the task complexity level increased. In the easy question, the mean answering time in the textual group was calculated to be 7 seconds less than facial expression avatar group and around 2 minutes less that the earcon group. The variance between the textual and the facial expression groups increased slightly in the moderate task and was around 24 seconds, but with the facial expression avatar group the variance increased to 2 minutes and 3 seconds. With respect to the difficult task, the variance increased as well reaching 55 seconds between textual and the facial

expression avatar groups and 2 minutes 11 seconds between textual and earcon groups.

The statistical tests revealed that the textual group presentation took significant less time than the users of earcons and facial expression avatars with p=.01 ($p<0.05$) for the different tasks complexity. However, the tests revealed that the facial expression avatar group needed significantly less time than the earcon group to finish the easy, moderate and difficult tasks with p=.01 ($p<.05$). In summary, these results showed that the use of visual metaphors, such as text with emojis and facial expression avatars, had contributed in reducing the time needed by the users when the task complexity gradually increased to another difficulty level.

3.9.2.3 Time Completion for Each Task

Figure 3.17 shows the mean time taken by the users to complete each task in all the groups. In all the tasks, the textual group and the facial expression avatar group users needed almost the same amount of time to finish the tasks with time difference about 0.01 minute for Task 1, 0.15 minutes for Task 2, 0.16 minutes for Task 3 and 0.21 minutes for Task 4. The difference between these two groups was not significant with mean time taken to finish a task 2.54 minutes for Group 1 and 3.07 minutes (2.67) for Group 3. However, the difference between the earcon group (Group 2) and the other groups in finishing a task varied across the tasks. These answering time variances can be verified by the different review rating interface along with the task complexity level.

The time taken by users to complete tasks in each group presented with a different interface condition was different. The time difference was found to be statistically

significant using the F-distribution test (F=270.2, df=2, p<.005) with η^2=0.94. Tables 3.8 and 3.9 present the statistical findings and explanation respectively.

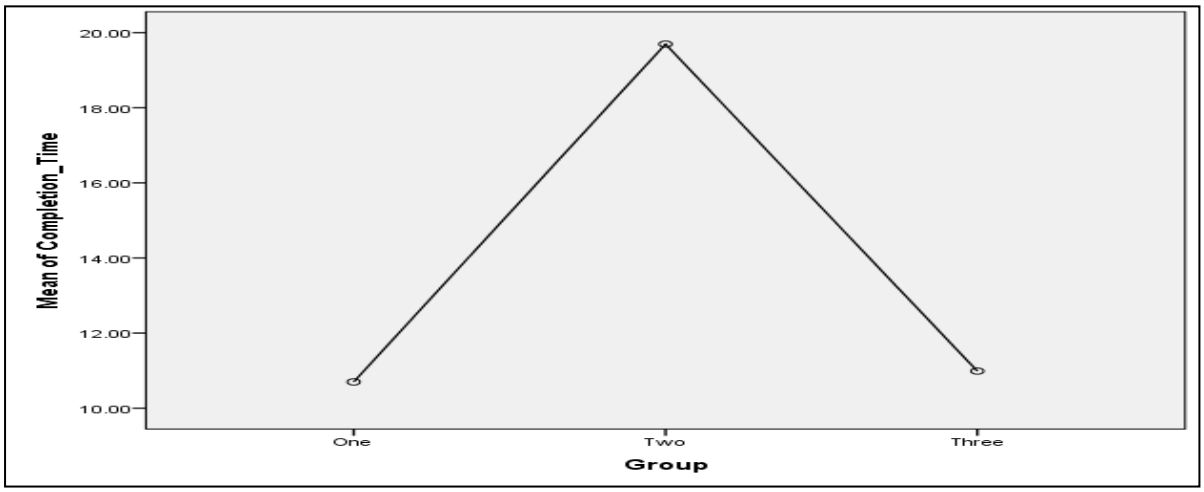


Figure 3.15: Mean of completion time corresponding to the experimental groups.

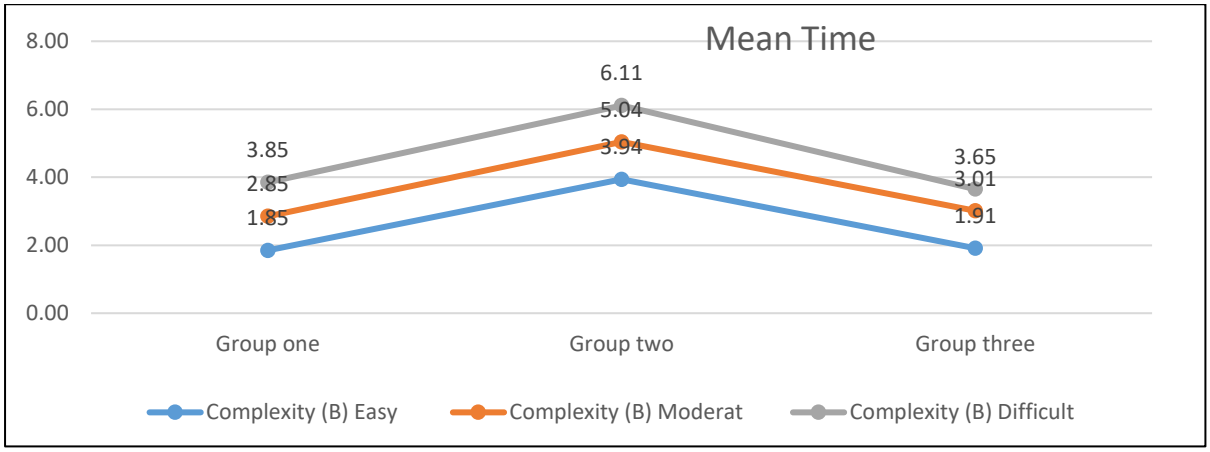


Figure 3.16: Mean task completion time by complexity level.

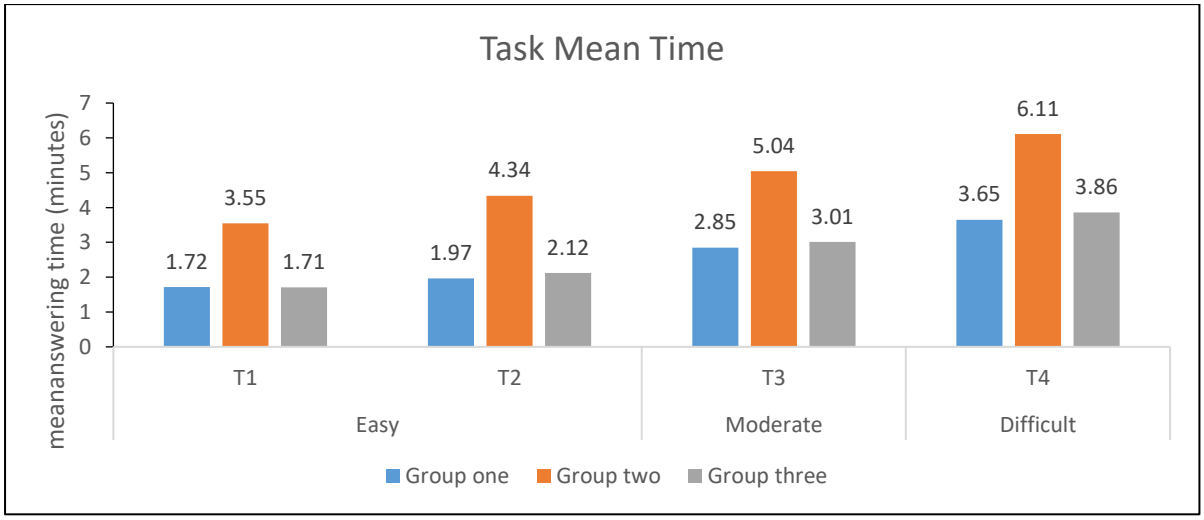


Figure 3.17: Mean value of time taken by the users in the groups to complete each task.

	Sum of Squares	df	F	Sig.
Between Groups	627.135	2	270.722	.000
Within Groups	38.223	33		
Total	665.358	35		

Table 3.8: ANOVA F-test to determine statistical significance for the time taken by users to complete tasks for each group.

Statistic	**Explanation**
F	F-Distribution (F-test)
df	Degree of freedom=2
270.22	F-Value
$p<0.05$	Probability of obtaining the F-value
$\eta^2=0.94$	The effect size (Eta Squared)

Table 3.9: F-distribution Statistics to determine significant time difference taken by users to complete tasks.

3.9.2.4 Time Taken by User

Figure 3.18 shows the total time spent by each user in the three groups to complete all the tasks. The longest amount of time need to perform and finish the tasks was that of the earcon group compared to the users of the other groups (textual and facial expression). The minimum and the maximum times consumed by the textual group (Group 1) were 8.55 minutes (User 4) and 11.25 minutes (User 6) respectively.

The earcon group (Group 2) had the minimum time of 18.35 minutes (User 1, User 4 and User 9) while the maximum time taken was 22.15 minutes (User 12).

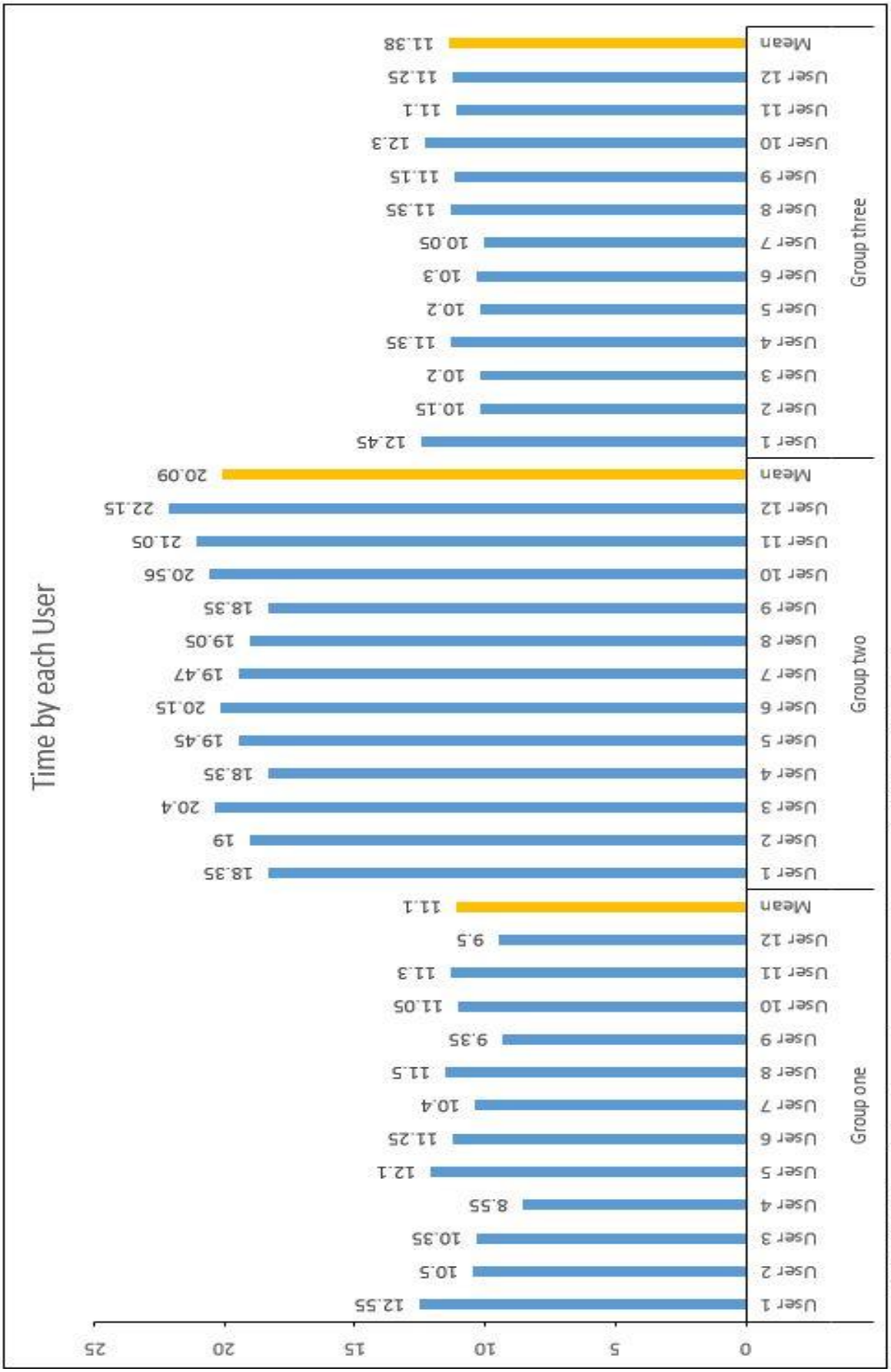


Figure 3.18: Total time taken by each user in each group to finish all the tasks.

For the facial expression group (Group 3) the minimum taken was 10.07 minutes (User 7) while the maximum was 12.45 minutes (User 1). Overall, the users of the emojis textual group were the fastest among all group users; on average they were 9.08 minutes faster than the earcon group and 0.27 minutes faster than the facial expression avatar group.

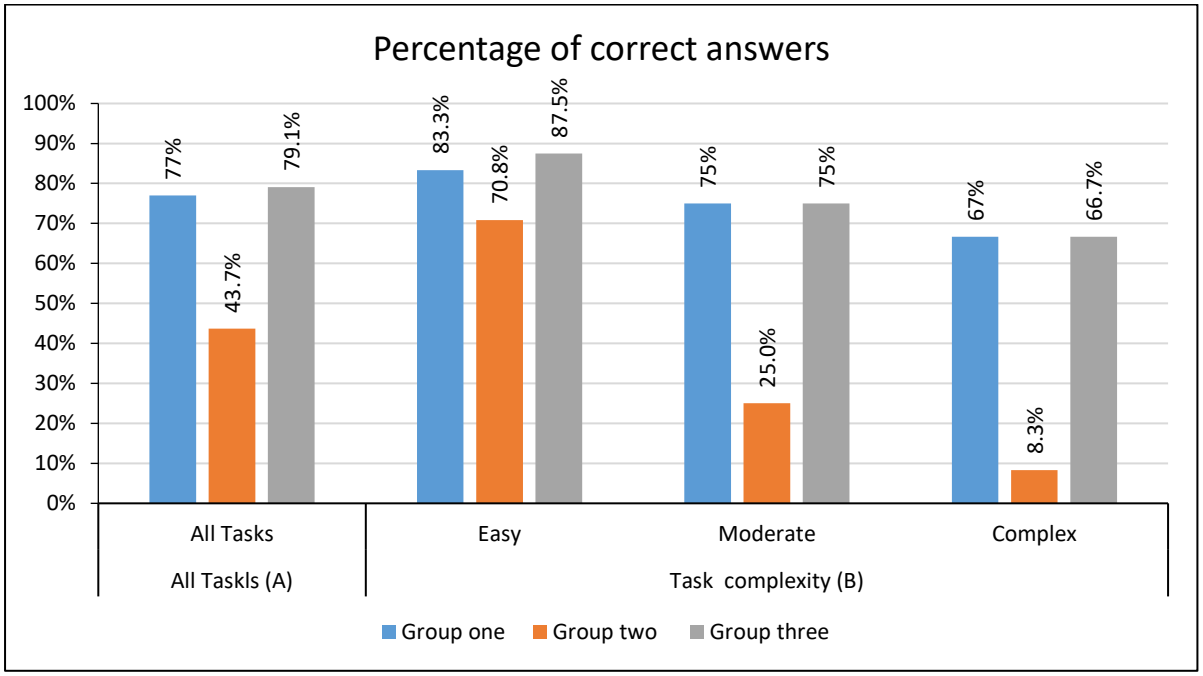


Figure 3.19: Percentage of correctly completed tasks achieved by the users in the three groups for all tasks (A) and for task complexity (B).

3.9.3 Effectiveness

The effectiveness was measured by the number of tasks completed successfully by the users during the experiment. This measure was considered for all the tasks in total and by task complexity (easy, moderate, and difficult) as well as for each task and each user in all the three groups. Figure 3.19 shows the percentage of tasks completed successfully for all the tasks (A) and according to task complexity (B).

The users in textual and facial expression groups (Groups 1 and 3 respectively) performed much better than the users of the earcon group (Group 2) in terms of tasks' successful completion as well as at each complexity level.

3.9.3.1 Effectiveness for All Tasks

In Figure 3.19(A) it can be seen that the users of the facial expression avatar performed better than the users of the other groups with regard to the tasks completed successfully. The percentage of correctly answered questions achieved in the facial expression avatar (Group 3) was 76%, nearly one-third (30%) greater than that of the earcon group (46%). However, compared with the textual group users the difference was slight with the facial expressions group having 1% more successful tasks. The total number of correctly completed tasks in the facial expression group was 43 compared to the earcon group's 21 and 37 of the textual group. Also, the mean value of successfully completed tasks per user calculated for the facial expressions avatar group (3.58) was 1.5 successfully completed tasks better than that of the earcon group (1.75) and marginally better, by 0.5, than that of the textual group (3.08). The ANOVA results showed that variance between facial expression avatar and earcon groups to be significant $p<.05$.

Chi-squared test

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Squared	10.923[a]	2	.004
Likelihood Ratio	12.359	2	.002
Linear-by-Linear Association	.000	1	1.000
N of Valid Cases	36		

Table 3.10: Chi-squared statistics for association between groups.

The statistical test showed that the variance between the textual and the facial expression groups was not significant with the result p was greater than 0.05 ($p<.05$).

A chi-squared test was used to check if there was any association between the groups for tasks completion. A significant difference was calculated (x^2=10.92 *df*=2, p<0.05).

The presentation of facial expression avatars as a visual communication metaphor for the review rating in Group 3 helped the users to understand and correctly conclude the product review being communicated. Meanwhile, the presence of audio metaphors in Group 2 did not help the users to quickly understand and successfully conclude the rating being communicated as they had to listen and perform the task over a longer time. But the textual emojis presentation did help the users in Group 1 to read and eliminate unnecessary ratings which accelerated the task execution. Thus, the users of the facial expression avatar group along with the textual group outperformed the users of the earcon group who received the rating via audio channels. In summary, it is clear that the visual metaphors such as visual expression avatars and text with emojis were more effective in successfully completing tasks and considerably helped the users to achieve a higher effectiveness rate compared to the earcon group.

3.9.3.2 Effectiveness According to Task Complexity

Figure 3.19(B) shows the percentage of the easy, moderate and difficult tasks completed successfully in the three groups. It can be noticed that the facial expression avatar group (Group 3) outperformed all other groups in the easy and difficult (complex) tasks while the textual group (Group 1) marginally outperformed the facial expression avatar group in the difficult task. Moreover, the users' performance increased in favour of the textual and facial expression groups as the task complexity increased. In the easy task the users of textual and the facial expression groups scored a minimum of 13% of more successful completions than those of the earcon group. However, this percentage increased in the moderate task (50%) and was largest in

the difficult task (58%) where the users in the textual and facial expression groups achieved around an eight times higher figure than those in the earcon group. Using the facial expression avatar, the users in that group correctly completed 87%, 75% and 66.7% of easy, moderate and difficult tasks respectively. The textual group users achieved the second highest percentage of successfully completed tasks with 83% in the easy level, 75% in the moderate level and 67% in the difficult level. On the other hand, the users in the earcon group achieved the lowest percentages where they successfully completed tasks with 70%, 25% and 8.3% of easy, moderate and difficult levels respectively. The results of the Kruskal-Wallis test for all the groups revealed that there was no significant difference between the groups in the easy task but a significant difference was found in the moderate and the difficult task (moderate $x=8.00$ $df=2, p<0.05$; difficult $x=10.61$ $df=2$ $p<0.05$).

Kruskal Wallis Test

	Easy	Moderate	Difficult
Chi-Squared	1.167	8.000	10.619
Df	2	2	2
Asymp. Sig.	.558	.018	.005

Table 3.11: Kruskal-Wallis test for completion according to task complexity.

As Table 3.11 shows, the statistical test reflected the difference among the groups based on the task complexity. The chi-squared test did not show significant difference between groups in task completion at the easy level. This could be verified to the task level that the interface did not significantly cause any difference among the groups. A one-way ANOVA test showed that significant difference does exist especially at the task complexity of moderate and difficult ($p<0.05$). The test gave similar results as Kruskal-Wallis in terms of significant difference among the groups in successfully completing tasks according to task complexity as in Table 3.12.

Fisher's post hoc test of least significant difference (LSD) showed where the significance is found between the groups. Table 3.13 presents the post hoc analyses and shows that there is a significant difference between the earcon group (Group 2) and the other groups in the moderate and complex tasks ($p<0.05$). Also, there is no significant difference between the groups in the easy task with $p>0.05$ ($p<0.05$ for significance).

Thus, the variance between the facial expression avatar and the textual groups was not significant regarding the percentage of the tasks successfully completed. However, there was a significant difference between the earcon group on one side and the facial expression and the textual groups on the other side; the variance was not in a close relationship with the complexity level regarding the successful completion of the tasks as the difference rate increased (i.e. completion rate decreased) with the increase of the complexity level. The use of earcons in the Group 2 presentation had the impact of lowering the number of successfully completed tasks which could be justified by the mapping required by the users to link between the earcon, ratings and the task requirement.

ANOVA

		Sum of Squares	df	Mean Square	F	Sig.
Easy	Between Groups	.222	2	.111	.611	.549
	Within Groups	6.000	33	.182		
	Total	6.222	35			
Moderate	Between Groups	2.000	2	1.000	4.889	.014
	Within Groups	6.750	33	.205		
	Total	8.750	35			
Difficult	Between Groups	2.722	2	1.361	7.187	.003
	Within Groups	6.250	33	.189		
	Total	8.972	35			

Table 3.12: One-way ANOVA test results.

Post Hoc Multiple Comparisons

LSD

Dependent Variable	(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Easy	One	Two	-.167	.174	.345	-.52	.19
		Three	.000	.174	1.000	-.35	.35
	Two	One	.167	.174	.345	-.19	.52
		Three	.167	.174	.345	-.19	.52
	Three	One	.000	.174	1.000	-.35	.35
		Two	-.167	.174	.345	-.52	.19
Moderate	One	Two	-.500*	.185	.011	-.88	-.12
		Three	.000	.185	1.000	-.38	.38
	Two	One	.500*	.185	.011	.12	.88
		Three	.500*	.185	.011	.12	.88
	Three	One	.000	.185	1.000	-.38	.38
		Two	-.500*	.185	.011	-.88	-.12
Difficult	One	Two	-.583*	.178	.002	-.94	-.22
		Three	.000	.178	1.000	-.36	.36
	Two	One	.583*	.178	.002	.22	.94
		Three	.583*	.178	.002	.22	.94
	Three	One	.000	.178	1.000	-.36	.36
		Two	-.583*	.178	.002	-.94	-.22

Table 3.13: One-way ANOVA post hoc (LSD) test for task completion according to task complexity.

In a contrary fashion, the users of the expressive avatar group (Group 3) had less difficulty in linking the task requirement to the ratings visually presented which increased the number of correctly completed tasks. Hence, the contribution of the facial expression avatar as a multimodal metaphor in the users' performance was clear in the tasks completion, especially as the tasks level increased.

3.9.3.3 Effectiveness According to each Task

The percentage of users' successful task completion in each of the three groups is shown in Figure 3.19. It can be noticed that the users of Group 3 performed better than Group 2 users with 79.17% of successful task completion (Group 3) compared to

43.75% (Group 2). Compared to Group 2 users, Group 3 users marginally performed better by 2.1% (79.17% for Group 3 and 77.07% for Group 2). The task complexity levels did impact the users' performance in successfully completing the tasks. Figure 3.20 showed that the three groups in the easy task successfully achieved more than 60%. While the textual group (Group 1) and the facial expressive avatar group (Group 3) maintained a higher successful rate in the moderate and difficult compared to the earcons users (Group 2). The percentage of successfully completed tasks in the earcon group (Group 2) has dramatically dropped to 25% in moderate and 8.3% in the difficult task. In the other hand, the users in both textual group and facial expressive group achieved an equal rate in completing tasks with 75% in moderate and 66.7% in difficult.

Chi-squared results, shown in Table 3.13, demonstrated a significant difference among the groups in Tasks 3 (x^2=8.22 *df*=2, p<0.05) and 4 (x^2=10.92 df=2, p<0.05). The difference is noticeable from the chart where the users of Group 2 (earcons) had very low successful completion in both Tasks 3 and 4. The key ratings required to complete these tasks in Group 2 (earcons) were delivered using musical files (refer to Table 3.2). However, there were no significant differences obtained in Tasks 1 (x^2=1.20 *df*=2, with p>0.05) and 2 (x^2=1.286 *df*=2, with p>0.05). Overall, it can be said that the presence of the visual multimodal metaphor used in Group 3 (facial expression avatar) contributed to the performance of the users in all the required tasks compared to the performance of other groups.

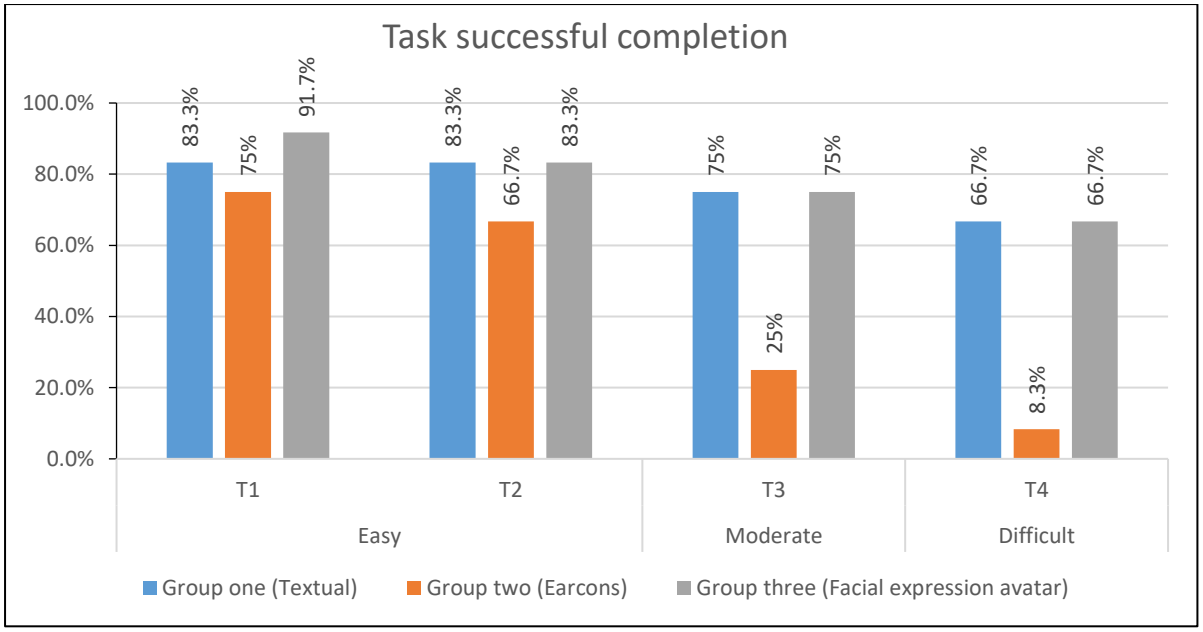


Figure 3.20: Percentage of correctly completed tasks according to the groups.

Test Statistics

Complexity	Groups	Tasks	Task Completion	X^2 Value	p-value	Significant
Easy	One	Task 1	83.3%	1.20	>0.05	No
	Two		75%			
	Three		91.7%			
Easy	One	Task 2	83.3%	1.28	>0.05	No
	Two		66.7%			
	Three		83.3%			
Moderate	One	Task 3	75%	8.22	<0.05	Yes
	Two		25%			
	Three		75%			
Difficult	One	Task 4	66.7%	10.92	<0.05	Yes
	Two		8.3%			
	Three		66.7%			

Table 3.13: Chi-squared results for the users' successful completion of tasks in the three groups.

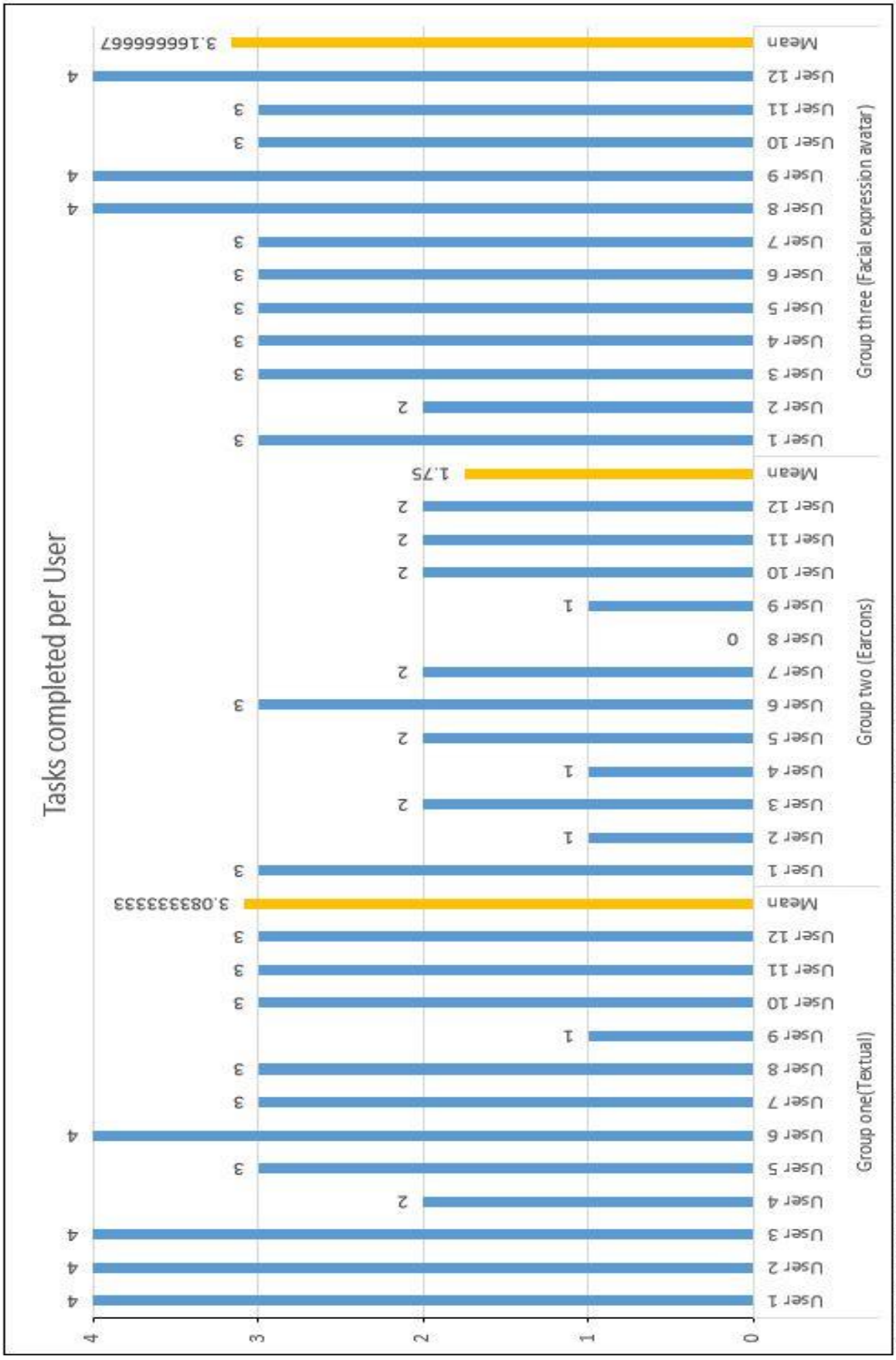


Figure 3.21: Total number of successfully completed tasks achieved by each user.

3.9.3.4 Effectiveness for each User

Figure 3.21 shows the total number of successfully completed tasks achieved by every user in each group. It can be noted that four users successfully completed all tasks in Group 1 (Users 1, 2, 3 and 6) while three users in Group 3 (Users 8, 9 and 12). On the other hand, none of the users in Group 2 managed to successfully complete all tasks and the highest achievement was for one user (User 6) completing three tasks. The weakest users in the groups were User 9 in Group 1 with only two tasks completed successfully, User 8 in Group 2 with zero tasks completed successfully and User 2 in Group 3 with two tasks completed successfully. On average, the number of tasks completed successfully per user in Group 1 was 3.08, 1.75 in Group 2 and 3.17 in Group 3.

Using the visual multimodal metaphor of the facial expression avatar in communicating the product reviews rating had a higher impact on the users of Group 3 than the users of the audio multimodal metaphor in Group 2 and this enabled them to outperform the users in the other group in successfully completing the tasks.

3.9.4 User Preference of Social Media Review Source

The experiment was designed to investigate the users' preference regarding the review source based on two social media networks, Facebook and Twitter. The reviews presented in each task have a review source, either labelled from Facebook or Twitter, which helps to investigate if the users have a social media preference. Due to the design of the experiment the tasks' completion was not taken into consideration while investigating social media preference. Figure 3.22 shows the percentages of preferred social media sources within each group. The figure presented the percentages regarding the social media preferences among the groups. It can be

noted that in all the groups Facebook had the highest percentages compared to Twitter. In Group 1 the preference was 60% of users chose products with reviews from Facebook and 40% chose products with reviews from Twitter. The difference between the two sources varied between approximately 18% and 33% in the groups.

The mean (average) between the sources in the whole experiment was 61.67% of users chose products with Facebook as review source while only 38.33% of users chose products with Twitter as review source. With these figures it is clear that the users preferred Facebook as social media source rather than Twitter.

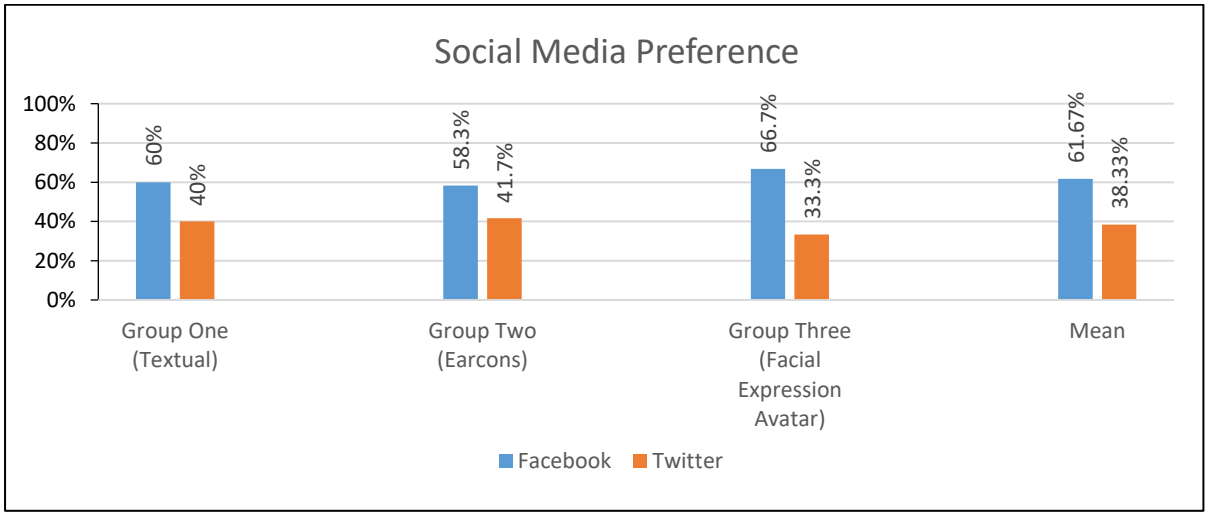


Figure 3.22: Social media source preference according to groups.

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10	S11
Chi-Squared	15.111	36.500	24.500	28.722	15.167	13.444	30.444	18.722	17.111	45.111	25.167
df	4	2	2	4	2	1	3	4	3	3	2
Asymp. Sig.	.004	.000	.000	.000	.001	.000	.000	.001	.001	.000	.000

Table 3.14: Chi-square results of users' satisfaction statements.

3.9.5 User Satisfaction

User satisfaction in regard to different conditions of the experimental platform was measured in all the groups with answers to post-questionnaire questions consisting of 11 statements related to the task difficulty, presentation of reviews, social media source and overall satisfaction. A users' responses system usability scale (SUS) was used to measure users' satisfaction. The statements were measured according to a five-point Likert scale (5 representing strongly agree and 1 strongly disagree).

The overall satisfaction score was calculated using a SUS method (Bangor et al., 2013). The mean satisfaction score for the users by group was 83.67% in Group 1, 39.39% in Group 2 and 75.76% in Group 3. Statistically a chi-squared test showed that there was a significant difference in the users' satisfaction statements with $p<0.05$. Table 3.14 presents statistical analysis for all the satisfaction statements answered by the users of all groups with all showing significant difference between agreement and disagreement.

Figure 3.23 shows the frequency of users' agreement to each of the statements in the post-experiment questionnaire. It can be noted that similar levels of agreement were expressed by users in all groups for statement S6 related to tasks' complexity (*Tasks complexity increased as I'm moving from one task to another*). However, it can be noted that the users in Group 2 were less satisfied with the review presentation, S10 and S11. In the statement S10 users in the three groups were asked if they were satisfied with the review presentation, with 83% in Group 1 and 100% in Group 3 satisfied compared to 41.7% in Group 2. Additionally, the users of both Groups 1 and 3 answered S4 (*the reviews presentation of all tasks to be easy)* with 83.3% agreed on the statement while 0% concurred in Group 2. It is clear that the users of Groups 1

and 3 were more satisfied (with review rating presentation using textual and facial expression avatars) than Group 2 (with reviews rating presentation using earcons). Users had a similar response when it came to making choices based on the review source (S2) as in Group 1 and 3 with 91.7% and 75% for Group 2. The users of groups had slightly different satisfaction ratio regarding the presence of emojis in the review text. S9 asked the users if they were satisfied with text reviews without the presence and the use of emojis. Group 1 users were the most satisfied with 66.7%, then Group 3 users with 58.3% and finally Group 2 with 33.3%.

In brief, using the visual multimodal metaphor as in Group 3 (facial expression avatars) resulted in producing a more satisfied view from users than of the audio multimodal metaphor in Group 2 users (earcon users).

Also, there was a slight advantage in terms of satisfaction using the visual multimodal metaphor than the text based presentation. Therefore, the visual multimodal review presentation can be considered more satisfactory than the textual and audio review presentations.

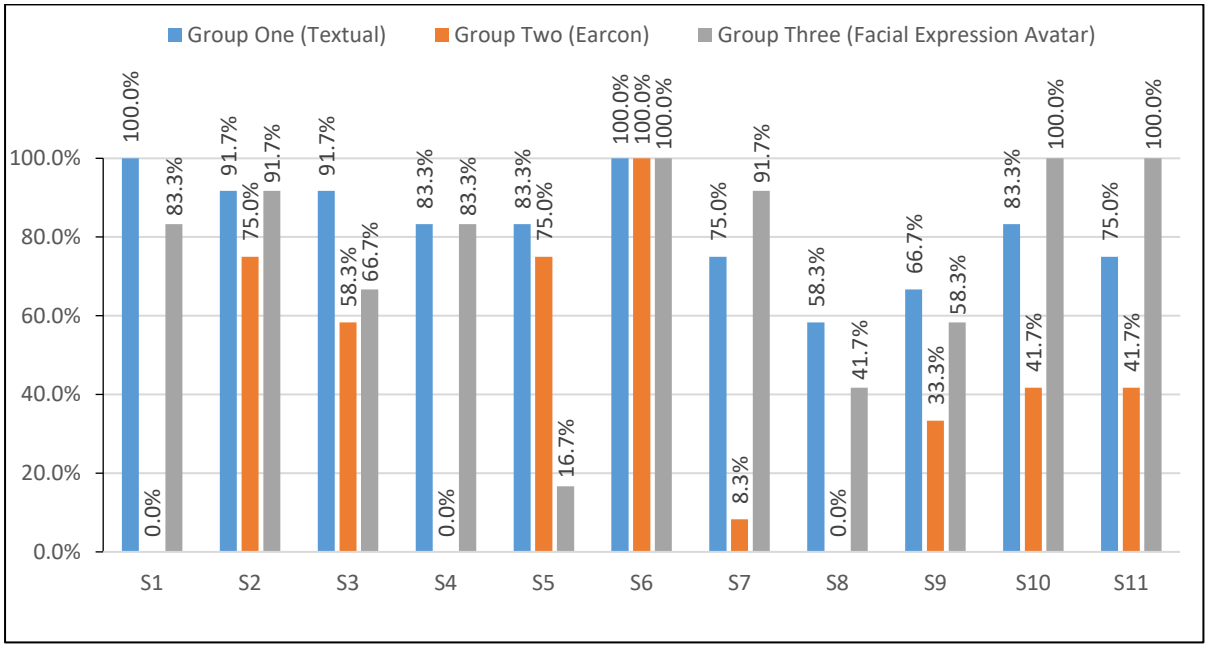


Figure 3.23: Frequency of users' agreement to each satisfaction statement in all groups.

3.10 Discussion

The empirical study investigated the multimodal presentation of social media product review messages. The study was based on the impact that multimodal metaphors, earcons (audio) and facial expression avatars had with different task complexity levels (simple, moderate and difficult) of e-commerce product review presentations. The experimental results have been used to compare the different presentations in terms of efficiency, effectiveness and user satisfaction. Also, the results discussed the role, and the users' preference, of the social media review source. Therefore, these results are discussed from different perspectives:

1- Effectiveness (correctness of completed tasks in terms of task complexity and review presentation)
2- Efficiency (time taken by users to complete tasks according to task complexity and review presentation)
3- Social media preference (users' preference of social media review source)
4- User satisfaction and experience of the tested review presentations.

Although, the audio metaphor presentation of the review messages provided a new approach it did not prove to be more efficient or effective than the use of the visual metaphor of facial expression avatars. The result showed that the use of a visual metaphor presentation (facial expression avatars) was significantly more efficient, effective and satisfactory than using the audio metaphor for review presentations. Moreover, the study showed that text with emojis offered simpler review presentations than the audio metaphor.

3.10.1 Efficiency

The first hypothesis assumed that using the visual multimodal metaphor (facial expression review presentation) would be more efficient than textual and earcon review presentations. The experimental result as shown in Figure 3.14 demonstrated that using the facial expression avatar resulted in significant reduction in time in completing the tasks than earcon presentations. However, the textual presentation showed a narrow advantage over facial expression with regard to efficiency. Hence, these findings provide partial support to Hypothesis 1(c). Also, the figure shows that the earcon presentations were considerably more time consuming for all complexity levels. Overall, there was around +9 minutes difference between the earcon users and the other groups' users. Table 3.8, the ANOVA test, shows that there was significant difference between the groups with regards to time completion ($F=270.22$ $df=2$, $p<00.5$). Fisher's post hoc test (LSD) showed no significant difference between facial expression avatar and textual groups with $p>0.005$; however, it showed there was a significant difference between the earcon group and the other groups with $p<0.05$. From these findings, as there was a significant difference among the groups, Hypothesis 1(c) was accepted. Also, the figure shows that the facial expression avatar had a similar efficiency in all the tasks with respect to task complexity. The completion time variance was not significant in single, two, three or four product reviews. Thus Hypothesis 1(b) was supported. Figure 3.17 shows that earcons were more efficient in single product reviews than in two, three and four. Hence, Hypothesis 1(a) was accepted. Therefore, Hypothesis 1 was accepted.

3.10.2 Effectiveness

It was expected that the users of the facial expression avatar group would outperform the users of the textual and earcon groups in terms of correctly completed tasks. As Figure 3.19 shows, 79.1% of tasks were successfully completed by the facial expression group users. It seems that using the visual multimodal metaphor (facial expression avatars) made completing the tasks easier for the users. The fact that the users in the earcon group had to listen to the review rankings rather than using the visual channel required more attention and focus. The earcon group users successfully managed to complete only 43.7% of the tasks. Also, the figure shows that textual groups had 77% of tasks completed successfully. The experimental results presented support Hypothesis 2(a). The chi-squared test revealed that there was a significant difference between the groups in terms of successful completion (x^2=10.92 *df*=2, p<0.05). Comparison between the successful completion task at the simple level for the facial expression avatar group and the textual group showed an advantage for the facial expression avatar group with an additional 4% of tasks completed successfully. The ANOVA test showed that there was no significant difference between the groups in the easy task. The post hoc test showed that there was significant difference (p<0.005) between the groups at the moderate and difficult levels (refer to Table 3.12). Thus, this result and test confirmed Hypothesis 2(a). Hypothesis 2(b) was not supported as Figure 3.19 reveals the earcon group had the lowest completion rate in all the tasks.

3.10.3 Social Media Preference

Figure 3.21 shows the users' social media preference in the experiment. It shows that the users' preference of Facebook as review rating source was higher than of Twitter.

Users' preferred Facebook as the source of the reviews with 61.67% while only 38.33% preferred Twitter. This difference can be due to a high number of users having and using Facebook, 100% in all groups, while it varied for Twitter with the highest at 58.3% (refer to Figure 3.12). Also, having Facebook considered to be the most used social network could have played a role in the results. There was around 23.34% difference between the two social media networks. This result supports Hypothesis 3 that considered Facebook to be the users' social media preference for review rating source.

3.10.4 Users' Satisfaction

It was expected that the textual group users would be more satisfied than earcon group users with them scoring higher in all the statements. Also, Figure 3.23 shows the users' satisfaction among the groups for all the statements. Regarding the review presentations 83.3% of textual group users considered the textual presentation to be good while only 41.7% of the earcon group considered the presentation to be good. Thus, Hypothesis 4 was supported. In addition to that, the figure shows that the users of the facial expression avatar were more satisfied than the earcon group users. Overall, the mean satisfaction for the textual, earcon and facial expression avatar was 82.57%, 39.39% and 75.67% respectively. The chi-squared test showed that there was a significant difference between the groups ($p<0.05$) in answering the questions for all the statements as in Table 3.14. Therefore, this result confirmed what was expected in Hypothesis 4.

3.11 Conclusion

The experiment studied the social media multimodal review message presentations' impact on e-commerce. The study tested the hypotheses related to the presence of

multimodal metaphors, especially the visual metaphor, in the presentation of the social media review messages. This involved creating a testing platform with three different review rating presentations (textual, earcons, and facial expression avatars) which were tested and evaluated by the users (n=36). The users were evenly distributed into three groups (n=12) with each group testing one presentation.

Results showed that the presence of the visual multimodal metaphor (facial expression avatar) was more efficient than other modes. It also showed that using the multimodal metaphor reduced time consumed by users to complete the tasks along with a higher number of tasks successfully completed. This result did not show a hugely significant difference between the textual review and the facial expression avatar presentations. However, if effectiveness, efficiency and user satisfaction results are combined together the suggestion of the impact of the multimodal metaphor (visual) becomes stronger. The overall results of this study showed the preferred social media source for review messages and highlighted the importance of the visual multimodal metaphors in presenting review ratings that enhanced the users' performance and the usability of the metaphors in e-commerce in terms of efficiency, effectiveness and user satisfaction.

Despite that the study showed the role of the visual multimodal metaphor of the facial expression avatars in presenting the social media review messages there was less impact or role for the audio multimodal metaphor. The design of the study did not take into consideration the individual perception of the earcons among the users of the earcon group. From the experimental observation, the earcon users were retrieving information based on the memory of what they had managed to store after the introduction video (explaining and playing the different musical notes used). The users'

perception of each musical file was not taken into consideration in this study, hence the results of this study showed little or no role for earcons, in terms of efficiency, effectiveness and user satisfaction, for social media review messages. This study did not investigate the users' perception of the musical files for the review ratings. However, the study showed possible application of the earcons for users with disability or users with impaired vision. Also, the study gives a reason to check users' performance using another type of visual multimodal metaphor, such as video presentation It is important for research to check and rate different concepts to develop a new experimental scenario to test new hypotheses. Therefore, the next experiment will be designed and prepared to explore the users' perceptions of rating modes employing visual multimodal metaphors only (facial expression avatars, emojis and animation clips), on the usability (efficiency, effectiveness and user satisfaction) and enjoyment of e-commerce product reviews.

Chapter 4

Experimental Phase II:

An Empirical Investigation on the Role and Impact of the Visual Multi Modal Messages in e-Commerce Interface

4.1 Introduction

This chapter describes the experiments (second phase) to investigate the usability and impact on users of visual multimodal review messages in e-commerce. The visual multimodal messages used incorporate presentations of different metaphors such as emojis, avatars with facial expression and animation clips. The main aim was to identify empirically the suitability of the visual multimodal presentation in delivering the review messages and ratings. The experiment also aimed to identify whether the inclusion of such metaphors can improve the user's experience, enjoyment and usability in e-commerce interfaces. An updated e-commerce experimental platform was developed as a basis for this experiment. Three conditions were implemented and investigated. These were (1) emoji's, (2) avatars with facial expression and (3) animation clips. The study involved one group to test the different conditions in which the usability performance of the group users in terms of efficiency, effectiveness, user satisfaction and enjoyment was measured and compared.

4.2 Aims

The aim of the second experiment was to investigate the impact of visual multimodal reviews and ratings using the three conditions (emojis, facial expressive avatars and animation clips). It aimed to test each condition impacting efficiency, effectiveness, user satisfaction and enjoyment. To identify the differences in user performance between the different multimodal conditions. Also, to evaluate the impact of visual multimodal reviews and ratings by assessing the usefulness of each condition. In addition to that, to explore the usability factors with different task complexities (easy, moderate and difficult). Finally, to evaluate the user satisfaction and enjoyment of each of the multimodal conditions.

4.3Objectives

The objectives needed in order to achieve the aims including the experimental hypotheses based on the aim. Which followed by the development of the experimental platform and use this platform to examine the three experimental conditions emoji's review and rating presentation (EMP), facial expressive avatar review and rating presentation (AVP) and animation clips for review presentation (ARP). Also to evaluate the experimental conditions with tasks that reflect the variety and difficulty of review presentations in order to gather product reviews by different comparison approaches (comparing two, three and four products) using the measurement parameters of efficiency of task completion (time taken by user to complete all tasks), effectiveness of multimodal metaphors (correct task completion) and post task user viewpoint, satisfaction and enjoyment regarding the multimodal condition tested.

4.4 Hypotheses

The results from the previous experiment showed the role of the visual multimodal metaphor in improving system usability. Accordingly, the overall hypothesis was developed that using emoji's, facial expression avatars and animation in communicating product reviews and ratings would affect and enhance users' decision making, performance (effectiveness and efficiency), system usability and enjoyment, the following sub-hypotheses were formulated:

H1: a) EMP (emoji's presentations) will have the same efficiency in two, three or four product comparisons.

b) The presentation metaphors will have the same efficiency for all tasks.

c) EMP (emoji's presentation) will have more efficiency in communicating a large amount of information in product comparisons than AVP (avatar presentations) and AMP (animation presentation).

d) AVP (avatar presentation) will be more efficient than AMP (animation presentation) in all product review presentations.

e) AMP (animation presentation) in single product reviews will be more efficient than in two, three or four.

H2: a) EMP (emoji's presentation) will be more effective than AVP (avatar presentation) and AMP (animation presentation) in terms of tasks completed successfully.

b) AVP (avatar presentation) will be more effective than AMP (animation presentation) in terms of tasks completed successfully.

H3: Using EMP (emoji's presentation) will be considered more enjoyable by users

compared to AVP (avatar presentation) and AMP (animation presentation).

H4: Users will be more satisfied with EMP (emoji's presentation) than AVP (avatar presentation) and AMP (animation presentation) in product comparisons.

H5: AVP (avatar presentation) users' decisions will be perceived more confident than EMP (emoji's presentation) and AMP (animation presentation).

4.5 Experimental Platform

To serve as the basis for this experiment an e-commerce platform was designed and developed by the author (similarly as section 3.5). The platform was designed and built to employ different visual multimodal communication conditions, such as facial expression avatars, emoji's and animated videos of cartoon avatars. All the review and rating presentations were designed to deliver the same information about specific products according to the associated task. The presented page of the product contained sections related to the product (image) and product specification along with the ratings and reviews section. The product and the description were the same for all the multimodal conditions, while the reviews and ratings were different according to the condition being examined. This section highlights the design and implementation stages for the experimental platform for the experiment phase two. It covers the implementation of the conditions interfaces implemented in the platform.

The presentation metaphors used in the platform included: facial expressive avatar presentation (AVP), emoji presentation (EMP) and the animation presentation (AMP). The complexity of the tasks (easy, moderate, difficult) that was determined in the previous experiment (refer to section 3.5) has been implemented in this platform. This complexity level was increased in every task and the review presentation task

complexity increased accordingly. Also, each task is presented separately from the previous task with the use of a different multimodal condition.

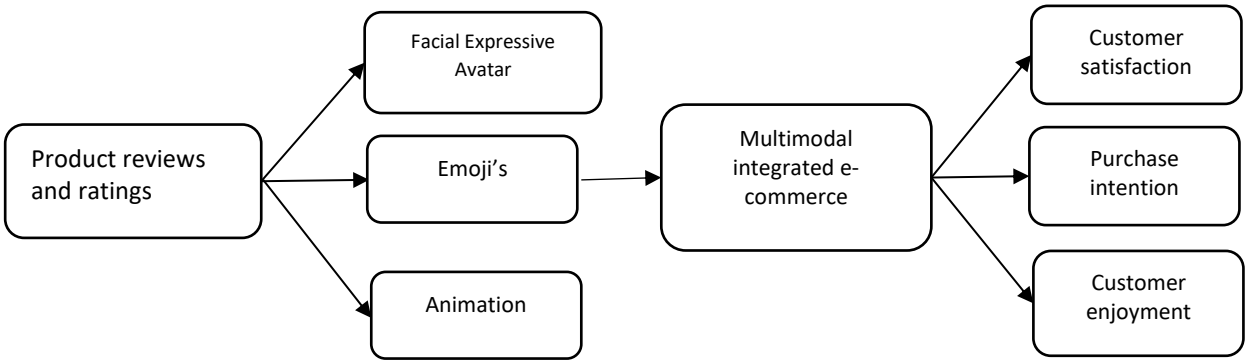


Figure 4.1: Conceptual model for the relationship between review messages and ratings with multimodal metaphors for multimodal integrated e-commerce and the customer's satisfaction, purchase intention and enjoyment.

Each user will test the three different multimodal conditions with each task presented using a different condition. Each subject or user will have to finish four tasks ranked as easy, medium and difficult. A within subject approach was used to ensure that each user tested the three different presentation metaphors at different complexity levels. Table 4.1 shows the mapping between content and the visual multimodal metaphors. As the table shows the product related contents were all communicated using text and pictures. However, the product ratings and reviews were all communicated using the different visual communication metaphors. The reviews and ratings were presented using different multimodal conditions to support the delivery of the information. In summary, the multimodal review and rating presentations used three multimodal conditions: FVP (Facial expression avatar presentation, EMP (Emoji presentation) and AMP (Animation presentation). The FVP uses different human facial expressions identified in the literature, while EMP uses the most used emojis to communicate information and the AMP uses different avatars as cartoons to communicate reviews.

Experiment	Presentation			Multimodal presentation		
Interaction Metaphor / Content	Text	Graphics	Colours	Facial Expression Avatar	Emojis	Animation presentation
Product Description	✓					
Price	✓		✓			
Customer Reviews	✓			✓	✓	✓
Reviews Ratings	✓	✓		✓	✓	✓

Table 4.1: The allocation of metaphors to the information communicated.

4.5.1 Implementation of Facial Expression Presentation (AVP)

This presentation uses facial human expressions presented by an avatar. Figure 4.2 shows an expressive avatar with the facial expressions employed. As indicated previously, the expressions used are based on our daily life. Fabri M. et al., (2002) presented the facial expressions used in our daily life. Similarly to the use of facial expression in the first experiment, the same tool was used to implement these avatars in this experiment. The tool used to create the face and implement the facial expressions was the Poser tool. Poser has a set of built-in templates of characters with the option of customisable facial expressions. The file created was saved in a picture format (JPG) so it can be implemented in the experimental platform. Figure 4.3 shows the expression avatar used in AVP. Table 4.2 shows the mapping between the expression used and the rating value. The rating indicated below demonstrates that a rating between 2.5 and 3 was considered to be neutral, while, any rating between 2.4 and 2 was communicated using a sad expression. The angry expression was used for

ratings below 2. The smile expression communicated the rating 4 and the happy expression indicates the rating 5.

The presentation platform design objective was to communicate the highest possible number of reviews and ratings in the same page (rather than moving to various pages). For instance, the design was implemented using the communication avatar with a maximum number of 100 facial expression avatars presented in one product presentation with an ordering of angry, sad, neutral, smile and happy applied. As Figure 4.3 shows, the AVP is used to communicate ratings, and the user could reveal a particular review by moving the mouse cursor over it as in Figure 4.4.

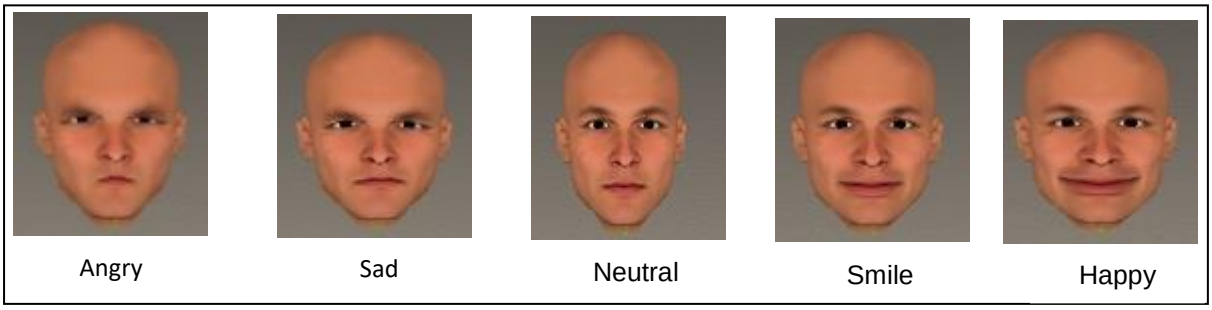


Figure 4.2: Facial expressions used in the AVP.

Rating	Expression	Picture
1	Angry	
2	Sad	
3	Neutral	
4	Smile	
5	Happy	

Table 4.2: Facial expression mapping with ratings.

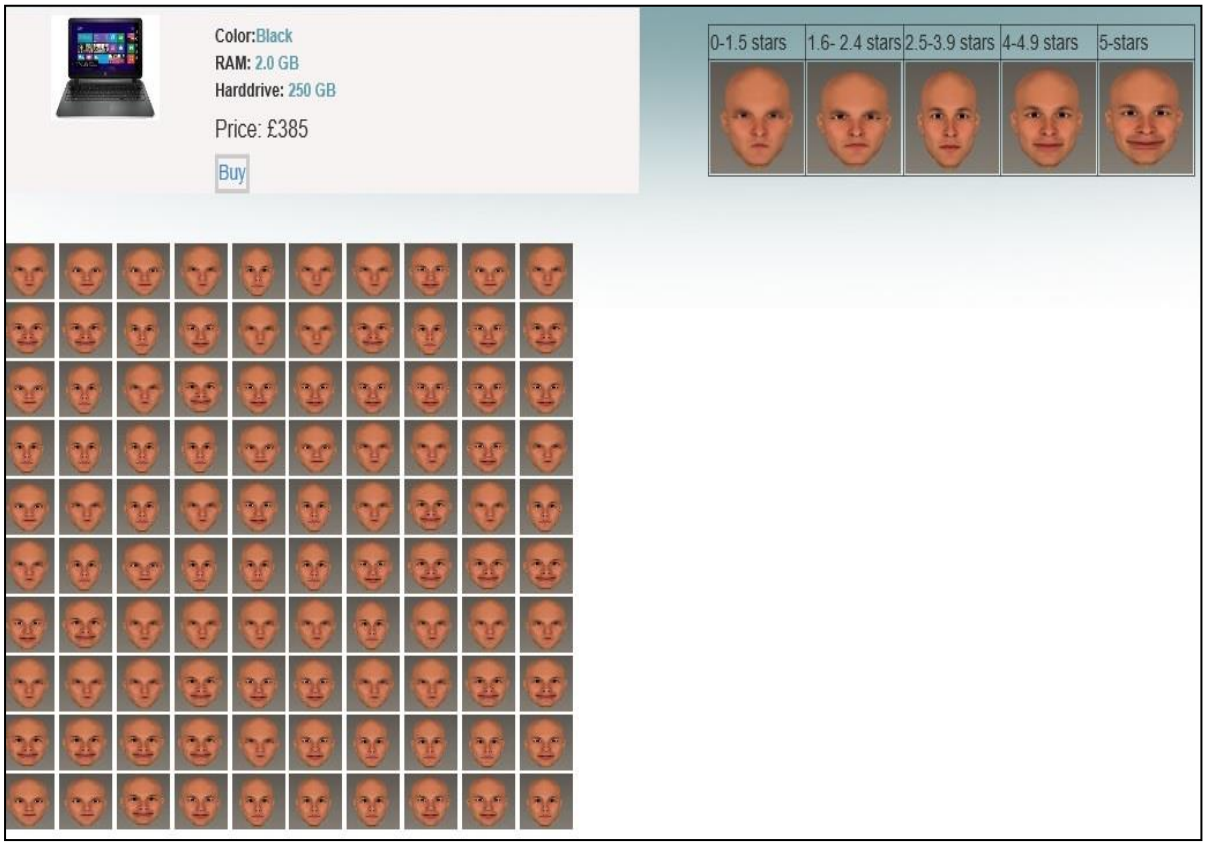


Figure 4.3: Facial expression avatar ratings for single product.

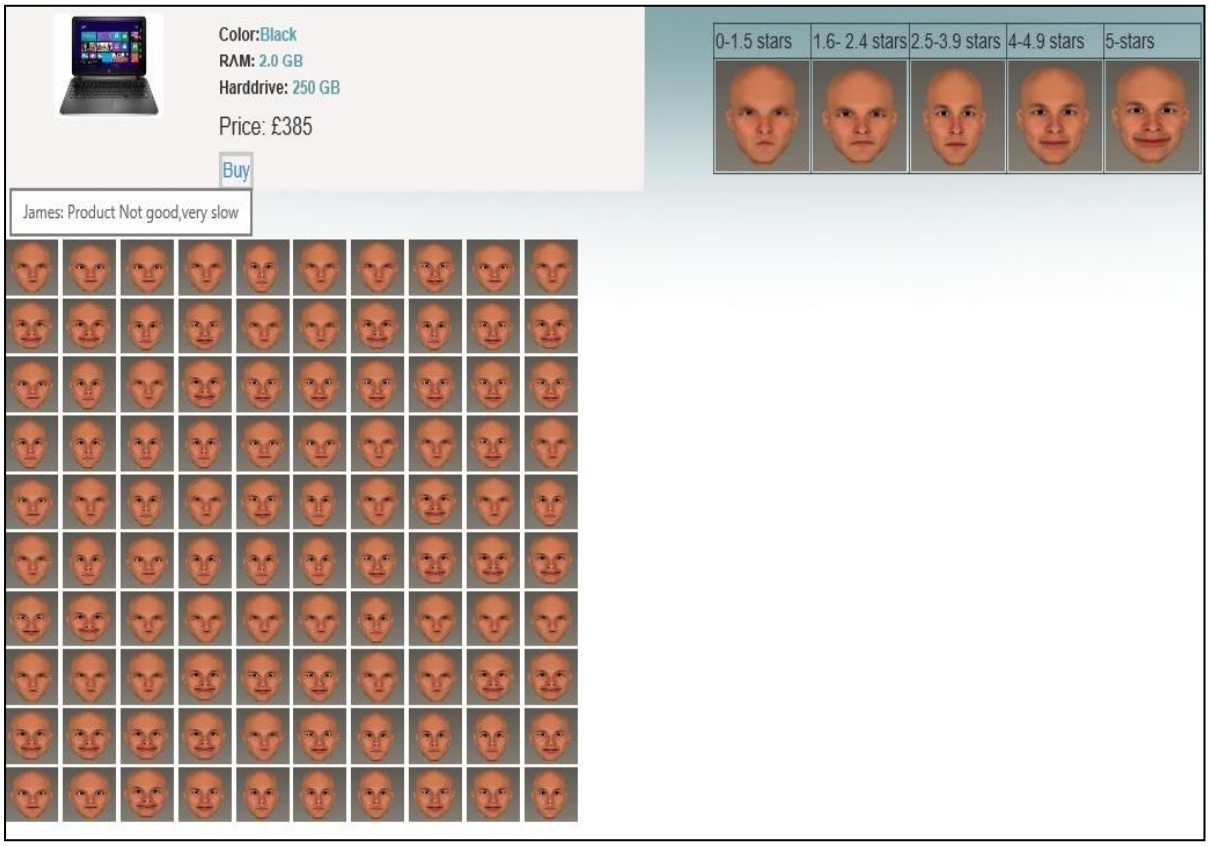


Figure 4.4: Facial expression avatar reviews and ratings.

The presentation context was repeated for two-, three- and four-product comparisons. As the choice increases the space available to compare the products is reduced which makes the ratings able to be communicated less than 100. The maximum number of reviews communicated in a two-product presentation was 80 reviews. While in the four-product comparison the number of reviews dropped to 50 reviews per product. Figures 4.5 and 4.6 demonstrate the communication applied in the two- and four-product comparisons. The same procedures were applied to the other conditions.

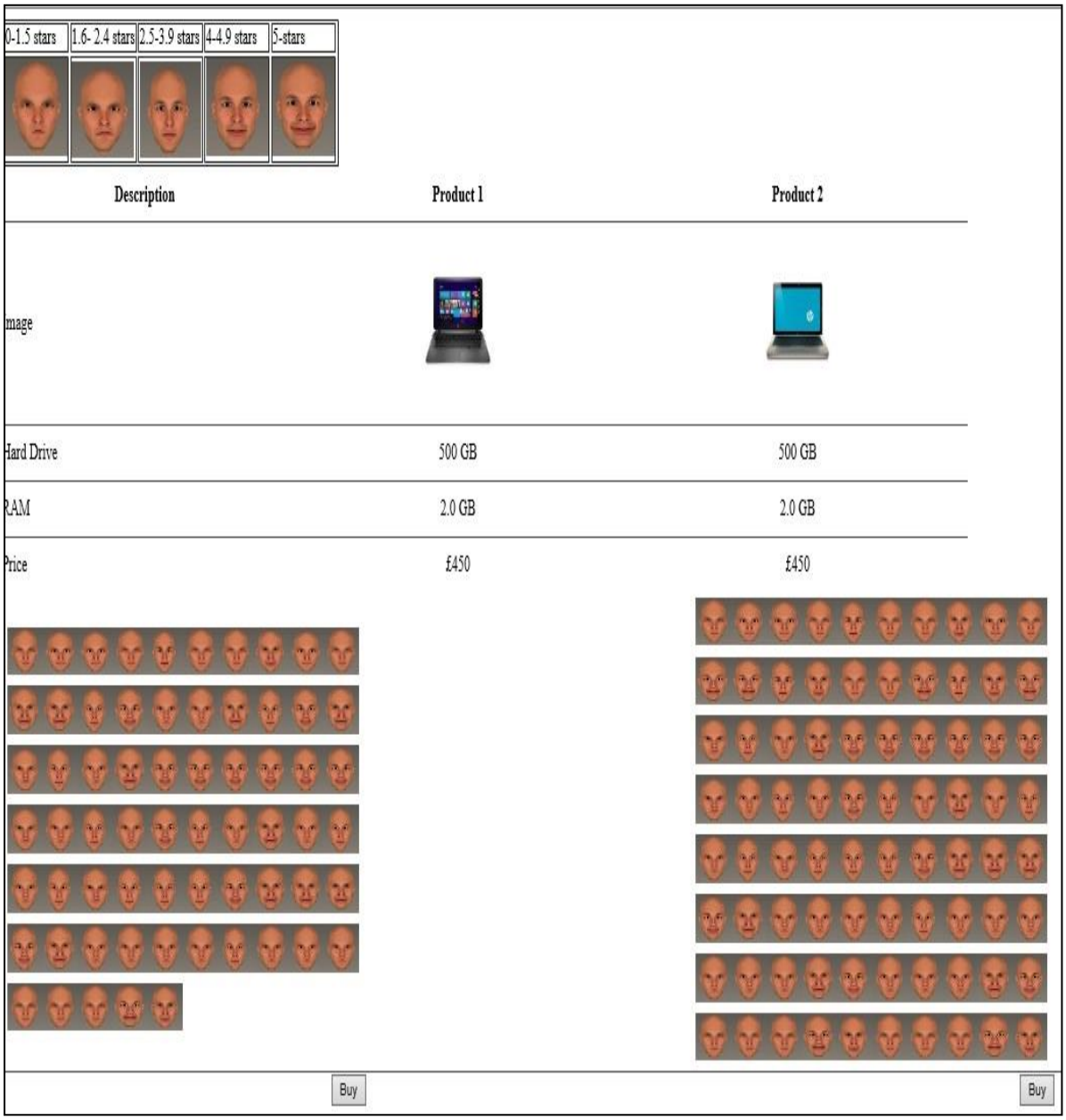


Figure 4.5: AVP for two products comparisons

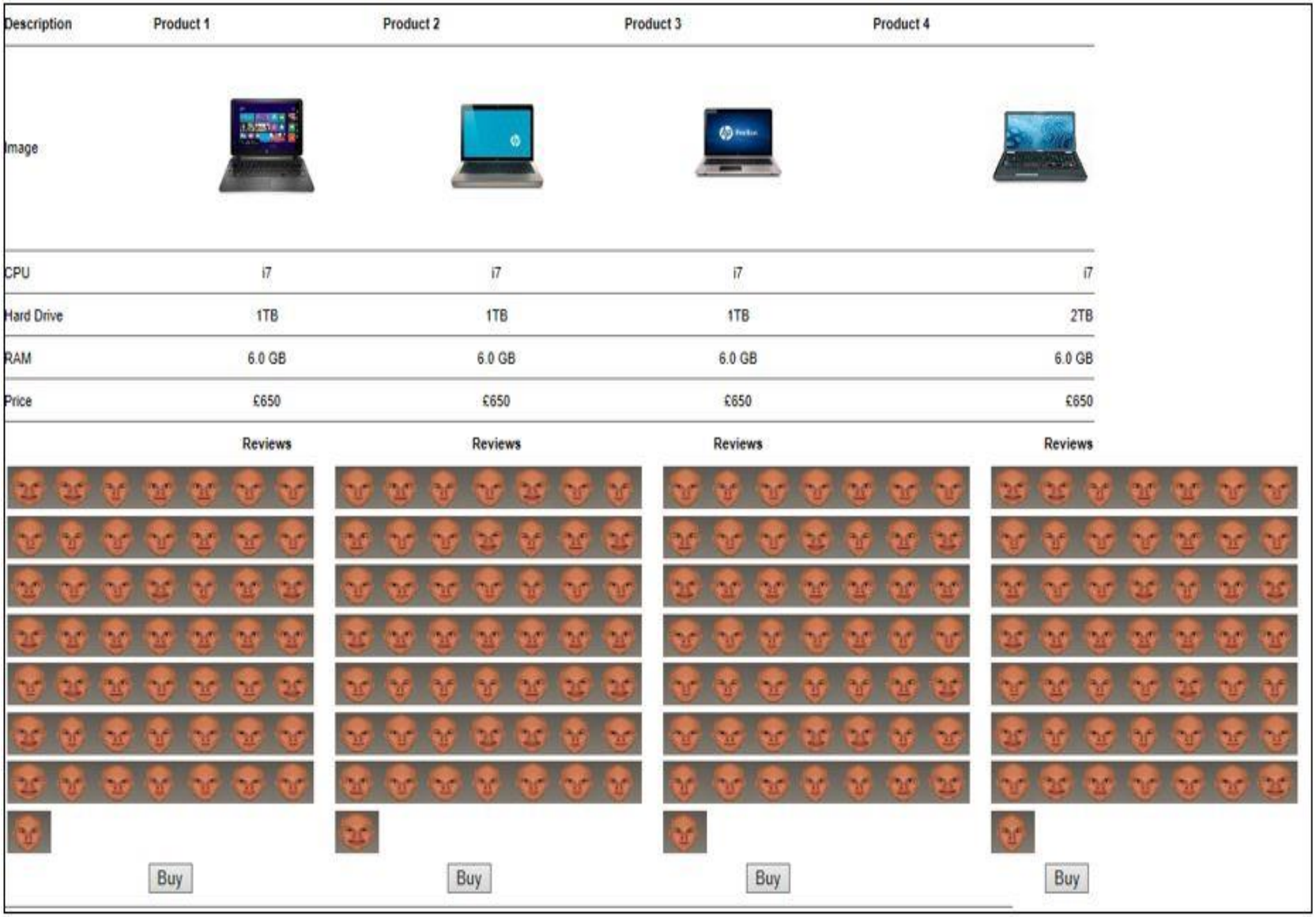


Figure 4.6: AVP four products comparison.

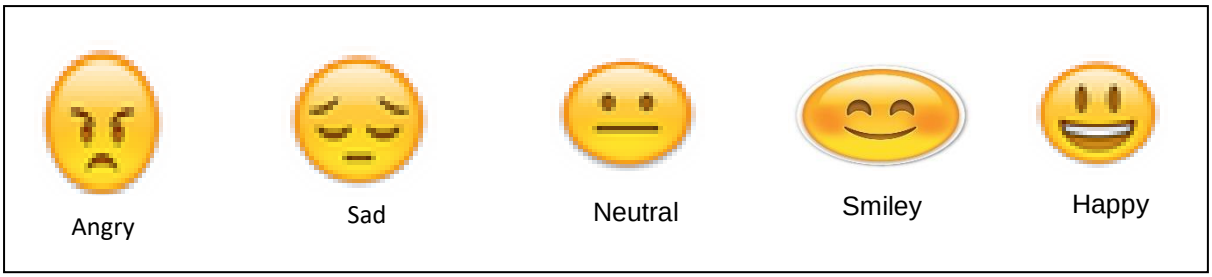


Figure 4.7: Emoji's used for the Emoji Presentation (EMP).

Rating	Expression	Picture
1	Angry	
2	Sad	
3	Neutral	
4	Smiley	
5	Happy	

Table 4.3: Emoji's and rating mapping in EMP.

4.5.2 Implementation of the Emoji Presentation (EMP)

Emoji's were used as the second communication metaphor. The emojis presented were the ones that can be used to communicate product ratings and reviews, namely the angry, sad, neutral, smiley and happy faces. Figure 4.7 shows the emojis used in the EMP.

Table 4.3 shows the mapping between the emojis used and the rating values and it was implemented in a similar manner to the AVP mapping. Similarly, the ratings indicated below demonstrate that a rating between 2.5 and 3 was considered to be neutral, while any rating between 2.4 and 2 was communicated using a sad face. The angry face was used for ratings below 2. The smile face communicated the rating 4 and the happy face indicates 5.

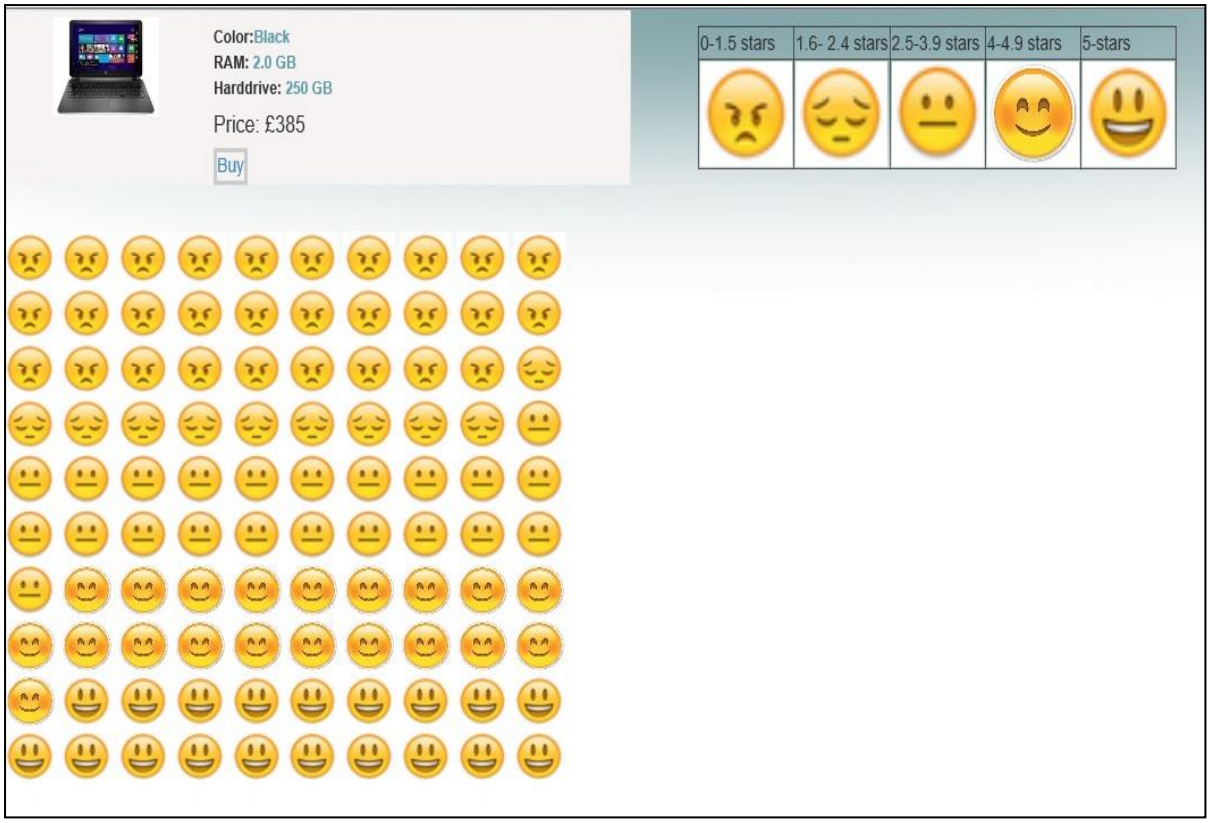


Figure 4.8: EMP in a single product presentation.

Figure 4.8 presents the EMP for a one-product presentation. As indicated before all presentations had a consistent layout similar to the ones presented and explained in the EVP; the only difference was the visual metaphor being tested.

4.5.3 Implementation of Animation Presentation (AMP)

The implementation of the animation involved using a set of ready cartoon designs. As indicated by Gazepidis N. (2008), abstract avatars are cartoon-like interactive characters with limited animation. Accordingly, the researcher used a set of cartoon-like characters to be used for an animation clip to communicate reviews and ratings. A study of 12 users conducted by the author using the chosen cartoon avatars helped to map the ratings with the characters. Table 4.4 presents the set of characters used and the mapping. Microsoft PowerPoint was used to create the short animation clips.

Rating	Expression	Characters	
1	Angry		
2	Sad		
3	Neutral		
4	Smiley		
5	Happy		

Table 4.4: Characters used in animation presentation (AMP).

The output files were saved as MPEG4 format that were then loaded into the testing platform. The duration of each clip was between 20 and 45 seconds.

The animation comprises the scene of a theatre as the background and characters moving from left or right toward the centre of the stage to present a certain review. The characters with the positive or neutral reviews appeared from the right then moved towards the centre while the characters with the negative reviews appeared from the right side then moved towards the centre. After a character has presented the review

and before the second character (appearing) moves towards the centre the first character fades away.

In addition to the displayed reviews, based on the animation clip, the user would be able to determine the ratings of the product. The clip demonstrated a new approach of creating a play-like surrounding with the aim of presenting the reviews and the ratings like a play with the user as the audience. Figure 4.9 presents a set of sequences from an animated clip that demonstrates the play scene.

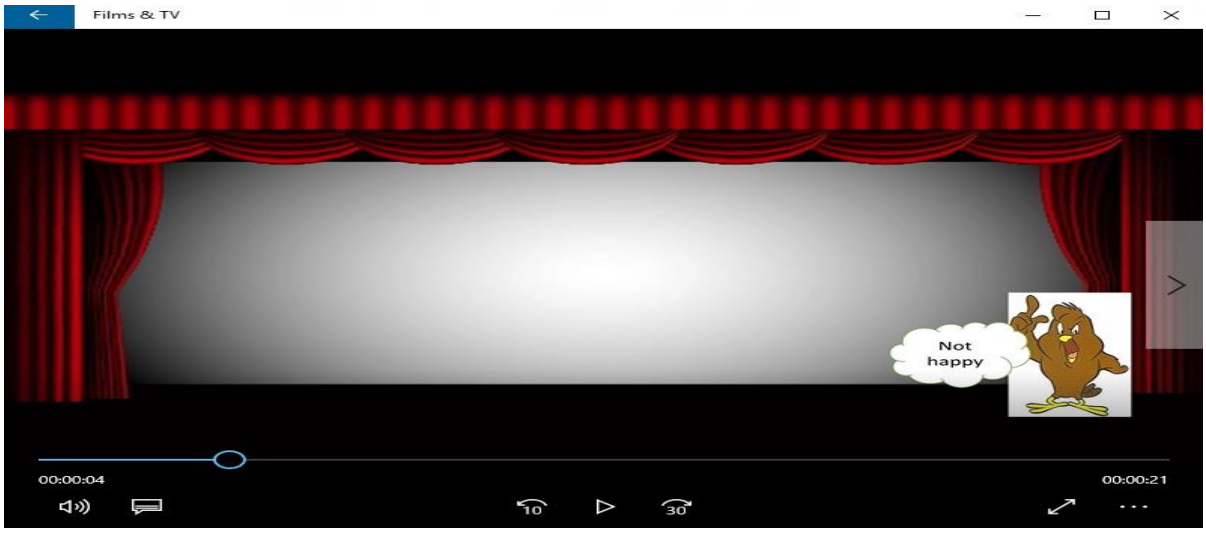


Figure 4.9-a: AMP sequences.

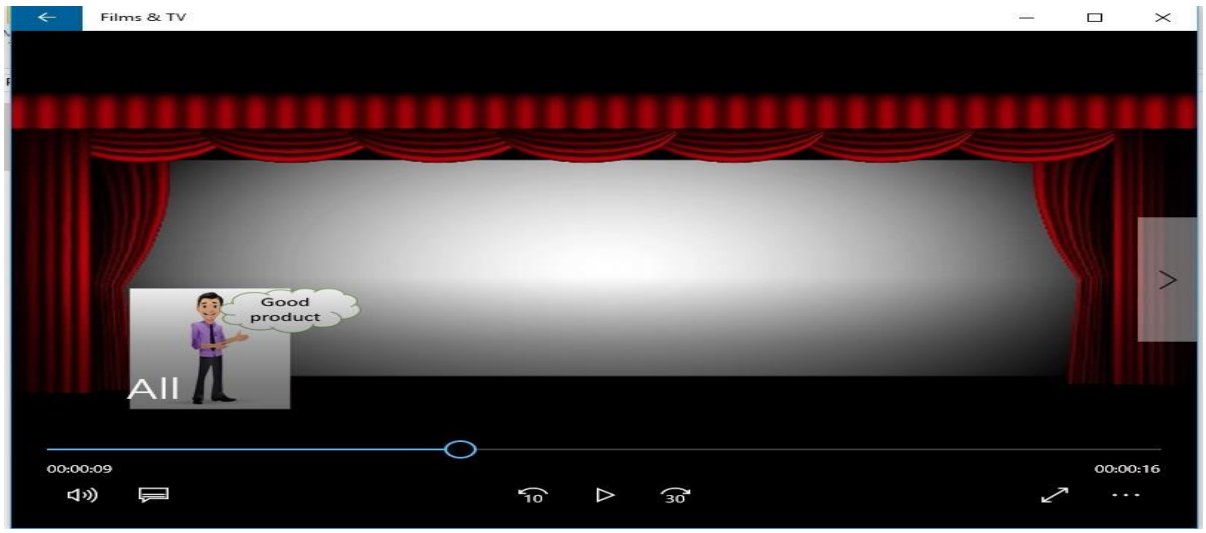


Figure 4.10-b: AMP sequence.

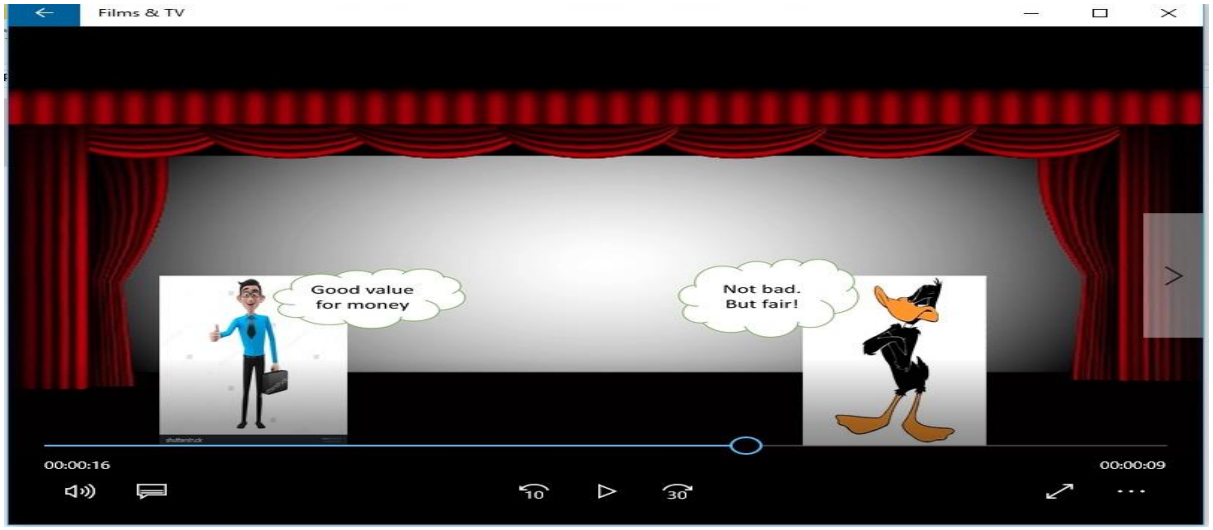


Figure 4.10-c: AMP sequence.

4.6 Experimental Design

To examine the effect of the visual multimodal metaphor review and rating presentations and to find out which presentation would provide better efficiency, effectiveness, user satisfaction and enjoyment for product reviews and ratings, all the multimodal visual presentations were empirically evaluated. A within subject approach was applied through this experimental investigation. The methodology of a single group of users was applied to ensure that every user tests all the different presentation metaphors on all the complexity levels. Such a design insures that each user tests all the systems being evaluated which eliminates external factors or influences that affect users' performance (Field A., 2005). Hence, the single group created tested the e-commerce platform with three review presentations: AVP, EMP and AMP. The sample of 48 users took part in the experiment. This sample was divided into six groups of eight users to perform the experiment's tasks using the three visual presentation metaphor conditions.

The experiment was made up of four parts. The first part was a pre-experiment questionnaire regarding user profile. The second part, the experimental platform

conditions were presented to the users (as in Section 4.5) and asked to complete the experiment's tasks according to each task requirement. This aim of this part was to acquire the data on how the users performed using the different presentation metaphors. After the completion of every task, the user was asked to complete a post-task questionnaire regarding the users' satisfaction and the enjoyment of the system. This was to record the preferences of the users of the metaphors tested.

4.6.1 Experimental Procedure and Tasks

To maintain consistency through the experiment, the users were introduced to the system before the experiment. The experiment was explained to the users before answering the pre-experiment questionnaire. In this experiment, there were two independent variables: the presentation metaphors and the complexity level. The presentation metaphors were: AVP, EMP and AMP.

Users	*Pre-Experimental Questionnaire*	*Experimental Task Requirements*	*Experimental platform*	**Tasks 1, 2**	Post Conditional Task questionnaire	**Task 3**	Post Conditional Task questionnaire	**Task 4**	*Post Conditional Task questionnaire*	*Post Experimental Questionnaire*
1,7,13,19,25,31,37,43				AVP		EMP		AMP		
2,8,14,20,26,32,38,44				AVP		AMP		EMP		
3,9,15,21,27,33,39,45				AMP		AVP		EMP		
4,10,16,22,28,34,40,46				AMP		EMP		AVP		
5,11,17,23,29,35,41,47				EMP		AMP		AVP		
6,12,18,24,30,36,42,48				EMP		AVP		AMP		

Table 4.5: Experimental procedure applied.

The tasks were four tasks labelled as T1, T2, T3 and T4. As the experiment had 48 users testing the three presentations, the presentations were rotated in every task. Table 4.5 demonstrates the experimental procedure applied while conducting the experiment. Table 4.6(a & b) shows the rotation of the presentation types along with the user number testing it.

The complexity level consisted of easy, moderate and complex tasks (refer to section 3.5). Tasks 1 and 2 were considered to be easy, Tasks 3 and 4 considered to be moderate and complex respectively. Of the easy tasks, Task 1 presented the product to the user as a single product at a time, while Task 2 users were presented with two product comparisons simultaneously. The complexity increased in Tasks 3 and 4 as users were presented with three product comparisons (Task 3) and four product comparisons (Task 4) at the same time. For every task, the reviews and ratings were presented to the users using a different multimodal condition and every task had a pre-defined requirement. The tasks' requirements presented the users with the right product to be chosen according to the rating and review conditions that changed between tasks.

Users	T1 & T2	T3	T4
1,7,13,19,25,31,37,43	AVP	EMP	AMP
2,8,14,20,26,32,38,44	AVP	AMP	EMP
3,9,15,21,27,33,39,45	AMP	AVP	EMP
4,10,16,22,28,34,40,46	AMP	EMP	AVP
5,11,17,23,29,35,41,47	EMP	AMP	AVP
6,12,18,24,30,36,42,48	EMP	AVP	AMP

Table 4.6-a: Users grouping by presentation.

Tasks / Subjects	T1 & T2	T3	T4
S1	AVP	EMP	AMP
S2	AVP	AMP	EMP
S3	AMP	AVP	EMP
S4	AMP	EMP	AVP
S5	EMP	AMP	AVP
S6	EMP	AVP	AMP
S7	AVP	EMP	AMP
S8	AVP	AMP	EMP
S9	AMP	AVP	EMP
S10	AMP	EMP	AVP
S11	EMP	AMP	AVP
S12	EMP	AVP	AMP
S13	AVP	EMP	AMP
S14	AVP	AMP	EMP
S15	AMP	AVP	EMP
S16	AMP	EMP	AVP
S17	EMP	AMP	AVP
S18	EMP	AVP	AMP
S19	AVP	EMP	AMP
S20	AVP	AMP	EMP
S21	AMP	AVP	EMP
S22	AMP	EMP	AVP
S23	EMP	AMP	AVP
S24	EMP	AVP	AMP
S25	AVP	EMP	AMP
S26	AVP	AMP	EMP
S27	AMP	AVP	EMP
S28	AMP	EMP	AVP
S29	EMP	AMP	AVP
S30	EMP	AVP	AMP
S31	AVP	EMP	AMP
S32	AVP	AMP	EMP
S33	AMP	AVP	EMP
S34	AMP	EMP	AVP
S35	EMP	AMP	AVP
S36	EMP	AVP	AMP
S37	AVP	EMP	AMP
S38	AVP	AMP	EMP
S39	AMP	AVP	EMP
S40	AMP	EMP	AVP
S41	EMP	AMP	AVP
S42	EMP	AVP	AMP
S43	AVP	EMP	AMP
S44	AVP	AMP	EMP
S45	AMP	AVP	EMP
S46	AMP	EMP	AVP
S47	EMP	AMP	AVP
S48	EMP	AVP	AMP

Table 4.6-b: Users' task rotation.

Group Number	Complexity		
	Easy	Moderate	Difficult
	Task Number		
Group 1	(T1 &T2) AVP	(T3) EMP	(T4) AMP
Group 2	(T1 &T2) AVP	(T3) AMP	(T4) EMP
Group 3	(T1 &T2) AMP	(T3) AVP	(T4) EMP
Group 4	(T1 &T2) AMP	(T3) EMP	(T4) AVP
Group 5	(T1 &T2) EMP	(T3) AMP	(T4) AVP
Group 6	(T1 &T2) EMP	(T3) AVP	(T4) AMP

Table 4.7: Groups rotation of tasks and conditions.

The users were separated into six groups according to the task level and presentation metaphor being tested. An alternating order was used among the users and the groups. Table 4.7 shows the six user groups along with the rotation of presentation metaphor and the task level.

4.6.2 Variables

As per Field A. (2013, p:43-484) the variables considered for the experimental design were classified into three types: dependant variable, independent variable and controlled variable. The controlled variables were the same as in section 3.6.3.3.

4.6.2.1 Independent Variables

These variables were:

IV 1: *Visual presentation metaphor*: the experiment presented three visual metaphor presentations: facial expression avatars, emoji's and animation.

IV 2: *Task difficulty level:* the tasks' complexity level increased as the user proceeded from one task to another.

Variable code	Variable name	Experiment Condition
IV 1	Visual Presentation metaphor	Facial expression avatar
		Emoji's
		Animation
IV 2	Complexity level	Easy
		Moderate
		Difficult

Table 4.8: Independent variables considered for the experiment.

Table 4.8 presents the independent variables with respect to the variable name in the experiment.

4.6.2.2 Dependent Variables

The dependent variables are those measured after manipulating the independent variable (Field A, 2013, p: 65-109). Below are the dependant variables that were used to measure the outcome of the experiment:

DV 1: *Task time*: duration taken by the user to complete each task.

DV 2: *Task successfulness:* to measure the task completion success by checking the correctness of the product chosen. The task was considered successfully completed if the selection choice was correct.

DV 3: *User satisfaction*: to measure the user's satisfaction by completing user satisfaction questionnaires. The questionnaire would provide information on different aspects of the experiment such as complexity, familiarity and help. Questionnaires were designed using a 6-points Likert scale.

Variable code	Variable name	Measures
DV 1	Task time	Efficiency
DV 2	Task successfulness	Effectiveness
DV 3	User satisfaction	Satisfaction
DV 4	User Enjoyment	Enjoyment
DV5	User Preference	Preference

Table 4.9: Dependent variables considered for the experiment.

After the questionnaire completion the SUS scoring method [Brooke J., 1996, p:189-194] was used to create the scores and calculate the user satisfaction in regard to the task presentation metaphor experienced.

DV 4: *User enjoyment*: on the completion of the tasks users would answer questions to measure their enjoyment level. Users would score their answers on agree/disagree statements using a 6-points Likert scale.

DV 5: *User presentation preference*: on the completion of the experiment users will be asked to choose their presentation preference. After completing all the tasks and testing the presentation metaphor users then will be able to choose which one they prefer. This will measure the presentation preference among the users.

Table 4.9 summarises the dependent variables used in the experiment.

4.6.3 Sampling

The factorial calculation of three was used to determine the number of rotations among the experimental conditions. The result was a total of six possible rotations of the condition metaphors for presenting reviews and ratings. Hence, the number of users determined was a multiple of six. Despite that five users could provide a test for system

usability having a larger number of users can offer more adequate usability results (Nelson J., 1993).

Thus, the sample consisted of 48 opportunistic users. The users had no prior knowledge regarding the experimental platform but were familiar with emojis and animation clips (refer to Section 4.8), which indicated that it was their first interaction with the experimental platform.

4.7 Data Collection

The experimental data were collected mainly through observation and questionnaires. Users answered both the pre-experiment questionnaires and post-experiment questionnaires that helped in collecting the data needed to obtain information about the users and to determine their preferences regarding the visual multimodal metaphor for review and rating communications. The collected data was analysed using descriptive statistics. The users' responses to post-task questionnaires provided the data needed for the evaluation of the usability performance efficiency, effectiveness and user satisfaction of the tested metaphors. Also, the post task-questionnaires contributed to the evaluation of the enjoyment variable among the users regarding the visual metaphor presentations tested. The descriptive statistics presented comparisons and summaries between the users (groups) on the experimental observation.

4.8 Users' Profile

Users' responses to the pre-experiment questionnaires helped in collecting information and creating the profile for each user. Users' information such as gender, age and education were collected and analysed. In addition to the users' personal

information, data related to previous knowledge of using computers, internet and online shopping frequency were also collected and analysed. Figure 4.11 presents the users' profile details; it shows that the age range in Groups 1 and 2 were 50% in both ranges of 18-24 and 25-34. Group 3 had the age ranges of 12.5% in both 18-24 and 34-44, 75% were in age range 25-34. Group 4 had 50% of the participants in the age range 25-34, 37.5% in 18-24 and 12.5% in age range 35-44. Group 5 had most participants in age ranges of 18-24 and 25-34 with 37.5% in each, the remaining 25% were in age range 35-44. The last Group 6 had 50% of the users in range 25-34, 37.5% in 18-24 and 12.5% in 35-44. The majority of the participants in all groups were males with 75% in both Group 1 and Group 2, 87.5.% in both Group 4 and Group 6, and 62.5% in Groups 3 and 5. Females presented 25% in Groups 1 and 2, 12.5% in Groups 4 and 6 and 37.5% in Groups 3 and 5. The education level was dominantly undergraduates with 50% in all Groups 1, 2, 3 and 4. The percentage was lower in Group 5 where only 25% were undergraduates, while in Group 6 the undergraduates presented the majority of the users with 87%. The groups had similar profiles in the second highest degree being a Master's (PG). Group 5 had the highest percentage of users to have a Master's with 75%, while Groups 2 and 4 had equally 37.5%, Groups 1 and 3 had 25% and Group 6 had only 12.5%.

The PhD numbers were similar in most of the groups. Groups 1 and 3 had 25% of the participants with an education level of PhD. Groups 2 and 4 had 12.5% while Groups 5 and 6 had no participants at that level.

Figure 4.12 presents users' knowledge with regards to the use of computers and the internet. The data show that the users had a good knowledge of using computers with usage of more than 10 hours a week in all the groups exceeding 60%. While with respect to internet use for more than 10 hours a week, Group 6 had 100%, Groups 1,

3 and 4 had 62.5% each. Groups 2 and 5 had 87.5% of users' accessing the internet for more than 10 hours. Also, Figure 4.11 presents the users' habits regarding online shopping frequency. Fifty percent of user's moderately shop online in Groups 1, 3 and 6 compared to 37.5% in Groups 2 and 4. In another shopping frequency pattern the figure revealed that 62.5% of users in Group 2 shop quite often online, while 37.5% in Groups 5 and 6 compared to 12.5% in Group 1 do so. The last online shopping pattern revealed by the figure is slightly often; Group 3 had 50%, Groups 1 and 3 each had 37.5%, while Groups 5 and 6 each had 12.5%.

Other data related to product reviews was collected from the users in the pre-experiment questionnaires. Figure 4.13 presents the users' approach regarding reading and writing reviews. The users had a figure of 100% for reading reviews. However, the number changed for writing reviews as almost 44% (43.9%) write reviews while up to 56% (56.1%) do not. Moreover, data regarding the time spent reading reviews was also collected. The figure shows that 37% of users usually spend 4 to 6 minutes or 7 to 9 minutes reading reviews with only 18.8% of users spending 1 to 3 minutes. Not many users spend more than 10 minutes, with only 6.2%.

The users' profile shows that they have a similar level of knowledge in the use of the internet, familiarity with online shopping and all of them read reviews. Also, the data indicates that the users have mainly similar levels of education (mainly undergraduate) and a good level of computer use. The figures show that the users have similar characteristics and online shopping experience. Hence, the difference in the users' performance is due to the experimental conditions applied.

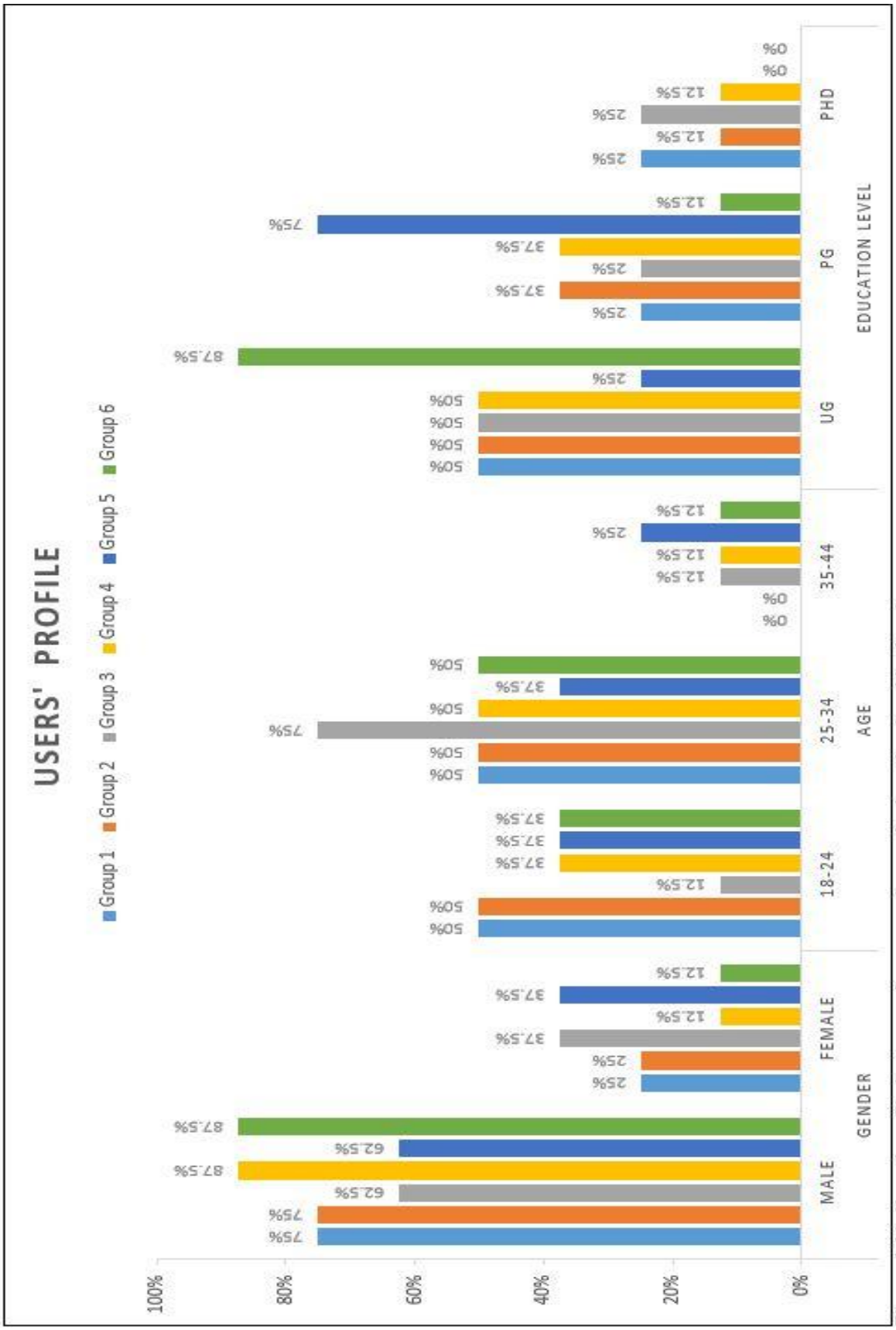


Figure 4.11: Users' profile in terms of age, gender, and education level in the six groups.

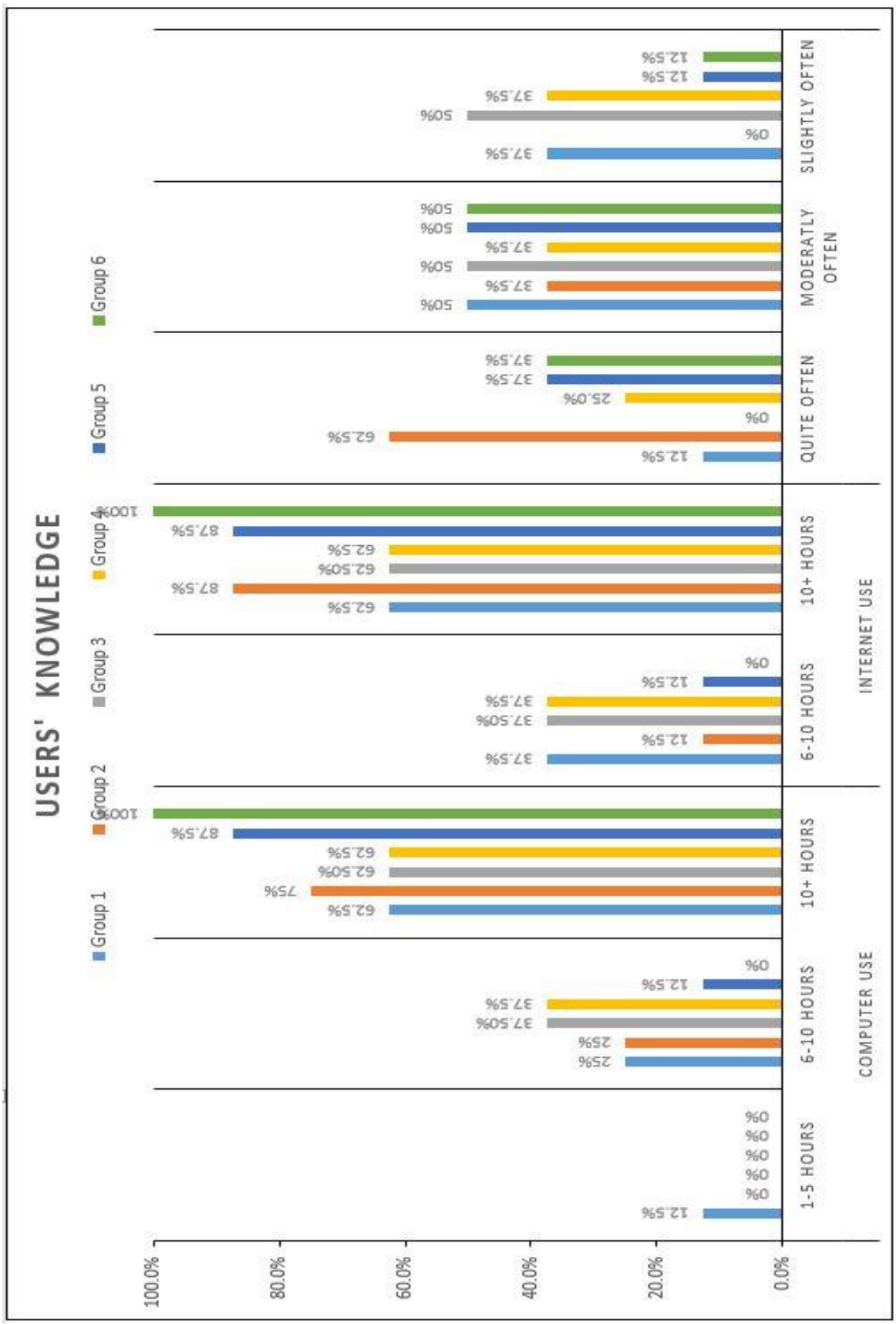


Figure 4.12: Users' knowledge in terms of using computers, internet and online shopping frequency.

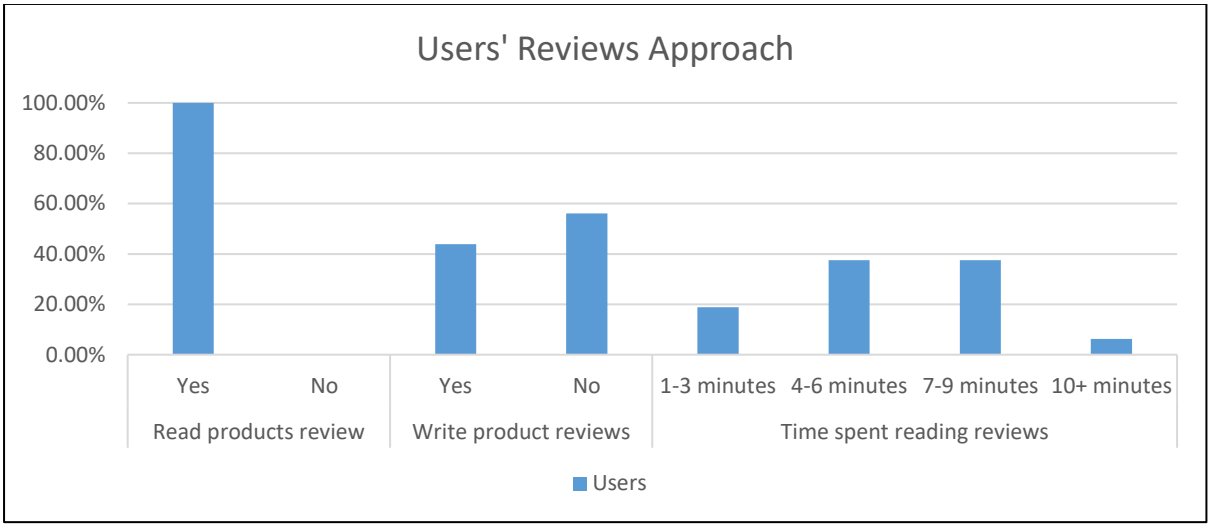


Figure 4.13: Users' reviews approach.

4.9 Results and Analysis

The results of the users were analysed in terms of the time taken by users to finish the tasks (efficiency), number of correct choices or selection (effectiveness) post-task satisfaction and post-task enjoyment ratings. A Kolmogorov-Smirnov test (Field A., 2013, p: 65-109) was used in the statistical analysis to test, calculate and present the normal distribution of experiment results. In addition to that, statistical analysis tables were used to present the mean, median and the mode of the data. As it is important to choose the correct statistical method to analyse the data depending on the data variables and values different statistical tests have been used. For instance, a chi-squared test was used for statistical analysis of categorical data (Field A., 2013, p: 65-109). The statistical analysis used α=.05 and the significance using p-value=.05 (which refers to be less than of 0.05). Also, a t-test was used to evaluate the parameters in the group to determine the significant difference among the users (or sub-groups). For the data that was not normally distributed an ANOVA test was used. This test can be used to test the differences between experimental conditions in a

within-subjects design when the assumption of normal distribution of the data is violated (Field A., 2005).

4.9.1 Efficiency

The time taken by users to complete the tasks using the three presentations (animation, avatar, and emoji) with different complexity levels (easy, moderate, and difficult) was used to measure the efficiency. Figure 4.14 shows the mean value of time taken to complete all tasks among the users (A) and the mean value based on the tasks' complexity in the user presentation (B).

It can be seen that the time taken completing the tasks was lower in the facial expression avatar and the emoji presentations. The data for the time taken can be found in Appendix C.

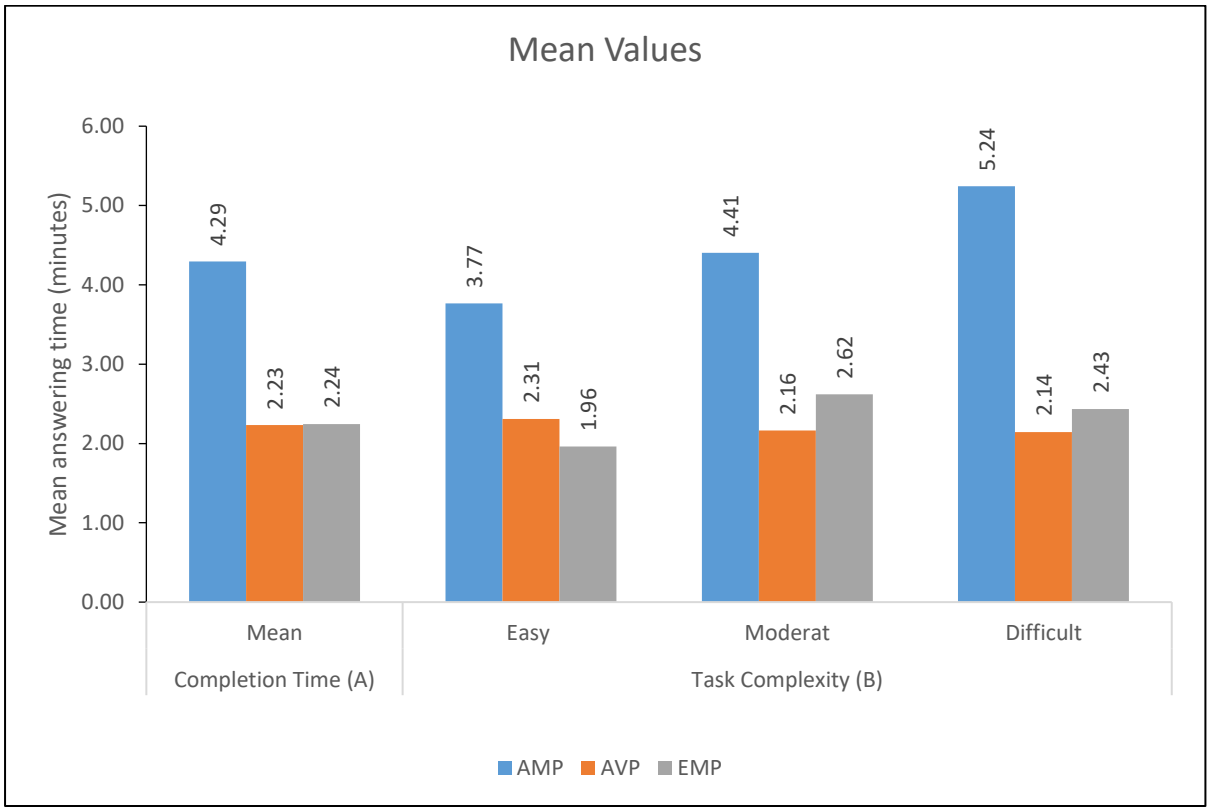


Figure 4.14: Mean values of time taken by users to complete the tasks grouped by the presentation A and complexity level B.

4.9.1.1 Task Completion Time

Each user in the different sup-groups had to complete four tasks in total of different complexity levels. As shown in Figure 4.14(A) the mean time consumed to complete the tasks using the avatar presentation (AVP) and the emoji presentation (EMP) was lower than that using the animation presentation (AMP). The mean value taken by the users to complete all the tasks using the avatar presentation was 2.23 minutes almost similar to the average time taken to complete the tasks using the emoji presentation which was 2.24 minutes. In comparison, the animation presentation consumed more time with an average of 4.30 minutes to complete the tasks. It showed that the mean value or the average time taken by the users has nearly doubled compared to the avatar and the emoji presentations. Moreover, the figure shows that the avatar and emoji presentation tasks were better than using the animation presentation by around 2 minutes. Due to the nature of the interface design of the animation presentation (AMP), which used animation files, it was expected that using this metaphor it would take more time to complete the tasks as users would be relying on watching the animation content. A Smirnov test was conducted to check the normality of the data. The result showed the data were not strictly normally distributed among the presentations of the tasks. A Levene test was conducted to check the homogeneity of variances among the group. The Levene test was not significant indicating that the data showed homogeneity of variance. A one-way ANNOVA test showed that time taken to complete all the tasks was significant with $p=.000$ ($p<.05$); however, the post hoc analysis did provide that the results were significant. Hence, Fisher's post hoc least significant difference (LSD) was used to determine the metaphor for which completion time was significant. The LSD showed that the difference in completion time between the animation and the avatar presentations was significant with $p=.000$

(p<.05). While the test showed there was no significant difference between the avatar and the emoji presentations p=0.51 (p>.05). Moreover, the calculation showed the difference in completing all the tasks between the sub groups was not significant.

Tests of Normality						
	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
AMP_Easy	.422	48	.000	.651	48	.000
AMP_Moderate	.422	48	.000	.647	48	.000
AMP_Difficult	.423	48	.000	.641	48	.000
AVP_easy	.422	48	.000	.647	48	.000
AVP_Moderate	.419	48	.000	.656	48	.000
AVP_Difficult	.420	48	.000	.656	48	.000
EMP_EASY	.422	48	.000	.643	48	.000
EMP_Moderate	.419	48	.000	.655	48	.000
EMP_Difficult	.421	48	.000	.659	48	.000

Table 4.10: Normality test of competition time taken by users of each presentation task.

ANOVA				
		df	F	Sig.
T1_Time	Between Groups	2	76.178	.000
	Within Groups	45		
	Total	47		
T2_Time	Between Groups	2	97.718	.000
	Within Groups	45		
	Total	47		
T3_Time	Between Groups	2	9.967	.000
	Within Groups	45		
	Total	47		
T4_Time	Between Groups	2	3.998	.025
	Within Groups	45		
	Total	47		

Table 4.11: Mean test of tasks completion time.

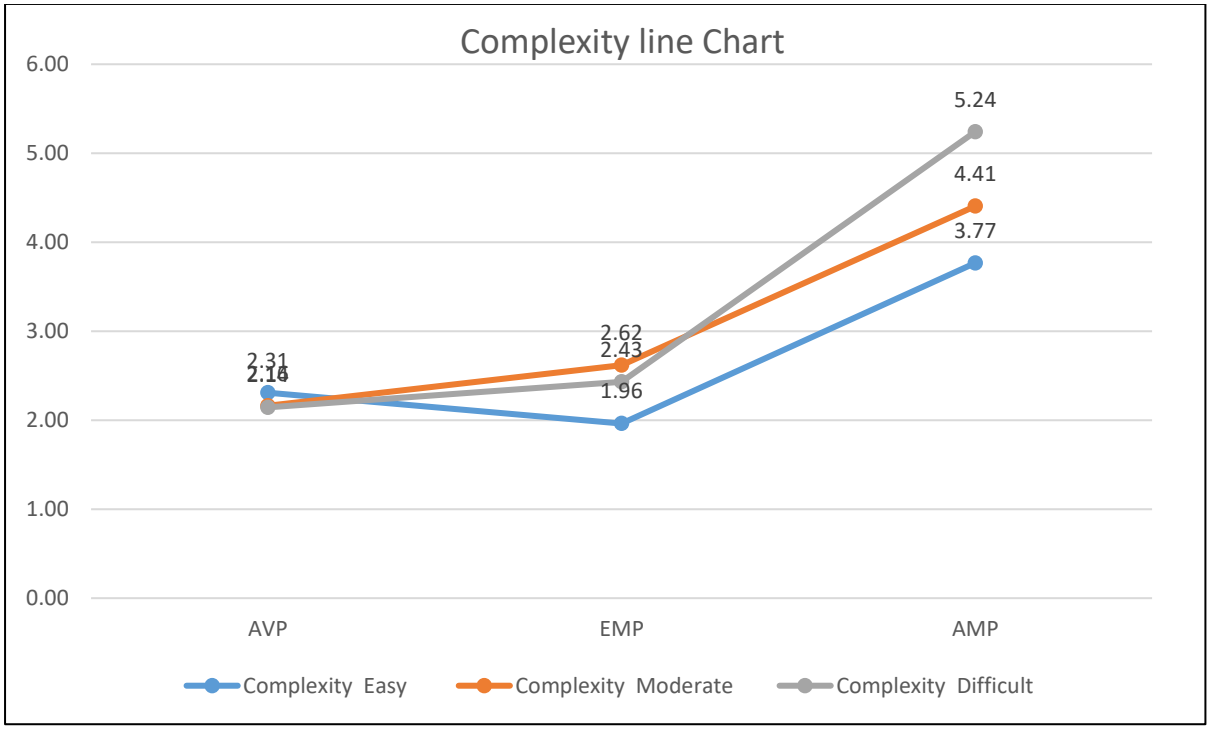


Figure 4.15: Mean task completion time by complexity level.

Figure 4.15 (B) shows the completion time based on the task complexity. The tasks were designed to increase in difficulty and were divided into two easy, one moderate and one difficult. From the figure it can be noticed that the completion time for the animation presentation was higher for all the complexity levels compared to the other presentation metaphors. The figure also showed that the variance time for the avatar and the emoji presentations was very close at all complexity levels with a mean difference up to 0.3 minutes (30 seconds).

Moreover, it can be noticed that the time variance increases when the animation metaphor was tested. The statistical test showed that the data for the completion time of all the tasks using the different presentation metaphors is significant with $p<0.05$ (Table 4.12). Also, The ANOVA F-test determined that the result was significant with F-distribution test ($F=5.985.2$, $df=5$, $p<.005$).

One-Sample Test						
	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
Completion_Time	79.964	47	.000	11.03458	10.7570	11.3122

Table 4.12: T-test for the completion time of all the tasks.

ANOVA			
Completion Time			
	df	**F**	**Sig.**
Between Groups	5	5.985	.000
Within Groups	42		
Total	47		

Table 4.13: ANOVA F-test to determine statistical significance for the time taken by users to complete tasks.

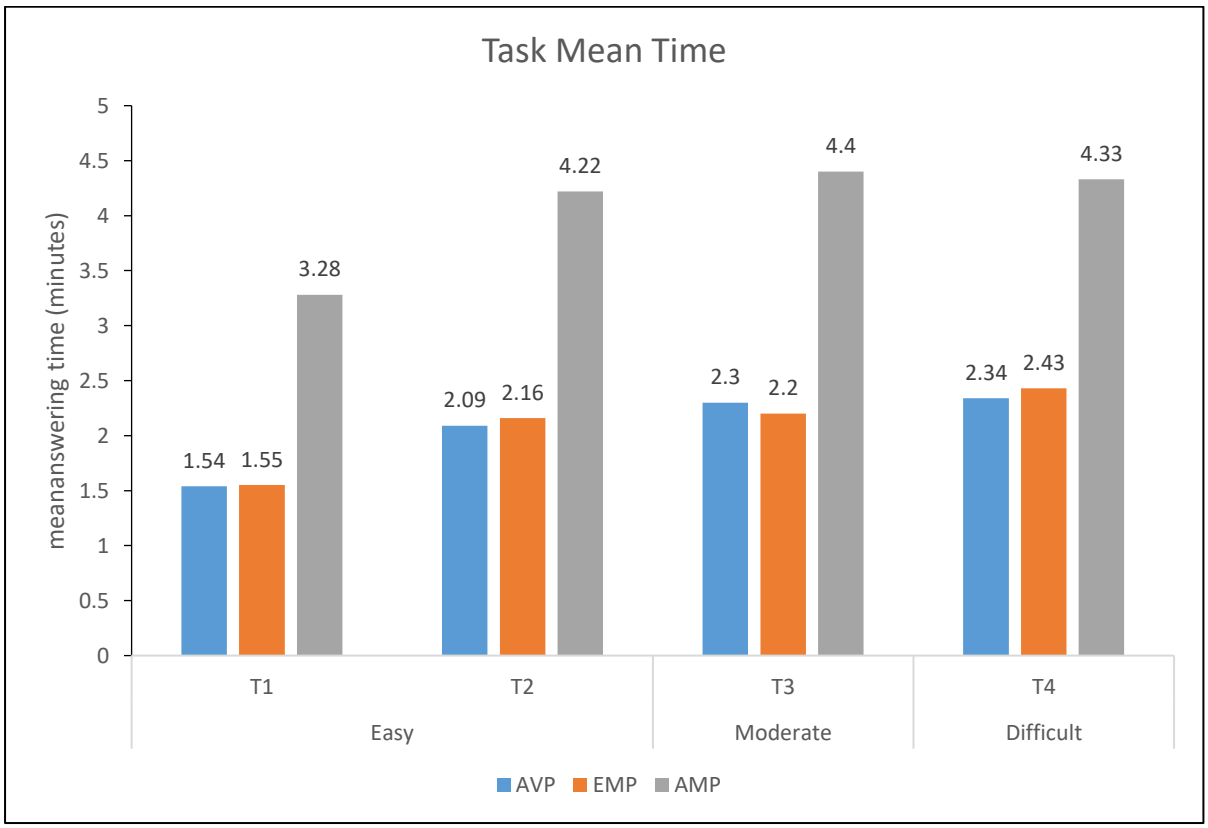


Figure 4.16: Mean value of time taken by the users to finish each task according to the presentation metaphor.

Figure 4.16 shows the mean time taken by the users to finish each task in all the groups. In all the tasks those using the avatar and emoji presentation metaphors needed almost the same amount of time to finish the tasks, with time difference approximately 0.01 minutes for Task 1, 0.15 minutes for Task 2, 0.1 minute for Task 3 and 0.9 minutes for Task 4. It could be noticed that the difference between these two presentations was not significant since the mean time taken to finish a task was 2.06 minutes for the avatar presentation metaphor and 2.08 minutes (2.085) for the emoji presentation metaphor.

Moreover, it could be noticed that the difference between the animation presentation metaphor and both the emoji and the avatar presentations varied across the different tasks. This time variances can be verified by the different presentation interfaces along with the task complexity level. The time taken by users to complete tasks in each group presented with different interface condition was contrasting. The time difference was found to be statistically significant using the F-distribution test ($F=5.985.2$, $df=5$, $p<.005$) (Table 4.13).

4.9.2 Effectiveness

The number of correct and incorrect task choices was required to evaluate the effectiveness of the different presentation metaphors in presenting reviews. Each user was required to complete four tasks with varied complexity levels (easy, moderate and difficult). This measure was considered for all the tasks in total and by task complexity (easy, moderate, and difficult). Figure 4.17 shows the percentage of tasks completed successfully, for all the tasks (A) and according to task complexity (B).

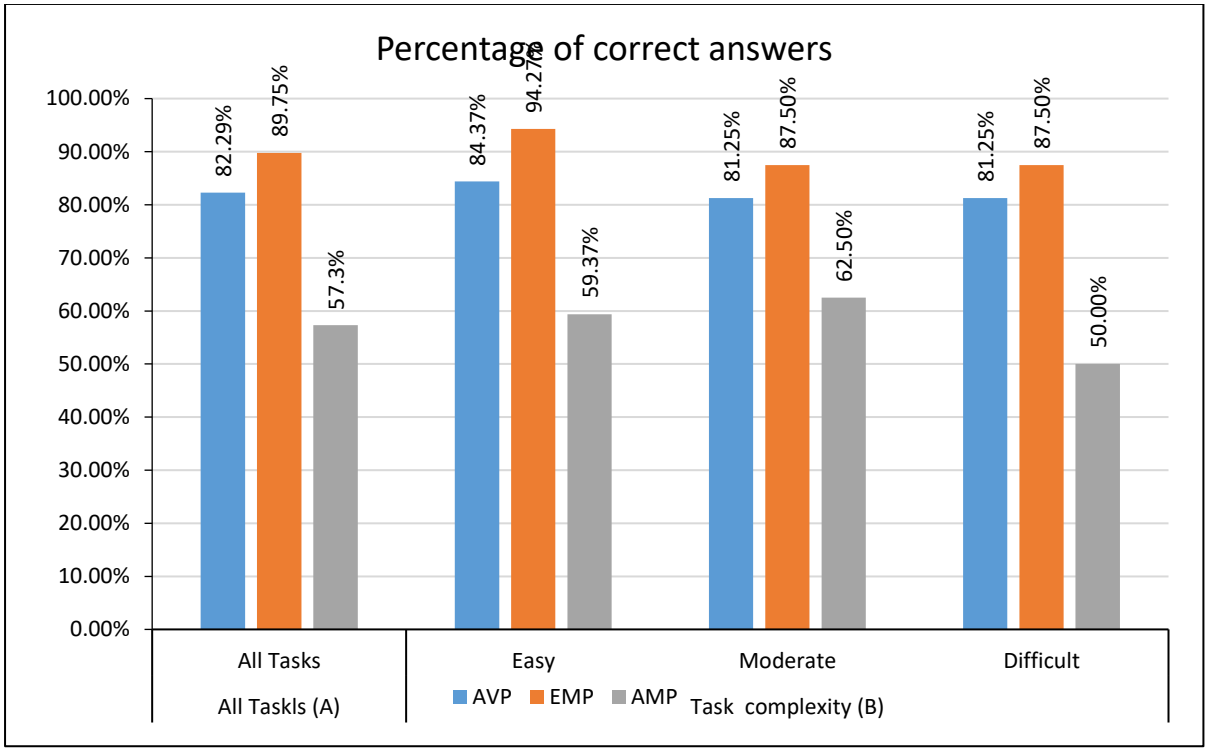


Figure 4.17: Percentage of correctly completed tasks achieved by the users in the three groups for all tasks (A) and for task complexity (B).

It can be noticed that the users using the avatar and the emoji presentation metaphors performed much better than when using the animation presentation metaphor in terms of successful task completion as well as at each complexity level.

4.9.2.1 Effectiveness for all Tasks

In Figure 4.17(A) it can be seen that the users performed better using the emoji presentation metaphor compared to the other presentation metaphors with regards to the tasks completed successfully. The percentage of correctly answered questions achieved using the emoji presentation (EMP) was 89.75%, almost 32% greater than the animation presentation metaphor (AMP) with only 57.3%. However, comparing the emoji presentation figure with the avatar (AVP) presentation metaphor interface the difference was slight with the emoji presentation (EMP) having around 7% more successful tasks. The total number of correctly completed tasks in the emoji presentation was 43 compared to the avatar presentation with 39 and 30 with the

animation presentation interface. Also, the mean value of successfully completed tasks per user calculated for the emoji presentation (3.58) was 1.08 successfully completed tasks better than that of the animation metaphor (2.5) and marginally better by 0.75 than that of the avatar presentation metaphor (3.25).

4.9.2.2 Effectiveness According to Task Complexity

Further data analysis regarding the task complexity and the presentation metaphor was conducted. Figure 4.17(B) shows the percentage of easy, moderate and difficult tasks completed successfully in all the presentation metaphors (AVP, EMP, and AMP). It shows that the emoji presentation metaphor (EMP) outperformed the animation presentation (AMP) over all task complexities but was only slightly better than the avatar presentation metaphor (AVP). Moreover, the users' performance partially decreased in all the emoji and avatar presentation metaphors as the task complexity increased. However, the users' performance improved in the AMP when the task complexity increased from easy to moderate. In the easy task using EMP and AVP the users scored a minimum of 25% more successful completions than when using the AMP. However, this percentage decreased and was smaller in the moderate task (18.75%) but increased in the difficult task (31.25%) where the users using the EMP and AVP managed to achieve approximately a six times higher correct response than those using the AMP. Using AVP, the users correctly completed 84.37%, 81.25% and 81.25% of easy, moderate and difficult tasks respectively. Using EMP the users achieved the highest percentage of successfully completed tasks with 94.27% in the easy level, 87.5% in the moderate level and 87.5% in the difficult level. On the other hand, using AMP the users achieved the lowest percentage where successfully completed tasks were 59.37%, 62.5% and 50% of easy, moderate and difficult levels respectively.

Further analysis conducted using the ANOVA F-test showed that there is a significant difference ($p<.05$) among the presentation metaphors in the easy and difficult tasks but no significant difference ($p>.05$) between them in the moderate task as Table 4.15 presents. This could be due to the performance of the users testing the other metaphors in this level. The one-way ANOVA showed only that there is a significant difference among the metaphors but did not show which had the significant difference. Advanced analysis using the LSD post hoc test and Tukey test showed where the significance is found among the presentation metaphors tested.

Table 4.16 presents Fisher's post hoc analyses that showed that there was a significant difference between the emoji and the animation metaphor presentations in the easy and complex tasks ($p<0.05$). A significant difference existed between AVP and AMP in the complex task ($p<0.05$), while the test showed no significant difference between the metaphors in the moderate task with $p>0.05$ ($p<0.05$ for significance). Thus, it can be concluded that the variance between AVP and AMP was not significant regarding the percentage of the tasks successfully completed in the easy level but was significant in the complex or difficult level.

ANOVA

		df	F	Sig.
Easy	Between Groups	2	3.590	.036
	Within Groups	45		
	Total	47		
Moderate	Between Groups	2	1.535	.226
	Within Groups	45		
	Total	47		
Difficult	Between Groups	2	3.550	.037
	Within Groups	45		
	Total	47		

Table 4.15: ANOVA F-test results.

However, there was a significant difference between EMP on one side and AMP on the other in both easy and complex tasks. The contribution of the avatar and the emoji interfaces as a presentation metaphor in the users' performance was clear in the tasks' completion, especially as the tasks' complexity level increased, compared to the animation presentation metaphor.

Post Hoc Multiple Comparisons LSD

Dependent Variable	(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Easy	AVP	EMP	.125	.143	.385	-.16	.41
		AMP	-.250	.143	.086	-.54	.04
	EMP	AVP	-.125	.143	.385	-.41	.16
		AMP	-.375*	.143	.012	-.66	-.09
	AMP	AVP	.250	.143	.086	-.04	.54
		EMP	.375*	.143	.012	.09	.66
Moderate	AVP	EMP	.063	.148	.676	-.24	.36
		AMP	-.188	.148	.213	-.49	.11
	EMP	AVP	-.063	.148	.676	-.36	.24
		AMP	-.250	.148	.099	-.55	.05
	AMP	AVP	.188	.148	.213	-.11	.49
		EMP	.250	.148	.099	-.05	.55
Difficult	AVP	EMP	.063	.151	.681	-.24	.37
		AMP	-.313*	.151	.044	-.62	-.01
	EMP	AVP	-.063	.151	.681	-.37	.24
		AMP	-.375*	.151	.017	-.68	-.07
	AMP	AVP	.313*	.151	.044	.01	.62
		EMP	.375*	.151	.017	.07	.68

Table 4.16: One way ANOVA post hoc (LSD) test for task completion according to task complexity.

4.9.2.3 Effectiveness According to each Task

The percentage of users' successful task completion using the three presentation metaphors is shown in Figure 4.18. It can be noticed that EMP performed better than the other presentation metaphors with 92.18% success rate compared to 82.18% in AVP and 57.18% in AMP. AVP was more effective compared with AMP with up to 25% success rate difference.

The chi-squared results shown in Table 4.17 demonstrated a significant difference among the users in the easy (x^2=6.604 *df*=2, p<0.05) and difficult (x^2=6.541 df=2, p<0.05) tasks. However, there was no significant difference between the metaphors in the moderate tasks (x^2=3.066 df=2, p>0.05). The difference is noticeable from the chart where the users of the animation presentation in all tasks scored lower compared to when using the EMP and AVP presentations. Overall, it can be said that the presence of the visual multimodal metaphor, especially avatar and emoji, in presenting the overall ratings contributed to the performance of the users in all the required tasks compared to the performance of the animation presentation.

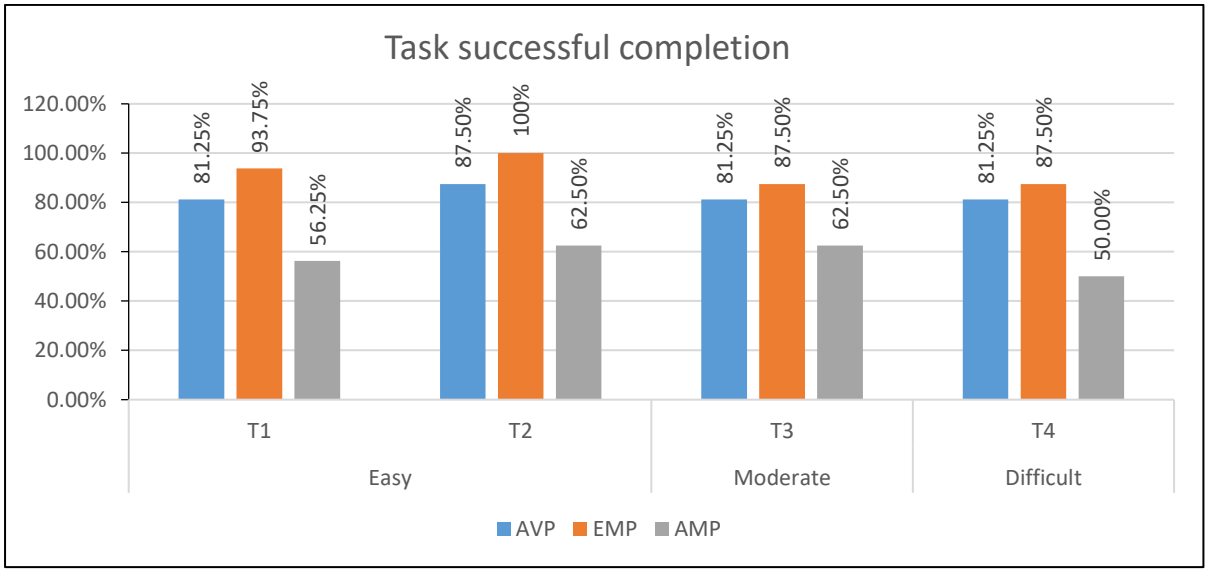


Figure 4.18: Percentage of correctly completed tasks according to the group.

Complexity	Metaphor	Tasks	Task Completion	X^2 Value	p-value	Significant
Easy	AVP	Task 1	81.25%	6.604	<0.05	Yes
	EMP		93.75%			
	AMP		56.25%			
Easy	AVP	Task 2	87.5%	8.400	<0.05	Yes
	EMP		100.7%			
	AMP		62.5%			
Moderate	AVP	Task 3	81.25%	3.066	>0.05	No
	EMP		87.5%			
	AMP		62.5%			
Difficult	AVP	Task 4	81.25.7%	6.541	<0.05	Yes
	EMP		87.5.3%			
	AMP		50%			

Table 4.17: Chi-squared results for the users' successful task completion using the three presentation metaphors.

4.9.2.4 Effectiveness for each User

Figure 4.19 shows the total number of successfully completed tasks achieved by every user. It can be noted 17 users successfully completed all tasks. The weakest users were User 16 and User 30 with only two tasks completed successfully. On average, the number of tasks completed successfully per user in Group 1 was 3.104.

With a high mean of successful completion among the users it is noticeable that the multimodal presentations had positively impacted the users during task completion. Using the visual multimodal metaphor of AVP and EMP had higher impact on the users than AMP and this enabled them to perform well in successfully completing the tasks.

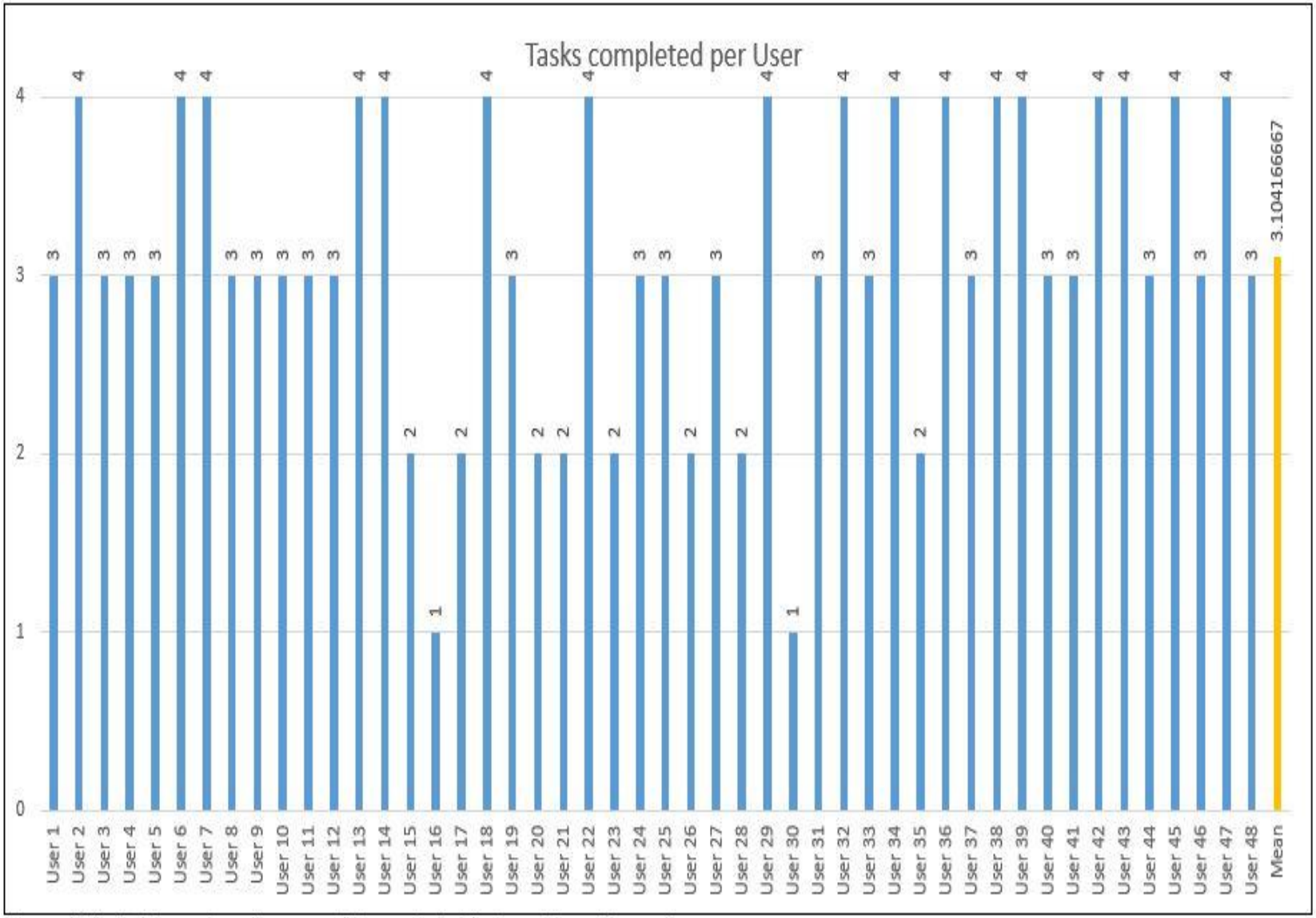


Figure 4.19: Total number of successful completed tasks achieved by each user.

4.9.3 Users' Satisfaction

User satisfaction with regards to the presentation metaphor of the experimental platform was measured among the users with answers to a post-task questionnaire, consisting of ten statements, after the use of each metaphor presentation. A system usability scale (SUS) measurement was adopted from Bangor et al., (2013, pp: 202-205). Table 4.19 contains the statement used for system satisfaction. Each statement used was measured using a 5 point Likert scale with 5 referring to strongly agree, 1 strongly disagree and 3 to neutral. After each task, every user was asked to evaluate the metaphor used and tested using the user satisfaction statements.

Figure 4.20 shows the frequency of users' agreement to each of the SUS statements in the post-task-questionnaire. It can be noted that similar levels of agreement were expressed by the users using different presentation metaphors for statement S5 related to the functions of the system (*I found the various functions in this system were well integrated*). However, it can be noted that the users were less satisfied with the AMP, by stating of the need to learn before using the system, with 50% agreeing on S10 (*I needed to learn a lot of things before I could get going with this system)*. In S1 users were asked if they would use the system more frequently (*I think that I would like to use this system frequently)* with AVP scoring 75%, 70% for EMP while only 50% considered using the AMP. Moreover, the users were asked in S3 regarding the ease of using the system (*I thought the system was easy to use)* where the users considered both EMP along with AVP to be the easiest with satisfaction of 100% and 95% respectively. Additionally, the users gave their satisfaction on the complexity of the system in S2 (*I found the system unnecessarily complex)* with 50% agreed on the statement for AVP while 0% for AVP and EMP. It is clear that the users were more

satisfied with review rating presentation EMP and AVP than with review rating presentation using AMP.

Statistical analysis conducted using the ANOVA with Friedman test showed a significant difference among the users when using the different presentation metaphors (x^2=381.994 *df*=9, p<0.05). Statistically, the chi-square test showed that there was a significant difference in the user's satisfaction statements with p<0.05. Table 4.20 presents statistical analysis for all the satisfaction statements answered by the users after completing Task 1 using the various presentation metaphors (refer to Table 4.6) with most of the statements showing difference between agreement and disagreement.

Statements 2, 5 and 6 were constant, either all agree or disagree, hence there was no significant difference among the users. Further analysis using Wilcoxon pair wise comparison for Task 1, to test the significance among the presentation metaphors, showed that there was a significant difference between the presentation metaphors (z=-1.988, *df*=4, p<0.05).

Statements
'I think that I would like to use the system frequently'
'I found the system unnecessarily complex'
'I thought the system was easy to use'
'I think that I would need the support of a technical person to be able to use this system'
'I found the various functions in this system were well integrated'
'I thought there was too much inconsistency in this system'
'I would imagine that most people would learn to use this very quickly'
'I found the system very cumbersome to use'
'I felt very confident using the system'
'I needed to learn a lot of things before I could get going with this this system'

Table 4.19: User satisfaction statements (Bangor et al.,2013).

	S1	S2	S3	S4	S5	S6	S7	S8	S9	S10
Chi-Squared	30.753	NA	48.000	48.00	NA	NA	48.000	48.000	48.000	48.000
df	4		2	2			2	2	2	2
Asymp. Sig.	.000		.000	.000			.000	.000	.000	.000

Table 4.20: Chi-squared results of users' satisfaction statements for Task 1.

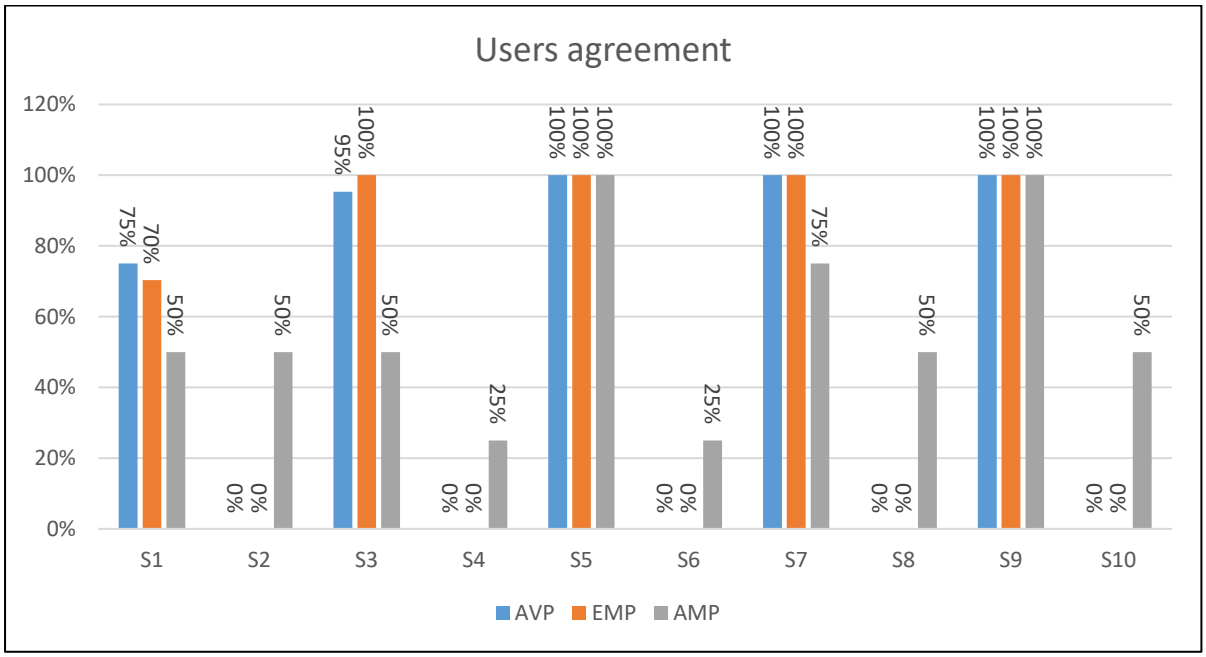


Figure 4.20: Frequency of users' agreement for each SUS statement for each presentation metaphor.

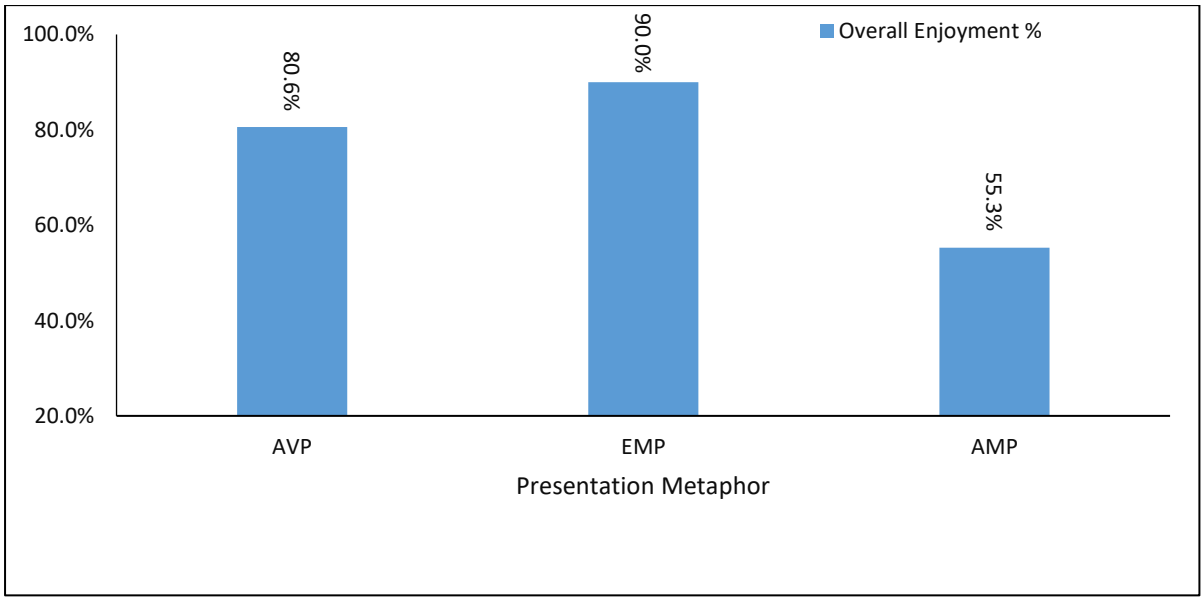


Figure 4.21: Enjoyment percentage for each metaphor presentation.

4.9.4 User Perceived Enjoyment

Enjoyment level is another important factor when it comes to measuring users' experience, as people remember enjoyable, useful and engaging experiences and want to repeat them (O'Brian, 2008). Previous studies have focused on understanding enjoyment when it comes to using systems.

MacFarlane and Casey (2002) emphasised that enjoyment is not just enjoying the experience but also leading to recommend the experience (overall experience) of site or product. Furthermore, researchers tried to link online shopping behaviour to the users' experience of the website or product; a feeling of enjoyment can influence online shopping (Fiore et al., 2005). Enjoyment was measured after each task and after completing the experiment. User enjoyment was measured using a 5 point Likert scale with 1 being least enjoyable to 5 very enjoyable. Their post-task enjoyment level was provided by each user after completing every task and after testing the presentation metaphor for that task.

Figure 4.21 shows the overall percentage value of enjoyment level for each presentation metaphor. It is clear that the users have stated that EMP was the most enjoyable with up to 90%. AVP was the second with up to 80.6% enjoyment level. The lowest enjoyment of 55.3% was for AMP. The results indicate the users enjoyed using the system with the EMP interface more than using AVP and AMP interfaces.

As every presentation metaphor is tested 16 times per task and the maximum enjoyment level is 5; the maximum score for each task is 80 (16×5). Also, for each presentation metaphor having four tasks with enjoyment scale of maximum 5 the possible overall score is 320 (16×4×5). Figure 4.21 shows the enjoyment score for each presentation metaphor per task. The line chart shows how the enjoyment level

changed for each of the presentation metaphors with the change of task. This change could be justified by the increased level of each task. Moreover, EMP was the most consistent among all the presentation metaphors with scores within between 70 and 74. The increase of task complexity effect can be seen on the line presenting AMP where enjoyment level dropped as complexity level increased. Task 1 score was 64 and went down to 33 when Task 4 was reached. AVP enjoyment level started with 61 at Task 1 and increased in Tasks 2 and 3 with 62 and 71 respectively. After the enjoyment level in Task 3 it reduced to 64 in Task 4. It can be noticed that the avatar presentation enjoyment level in Task 1 was lower than AMP with 61 compared to 64.

The enjoyment level of the presentation metaphor against the task complexity is presented in Figure 4.22. EMP had the highest enjoyment level compared to the other metaphor presentations with mean enjoyment value of 72 among all complexities, while AVP had higher enjoyment level compared to AMP with mean values 65.5 and 40.3 respectively.

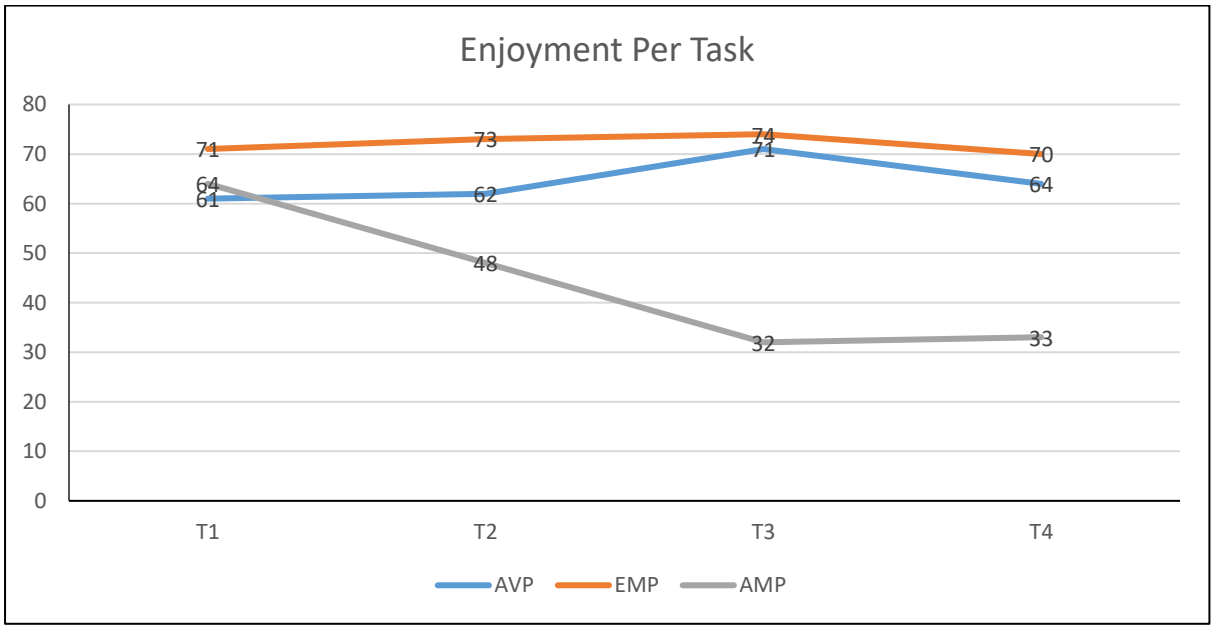


Figure 4.21: Line chart enjoyment score of each presentation metaphor per task.

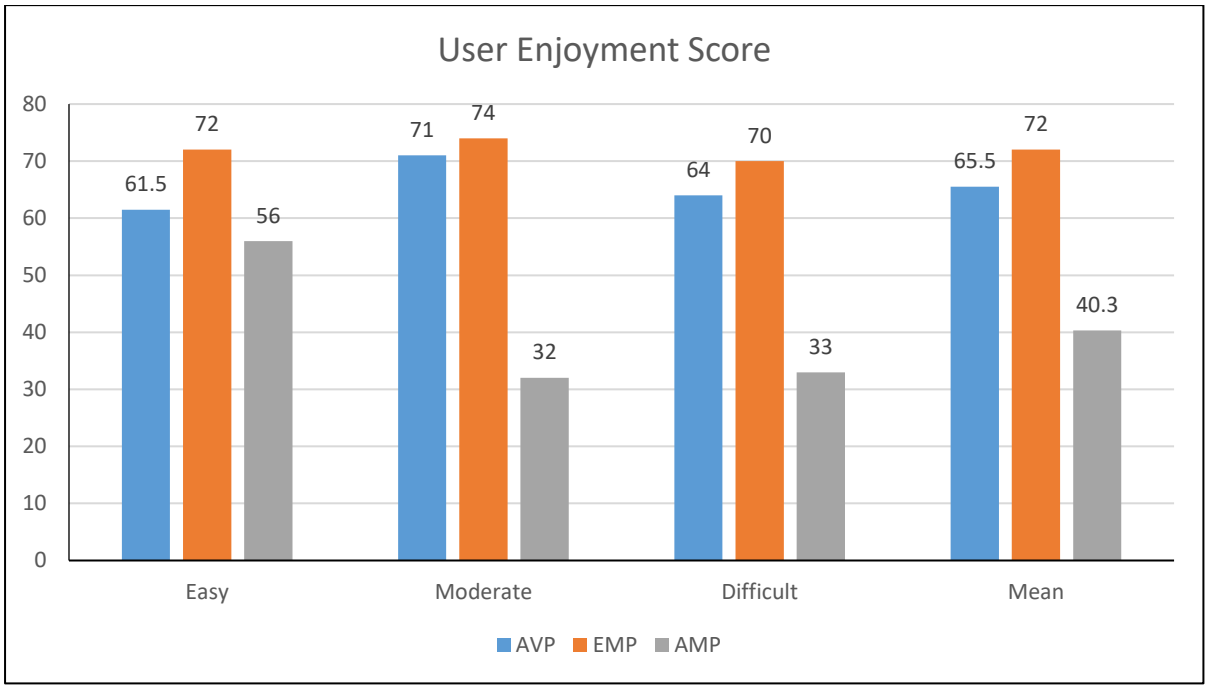


Figure 4.22: Enjoyment score for each metaphor according to complexity level.

		df	Mean Square	F	Sig.
T1_Enjoyment_Level	Between Groups	2	1.646	11.618	.000
	Within Groups	45	.142		
	Total	47			
T2_Enjoyment_Level	Between Groups	2	9.813	77.637	.000
	Within Groups	45	.126		
	Total	47			
T3_Enjoyment_Level	Between Groups	2	13.563	11.923	.000
	Within Groups	45	1.138		
	Total	47			
T4_Enjoyment_Level	Between Groups	2	6.083	6.248	.004
	Within Groups	45	.974		
	Total	47			

Table 4.21: ANOVA test enjoyment level presentation metaphor per task.

Statistical analyses using ANOVA showed that there was a significant difference between enjoyment levels with respect to each task. For instance, Task 1 had showed significant difference among the presentation metaphors ($F=11.618$, $df=2$, $p<.005$).

The ANOVA test was followed by post hoc analysis using Fisher's least significance difference (LSD) to check where the significant difference was among the presentation metaphors. Table 4.22 shows the result of the post hoc analysis.

Multiple Comparisons							
						95% Confidence Interval	
Dependent Variable	(I) T1_Presentation	(J) T1_Presentation	Mean Difference (I-J)	Std. Error	Sig.	Lower Bound	Upper Bound
T1	AVP	EMP	-.625*	.133	.000	-.89	-.36
		AMP	-.188	.133	.166	-.46	.08
	EMP	AVP	.625*	.133	.000	.36	.89
		AMP	.438*	.133	.002	.17	.71
	AMP	AVP	.188	.133	.166	-.08	.46
		EMP	-.438*	.133	.002	-.71	-.17
T2	AVP	EMP	-.688*	.126	.000	-.94	-.43
		AMP	.875*	.126	.000	.62	1.13
	EMP	AVP	.688*	.126	.000	.43	.94
		AMP	1.563*	.126	.000	1.31	1.82
	AMP	AVP	-.875*	.126	.000	-1.13	-.62
		EMP	-1.563*	.126	.000	-1.82	-1.31
T3	AVP	EMP	-.063	.377	.869	-.82	.70
		AMP	-1.625*	.377	.000	-2.38	-.87
	EMP	AVP	.063	.377	.869	-.70	.82
		AMP	-1.563*	.377	.000	-2.32	-.80
	AMP	AVP	1.625*	.377	.000	.87	2.38
		EMP	1.563*	.377	.000	.80	2.32
T4	AVP	EMP	.125	.349	.722	-.58	.83
		AMP	-1.000*	.349	.006	-1.70	-.30
	EMP	AVP	-.125	.349	.722	-.83	.58
		AMP	-1.125*	.349	.002	-1.83	-.42
	AMP	AVP	1.000*	.349	.006	.30	1.70
		EMP	1.125*	.349	.002	.42	1.83

*. The mean difference is significant at the 0.05 level.

Table 4.22: Post-hoc LSD ANOVA analysis for enjoyment level.

The results showed that in Task 1 there was no significant difference between AVP and AMP ($p>0.05$). However, there was significant difference between EMP and both AVP and AMP ($p<0.05$). For Task 2 there was a significant difference between all the presentation metaphors. Task 3 showed there is a significant difference between each of EMP, AVP and AMP ($p<0.05$). Similarly, the significant difference in Task 4 was repeated again between AMP and AVP and between AMP and EMP ($p<0.05$).

4.10 Discussion

The second experiment investigated the visual multimodal presentation of product reviews and ratings. The study was based on the impact of visual multimodal facial expression avatar, emoji and animation presentations with different task complexity levels (simple, moderate and difficult) of e-commerce product review and rating presentations. The results have been used to compare the different presentations in terms of efficiency, effectiveness, user satisfaction and enjoyment levels. Accordingly, these results were discussed from different perspectives:

1- Effectiveness (correctness of completed tasks in terms of task complexity and visual metaphor review presentation)

2- Efficiency (time taken by users to complete tasks according to task complexity and review presentation)

3- User satisfaction and experience of the tested review presentations.

4- Enjoyment level by users for each of the visual metaphor presentations.

Despite the fact that AMP of product reviews provided a new presentation approach it did not prove to be more efficient or effective than the use of AVP or EMP. The results showed that the use of AVP or EMP were significantly more efficient, effective and

satisfactory than using AMP. Moreover, the study showed AMP offered higher enjoyment level in Task 1 (single product presentation) than AVP.

4.10.1 Efficiency

The experimental results as shown in Figure 4.14 demonstrated that using AVP or EMP resulted in a significant reduction in task completion time over AMP. However, the EMP showed a narrow advantage on AVP with regard to efficiency. This could be due to the previous familiarity of the users with emojis. Hence, these findings provide partial support to Hypothesis 1(c). Also, the figure showed that the animation presentation was considerably more time consuming for all complexity levels. Overall, there was around +2.30 minutes difference between the animation presentation and the other presentation metaphors. Table 4.11 ANOVA test showed that there was significant difference between the presentation metaphors with regards to time completion ($p<00.5$). Fisher's post hoc test (LSD) showed no significant difference between AVP and EMP ($p>0.005$). Moreover, it showed that there was a significant difference between AVP and AMP ($p<0.05$). From these findings there was a significant difference among the groups; thus Hypothesis 1(b) was not accepted. Also, the figure showed EMP had a similar efficiency in all the tasks with respect to task complexity. The completion time variance was not significant in single-, two-, three- or four-product reviews. Thus, Hypothesis 1(a) was supported. Figure 4.16 showed AMP tasks completion time (efficiency) was close to each other in all product reviews. Hence, Hypothesis 1(e) was accepted. In addition to that, the figure showed that AVP was more efficient than AMP supporting Hypothesis 1(d). Therefore, Hypothesis 1 was partially accepted.

4.10.2 Effectiveness

It was expected that the emoji presentation metaphor would outperform the facial expression avatar and animation presentations in terms of correctly completed tasks. As Figure 4.17 shows, 89.7% of tasks were successfully completed by using EMP. It seems that familiarity with emoji's and wide use of them in communication and social media made completing the tasks easier for users. The fact that the users of the animation presentation had to watch the review rankings rather than checking required more attention and focus. When viewing AMP, users managed to successfully complete only 57.3% of the tasks. Also, the figure shows that using AVP produced 82.2% of tasks completed successfully. The experimental result presented supports Hypothesis 2(a). The ANOVA test revealed that there was a significant difference among the presentation metaphors in terms of successful completion ($p<0.05$) (refer to Table 4.15). Comparison between the successful completion task for the emoji presentation and the facial expression avatar showed an advantage for the emojis with an additional almost 7% of tasks completed successfully. The ANOVA test showed that there was no significant difference between these conditions in the moderate level, but there was at the easy and complex. The post hoc test using Fisher's least significance (LSD) showed that there was significant difference ($p<0.005$) between the metaphors in the easy and difficult levels (refer to Table 4.16). Thus, this result and test confirmed Hypothesis 2(a). Also, the results showed that there was a significant difference between AVP and AMP in the complex level only, partially supporting Hypothesis 2(b).

4.10.4 Users' Satisfaction

It was expected that the users of the emoji presentation metaphor would be more satisfied than those of the other presentation metaphors, scoring higher in most of the satisfaction statements. Also, Figure 4.20 shows the users' satisfaction for all the statements for each presentation metaphor. It shows that for EMP out 10 statements 8 were identical. The EMP score was higher than AVP in statement 3 but lower in statement 4. However, in statement 4 ('I think that I would need support of a technical person to be able to use the system') both the AVP and the EMP scored less than AMP. Thus, Hypothesis 4(a) was supported. Also, the figure shows the users of the AVP were more satisfied than when using AMP. Overall, the mean satisfaction percentages for AVP, EMP and AMP were 94%, 94% and 57.7% respectively. Moreover, the results showed the users were all confident in all the presentation metaphors. Hence, Hypothesis 4 was not fully supported. The chi-squared test showed that there was a significant difference between the groups ($p<0.05$) in answering the questions for all the statements as in Table 4.20. Therefore, this result partially confirmed what had been expected in Hypothesis 4.

4.10.3 Enjoyment Level

Figure 4.21 shows the enjoyment level for each metaphor presentation in the experiment. It shows that the users enjoyed using the emoji presentation the most. The emoji presentation was enjoyed by 90% of users while only 55.3% enjoyed using the animation presentation. Also, the results showed that the facial expression avatar presentation had 80.6% enjoyment, almost 10% less than the emoji metaphor. This difference could be due to the familiarity and the high popularity of emojis among the users considering its role in communication platforms. Also, having emojis integrated

in the most popular social network (Facebook) could have played a role in the results. This result does support Hypothesis 3, that using EMP would be more enjoyable than AVP and AMP.

4.11 Conclusion

The experiment studied the impact of visual multimodal presentation metaphors on the perception of product reviews in an e-commerce interface. The study tested the hypotheses related to the presence of the visual multimodal rating and review messages in an e-commerce interface. This involved designing a platform to include three different multimodal conditions, (1) facial expression avatars, (2) emojis and (3) animation clips, which were tested and evaluated by the users (n=48). The study was conducted using a within subject approach, the sample considered to be one group containing sub groups for the iteration of the presentations (refer to Tables 4.6b and 4.7).

Results showed that the presence of emoji or facial expression avatar presentations were more efficient than the animation presentation metaphor. It also showed that using these two metaphors EMP and AVP reduced the time consumed to complete the tasks along with a higher number of successfully completed tasks. The result did not show a hugely significant difference between the EMP and AVP. However, it did show significant difference between the animation presentation and the other two conditions. The overall results of this study showed the most enjoyable presentation for reviews and highlighted the importance of the metaphors in presenting reviews which enhanced the users' performance and the usability of an e-commerce interface in terms of efficiency, effectiveness, user satisfaction and enjoyment.

Although the study showed the role of facial expression avatars and emojis in presenting the rating and review messages there was less impact or role for the animation presentation metaphor. The design of the study did not take into consideration the individual perception of the animation among the users testing the metaphor. From the experimental observation, the animation presentation users were retrieving information based on the video and what they had managed to analyse in the animation clip. The users' perception of animation characters presented was not taken into consideration in this study, hence the results of this study showed little or no animation role in terms of efficiency, effectiveness and user satisfaction for the review messages. Also, the study gives a foundation to check if video presentation of reviews and ratings using emojis would give better results on users' performance. Therefore, the use of facial expression avatars and emojis was found to contribute to the usability of product reviews in e-commerce.

Chapter 5

Conclusions: Empirically Derived Guidelines and Validations.

5.1 Introduction

This chapter presents the main conclusions of the experiments. Also, empirically driven guidelines for multimodality use in communicating social media e-commerce product reviews are presented and discussed. These guidelines could be used by designers or software engineers for the design of a multimodal social media e-commerce site. Moreover, the chapter includes the limitations of the study. The final part of the chapter describes future work.

5.2 Empirical Derived Guidelines

The experiments' main findings and results supported and enabled producing a set of empirically driven guidelines that can be applied globally for the design of multimodal social media e-commerce sites, which could enhance the user interface and improve the user's shopping experience and performance. The guidelines act as general guidance and should be read along with the limitations of the study.

Predominantly, the study supports and recommends the use of social media for product reviews and ratings and the use of multimodality, especially the use of visual communicating metaphors, in communicating product reviews and ratings to enhance usability. The guidelines are related to: e-commerce use of social media reviews, of

audio in ratings, of facial expression avatars and emojis and the implementation of animation for communicating reviews and ratings.

5.2.1 E-Commerce Use of Social Media Reviews

The design of e-commerce using social media as a repository for reviews and ratings had a significantly positive impact on users. The users indicated that they would trust reviews and ratings provided by their friends and family members from their own social media network more than reviews and ratings provided by unknown users. This indicated that the design of e-commerce must include the users' social media networks as review and rating sources.

The design of e-commerce including use of social media reviews would increase the trust levels of the users when purchasing a product online. Moreover, the users indicated that Facebook and Twitter were the favourite social networks for the product review and rating source (refer to Section 3.9.3).

Knowing that the users had a preference for Facebook as source for the reviews, the design of the e-commerce interface could include both social networks Facebook and Twitter as review sources and the user could then choose between them or even compare. This approach will likely give the user the ability to compare reviews and ratings between his/her own social network sites. This design is likely to improve the site's popularity and improve the users' trust when purchasing online.

5.2.2 Use of Audio in Communicating Ratings

The literature presented the use of audio to communicate various types of information. The audio simulation, using short, musical files (earcons) with rising pitch, implemented in the experimental platform demonstrated the lowest impact on the

usability perspectives (efficiency, effectiveness and user satisfaction). However, the experimental observation showed that using such an approach with a single note had a positive impact on users as a new tool to communicate information that would make the time spent reading reviews more enjoyable.

The use of earcons in the easy task (one-product presentation) had high effectiveness as an auditory information communication for ratings (refer to Section 3.9.2). Earcons can be implemented in the e-commerce design to communicate ratings for a single product. Moreover, the earcons mapping with ratings were played only once to the users before being used. Hence, the users had to recall the mapping of every earcon before completing the task. The design could be implemented allowing the users to have access and the ability to play the mapping and understand it before using the earcon presentation. This approach will likely increase the usability of communicating ratings using earcons in single-product presentations. However, it is unlikely it would improve usability for reviews and ratings in two-, three- and four-product comparisons (refer to Sections 3.9.2.1 and 3.9.2.2).

5.2.3 Use of Facially Expressive Avatars and Emoji's

The first experiment empirically investigated the use of facial expression avatars and the use of text and emoji's in communicating ratings of product reviews. Based on the obtained results (refer to Sections 3.9.1, 3.9.2 and 3.9.3) designers of e-commerce sites can implement facial expressions (angry, sad, neutral, smiley and happy) using avatars to communicate ratings and implement text with emoji's as presentation tools to communicate reviews. The implementation of these presentation metaphors could make the presentation of product ratings and the e-commerce page content more effective and efficient. It has proved that the use of facial expression avatars and text

with emoji's had a positive impact on users with regards to usability (efficiency, effectiveness and user satisfaction) regardless of the task complexity or number of products being compared. These presentation metaphors (facial expression avatars, emoji's) were implemented to communicate both ratings and reviews at the same time. The designers could implement these metaphors to communicate up to 100 reviews and ratings for a single product, up to 80 reviews in two-product comparisons, up to 70 reviews in three-product comparisons and up to 50 reviews in one screen in four-product comparisons (refer to Sections 4.5.1 and 4.5.2). The use of the mouse cursor allowed the design of such presentation to be achieved, as the mouse cursor will reveal each review when hovered on any of the metaphors. This approach can improve the usability e-commerce interface and increases the number of users visiting the site. As Figure 5.1 visualises this guideline, it shows that the number of reviews decreases as the number of products (being viewed at the same time) increases, this guideline would help the developer of the e-commerce design to consider the number of products compared while implementing the review sections.

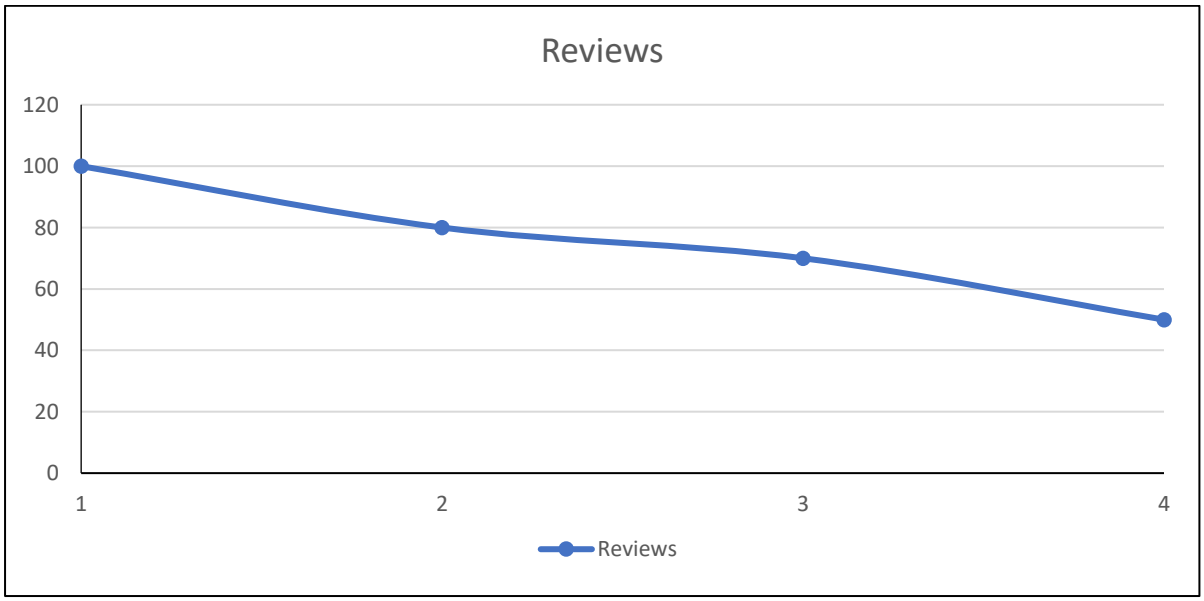


Figure 5.1: Number of reviews according to number of products displayed.

Moreover, the result indicated high user satisfaction and enjoyment level (refer to Sections 4.9.3 and 4.9.4) for these metaphors. Having these metaphors in the e-commerce interface and the option to allow the users to choose a preferred presentation could allow users to create and choose their own personalised reviews and ratings presentation which in return could improve system usability.

5.2.4 Implementation of Animation

The second experiment tested the use of animation clips to communicate reviews and ratings. The result (refer to Sections 4.9.1, 4.9.2, 4.9.3 and 4.9.4) indicated that the use of animation clips had the lowest levels of usability (effectiveness, efficiency and user satisfaction). However, the results also showed that the use of animation clips could improve the enjoyment level of the users.

The designer of an e-commerce site needs to identify the animation characters to be implemented in the animation clip with each character mapped to a rating for review communication. The experiment showed that the animation clip did not provide high efficiency (refer to Section 4.9.1) in terms of completion time; this was due to the fact that each clip duration was up to 40 seconds. The implementation should take into consideration the duration of the clip; limiting clips to communicate overall ratings and reviews to a shorter 20-30 seconds could improve the efficiency. The animation approach proved to have an acceptable enjoyment level regardless of the reviews or ratings being communicated. Building short animation clips in an e-commerce interface to communicate overall ratings and reviews could improve the system usability and the overall user satisfaction.

5.3 Prototype Validations

The researcher carried out the validation of the derived guidelines. In order to validate the guidelines, the paper prototyping approach was used. The use of a low fidelity prototype (e.g., paper prototype) is cheaper and faster to build (Sauer et al., 2009). This approach has a similar impact on users as a full operation interface or product; the majority of studies concluded that the reduced fidelity prototypes provided equivalent results to fully operational products (Sauer et al., 2009). A convenient sample of 20 users was used for the validation.

The use of the paper prototype approach allowed the users to check the guidelines as an actual output to answer a short questionnaire related to these guidelines. Users answered questions related to the social media sources (Facebook, Twitter or both), metaphor presentations (emoji's, facial expression avatars or an option to choose), facial expression avatar preference and whether the user should be given the ability to create/edit his facial expression avatar (refer to Appendix D).

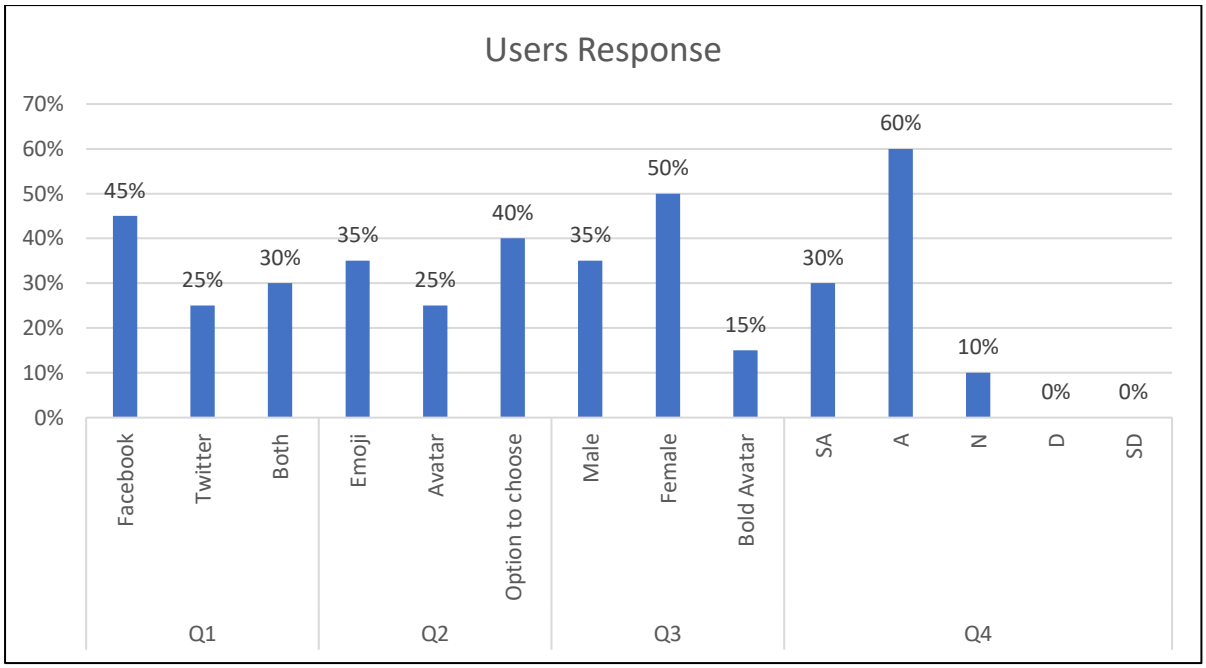


Figure 5.2: Users' response validation results.

The first question (Q1) asked the users to identify the main social media source (Facebook or Twitter) for the reviews and ratings or that both sources should be available so that the user can choose between them. Figure 5.2 presents the validation results. Q1 results showed that 45% preferred Facebook, 30% for both sources to be available and 25% for Twitter. This result supports the guidelines discussed previously (refer to Section 5.2.1). The second question (Q2) requested the users to choose a presentation metaphor (emoji's, facial expression avatars or option to choose) for the reviews and ratings. The results showed that the users preferred to have the option to choose between the presentation metaphors, with 40%, followed by emoji's with 35% and 25% for facial expression avatars (Figure 5.2). This result validates the guidelines derived from the experiments which indicated the importance of having metaphors available in the e-commerce interface (refer to Section 5.2.3). In addition to that, users were asked to choose a preferred facial expression avatar (Q3); the female facial expression avatar was a popular choice among the users with 50% followed by the male 35% and 15% for the avatar used in the study.

The final question (Q4) asked the participant if there should be an option to allow the users to choose and customise their own facial expression avatar. The answers had 60% of users agreed with another 30% strongly agreed to the statement. According to this result the ability to choose the facial expression avatar is another important factor to be considered, as mentioned in future work (Section 5.6).

5.4 Concluding Discussion

This research aimed to study the use of social media and multimodality in communicating product reviews and ratings in an e-commerce interface. The study was conducted using an experimental approach.

The first experiment's results showed that users trust reviews coming from friends and families using social media (refer to Section 3.9.3 and Figure 3.23). In addition to that, the results showed that the use of multimodality metaphors to communicate reviews have an impact on the usability of the e-commerce interface. The experiment showed that the use of visual multimodal metaphors presented in the facial expression avatar was more usable than the audio metaphors presented with earcons to communicate ratings. Using facial expression avatars was more efficient, in terms of time needed by users to complete the tasks, compared to the use of earcons (refer to Section 3.9.1 and Figure 3.14). Also, using textual reviews with emoji's was significantly better than earcons with respect to efficiency (refer to Section 3.9.1 and Figure 3.14). The use of facial expression avatars and the use of emoji's in textual reviews proved to be more effective in completing the tasks successfully compared to the use of earcons (refer to Section 3.9.2 and Figure 3.20). In addition to that, the users indicated more satisfaction with facial expression avatars than with earcons and textual presentation (refer to Section 3.9.4 and Figure 3.24). These findings were used for the design of the second experiment testing the use of visual multimodal metaphors to communicate reviews and ratings.

The second experiment which focused on the use of visual multimodal metaphors to communicate reviews and ratings showed the impact of the different metaphors on the system usability (efficiency, effectiveness and user satisfaction) and user enjoyment. The design implemented the display of the review on cursor approach over the facial expression avatar and emoji metaphors in addition to the implementation of the animation clip for communicating reviews and ratings (refer to Sections 4.5.1, 4.5.2 and 4.5.3). The obtained results demonstrated that using the facial expression avatars or emoji's to communicate reviews and ratings is more usable (in terms of efficiency,

effectiveness and user satisfaction) than using the animation in the e-commerce interface (refer to Sections 4.9.1, 4.9.2 and 4.9.3). Also, the results showed that users slightly performed better with the emoji's interface than with that of the facial expression avatar, but that advantage was not significant (refer to Section 4.9.2, Figure 4.17). Moreover, the satisfaction obtained showed users were more satisfied with the use of facial expression avatars and emoji's than with animation clips (refer to Section 4.9.3).

Additionally, the results obtained helped in determining which metaphor presented a better enjoyment level in the tested e-commerce platform. The most enjoyable interface was that of the emoji's followed by facial expression avatars with animation as the least (refer to Section 4.9.4, Figure 4.21).

Table 5.1 presents use of metaphors with cross reference to limited screen space (use of mobile devices) and the number of products presented in the page. These results showed the importance of using the correct metaphor in the e-commerce interface and highlighted the impact of different metaphors on the interface usability and enjoyment.

	Limited screen size (Mobile devices)	One product presentation	Two product presentation	Three product presentation	Four product presentation
Earcons	✓	✓	✗	✗	✗
Emoji's	✓	✓	✓	✓	✓
Facial Expression Avatars	✓	✓	✓	✓	✓
Animation clips	✗	✓	✗	✗	✗

Table 5.1: Guidelines cross reference table.

5.5 Limitations

This section presents the experimental limitations of this thesis.

- ***Facial Expression Avatar Customisation***

The experiments have used fixed or static pre-defined facial expression avatars. The same avatar was employed during the experiments. The platform did not provide the user with the ability to choose or customise the facial expressions or the avatar. Giving the user the options to select and modify the avatar was outside the scope of the platform.

- ***Choice of Earcons***

The platform used in the experiment had pre-defined musical notes for four different musical instruments (Piano, Guitar, Violin and Flute). The user had no facility or option to pre-select the musical instrument to map with the ratings. Also, the user was not given the option to choose the note to be used or mapped.

- ***Animation Implementation***

The animation clip used in the experiment was built and implemented using a tool with limited animation options and features. Use of specialised software and tools to create the animation clip was not within the scope of the work. Also, the user had no choice in the animation characters to be used in the animation clip. Building a dynamic implementation of the animation clip was beyond the scope of the research.

- ***User Sample***

The sample used was an opportunistic sample that differed from one experiment to another. The data were collected during the experiment simulation in the lab. The data analysis measurement could have been changed with the same users performing repeated tests of the platform.

5.6 Future Work

This section presents future work according to the experiments' limitations and conclusion. This details the work that could be carried out in the future to contribute to this research area.

5.6.1 Expressive Avatar Customisation

The experiments have used a static standard facial expression avatar to communicate both reviews and ratings. Further experiment can be carried out to check if the style of the facial expression avatar plays any role in the system usability. Different style templates can be implemented allowing the user to customise the expressive avatar by choosing gender, skin colour, hair style and any facial accessories. This experiment could contribute in producing additional guidelines for creating, using and implementing facial expression avatars to communicate reviews and ratings in an e-commerce interface.

5.6.2 Animation Engine

The second experiment tested the use of animation in a theatrical theme. It would be worthwhile to examine the impact of using animation software to implement a dynamic animation engine with customisation capabilities allowing users to choose their own characters for the play (cartoon-like avatars or human-like avatars) to communicate reviews and ratings in a play approach. This could contribute to the research by understanding the use of characters in animation clips and to know the user's preference (is it the cartoon-like character or human-like avatar).

5.6.3 Virtual Shopping Artificial Intelligence Avatar

The current progress in technology has led to the implementation of virtual reality in wider areas. An experiment can be implemented to create a virtual shopping centre with artificial intelligence avatars containing all the products available in e-commerce. Every user creates his/own avatar that is equipped with artificial intelligence allowing it to make purchases or prepare the shopping basket while the actual user is busy (or probably at work). The avatar can learn about the user's taste, size and style which later are used in purchase decisions. The avatar can be given a wish list of the items to be purchased from the virtual shopping centre. In addition to that, the avatar can retrieve the reviews and ratings for each product and make decisions accordingly.

This experiment could contribute to the understanding of artificial intelligence avatars in a virtual reality environment. This could help the busy user to assign the shopping task to the avatar to do his/her shopping. Therefore, there is a high potential to understand how artificial intelligence avatars could replicate the user's behaviour in the virtual environment and how it could be used as a shopping tool for a busy user or a user with limited time for shopping.

5.6.4 Musical Reviews in Mobile Devices

The availability of mobile devices for users has increased in recent years. Mobile devices such as smartphones or tablets are used for various functions including shopping. Using music to communicate review ratings in mobile devices is an area that requires further research. Music files with rising pitches can be tested in mobile devices with limited space of the visual communication channel. This research could explore the usefulness of music files to communicate product ratings in devices with limited visual space or small screen (smartphone, smart watch or tablet).

5.7 Lessons Learned

The success of the system design and the derived empirical analysis has mainly relied on the design and execution of the experiments. The researcher has learned that to be successful in this research and in experiments the following must be considered:

- *Experiment design*: the experiment design is considered to be the main element for the success of such research. It is highly important that the experiment design is identified at an early stage in the research i.e. before designing the experimental platform. Knowing the sample size, which should be based on similar research, would help in structuring the experimental platform and the data collection. Due to the nature of the first experiment, where different interfaces had to be tested, the between subject approach was considered to be the right choice. However, in the second experiment, even though the users were testing different interfaces at the same time, the within subject approach was used. This detail in the experiment design plays an important role when designing the experimental platform.

- *Experimental platform*: The researcher relied on his previous industrial experience in system developments and web design to implement the experimental platform. Such experience proved to be vital when developing and redesigning the system for different experiments. However, if such experience was not available the researcher would have used the support or help of a web developer to build the system. In the first experiment, most of the time spent by the researcher was to identify the application software to build the facial expression avatar, which led to the choice of Poser. Also, the earcons were edited using Audacity software to structure the notes according to the

guidelines of previous studies by Brewster (1993,1995,2000) and Rigas (2000). In the second experiment, the animation could have been implemented using a professional software animation application which was beyond the abilities of the researcher and, due to limited time, it was not possible to have a consultant or a third person to implement the animation.

- *Data collection and analysis*: After achieving the design and the implementation of the experimental platform the experiments were conducted by the users. One of the challenges was to get the required number of users (sample) to test the platforms. Most of the users were students, so the researcher targeted the end of the term to bring the users in to test the experimental platform. Having a computer lab to accommodate the users helped the researcher to save time collecting the data. In addition to that, it was good practice to write the analysis chapter while conducting the data analysis rather than wait until the analysis was completed. Moreover, it is critical to check the data collected (questionnaire) as soon as the user finished and before leaving the lab; the researcher had found a couple of questionnaires were not completed and had to re-run the second experiment to complete the required sample.

5.8 Epilogue

This research has investigated the usability of multimodality in communicating product reviews and ratings in e-commerce. Furthermore, the thesis studies the use of social media as a source for product reviews in e-commerce. The result obtained from the experiments indicated that users trust more the reviews coming from their own social networks, particularly from Facebook and Twitter. Also, the results obtained from the experiments with relevance to multimodality have showed that the use of visual

multimodal metaphors to communicate reviews and ratings could improve the usability interface in e-commerce. Moreover, the experiments provided empirical evidence regarding the use of musical files (earcons) or audio to communicate ratings which was not highly efficient or effective but could be considered as an option or solution for users with impaired vision and for devices with limited visual space (small screens). These findings, along with guidelines, on the implementation of multimodal social media e-commerce and its limitations provide a contribution towards the existing literature. Nevertheless, the future work highlighted earlier in this chapter details the additional research required to contribute towards the use of both social media and multimodality in e-commerce interfaces.

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Appendices

Appendix A

Pre-platform design questionnaire and data.

1. laptop should have the following specs preferences: The laptop price is less than £400. The laptop Hard drive at least 250GB. Also, it should have RAM of at least 2.0 GB.

Price	Less than 400
Hard disk	250 GB
RAM	2.0 GB
Rating	Overall 4

According to the information presented, what was the difficulty to acquire the laptop?

☐ Easy ☐ Moderate ☐ Difficult

2. The laptop should have the following specs preferences: The laptop price is less than £500. The laptop Hard drive at least 500GB. Also, it should have RAM of at least 2.0 GB. (You have **to compare two laptops** at a time).

Price	Less than 500
Hard disk	500 GB
RAM	2.0 GB
Rating	Overall 2

According to the information presented, what was the difficulty to acquire the laptop?

☐ Easy ☐ Moderate ☐ Difficult

3. The laptop should have the following specs preferences: The laptop price is less than £600. The laptop Hard drive at least 1TB GB. Also, it should have RAM of at least 4.0 GB. (You have **to compare three laptops** at a time).

Price	equal 600
Hard disk	1 TB
CPU	i5 processor
RAM	4.0 GB
Rating	Overall 4

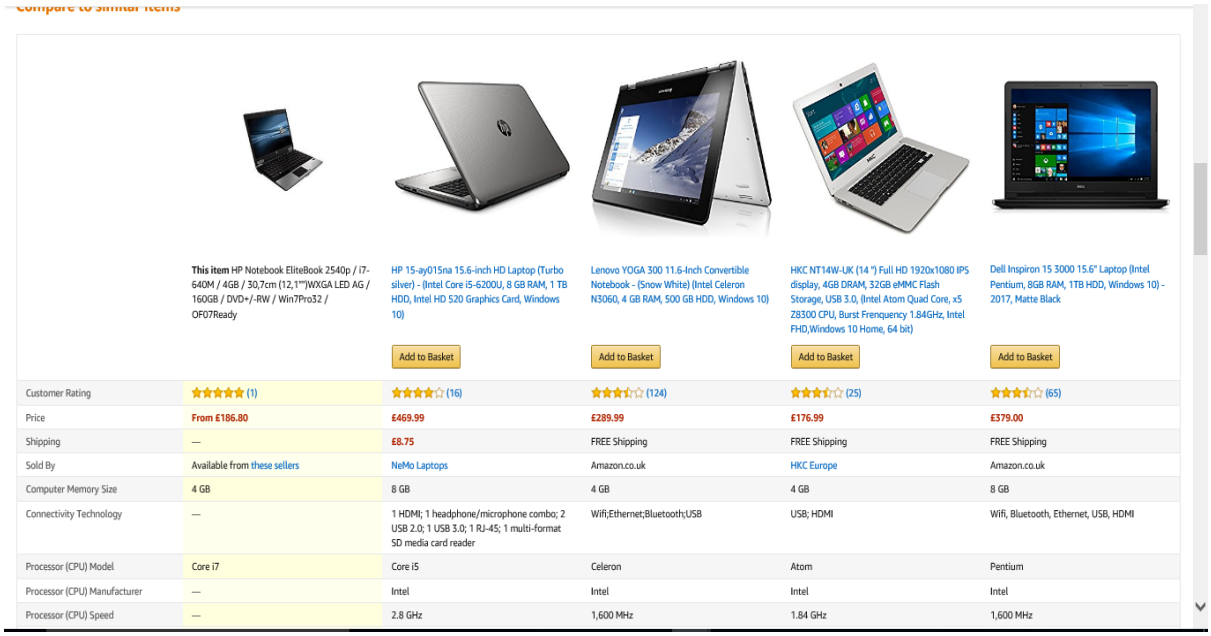
According to the information presented, what was the difficulty to acquire the laptop?

☐ Easy ☐ Moderate ☐ Difficult

4. The laptop should have the following specs preferences: The laptop price is greater than £600. The laptop Hard drive at least 1TB GB. Also, it should have RAM of at least 4.0 GB. (You have **to compare Four laptops** at a time)

Price	Greater than £600

Hard disk	1 TB
CPU	i7 processor
RAM	6.0 GB
Rating	Overall 2



	This item HP Notebook EliteBook 2540p / i7-640M / 4GB / 30,7cm (12,1"")WXGA LED AG / 160GB / DVD+/-RW / Win7Pro32 / OF07Ready	HP 15-ay015na 15.6-inch HD Laptop (Turbo silver) - (Intel Core i5-6200U, 8 GB RAM, 1 TB HDD, Intel HD 520 Graphics Card, Windows 10)	Lenovo YOGA 300 11.6-Inch Convertible Notebook - (Snow White) (Intel Celeron N3060, 4 GB RAM, 500 GB HDD, Windows 10)	HKC NT14W-UK (14 ") Full HD 1920x1080 IPS display, 4GB DRAM, 32GB eMMC Flash Storage, USB 3.0, (Intel Atom Quad Core, x5 Z8300 CPU, Burst Frenquency 1.84GHz, Intel FHD,Windows 10 Home, 64 bit)	Dell Inspiron 15 3000 15.6" Laptop (Intel Pentium, 8GB RAM, 1TB HDD, Windows 10) - 2017, Matte Black
		Add to Basket	Add to Basket	Add to Basket	Add to Basket
Customer Rating	(1)	(16)	(124)	(25)	(65)
Price	From £186.80	£469.99	£289.99	£176.99	£379.00
Shipping	—	£8.75	FREE Shipping	FREE Shipping	FREE Shipping
Sold By	Available from these sellers	NeMo Laptops	Amazon.co.uk	HKC Europe	Amazon.co.uk
Computer Memory Size	4 GB	8 GB	4 GB	4 GB	8 GB
Connectivity Technology	—	1 HDMI; 1 headphone/microphone combo; 2 USB 2.0; 1 USB 3.0; 1 RJ-45; 1 multi-format SD media card reader	Wifi;Ethernet;Bluetooth;USB	USB; HDMI	Wifi, Bluetooth, Ethernet, USB, HDMI
Processor (CPU) Model	Core i7	Core i5	Celeron	Atom	Pentium
Processor (CPU) Manufacturer	—	Intel	Intel	Intel	Intel
Processor (CPU) Speed	—	2.8 GHz	1,600 MHz	1.84 GHz	1,600 MHz

According to the information presented, what was the difficulty to acquire the laptop?

☐ Easy ☐ Moderate ☐ Difficult

Data

Question\Task Difficulty	Easy	Moderate	Difficult
Q1	20		
Q2	18	2	
Q3		19	1
Q4			20

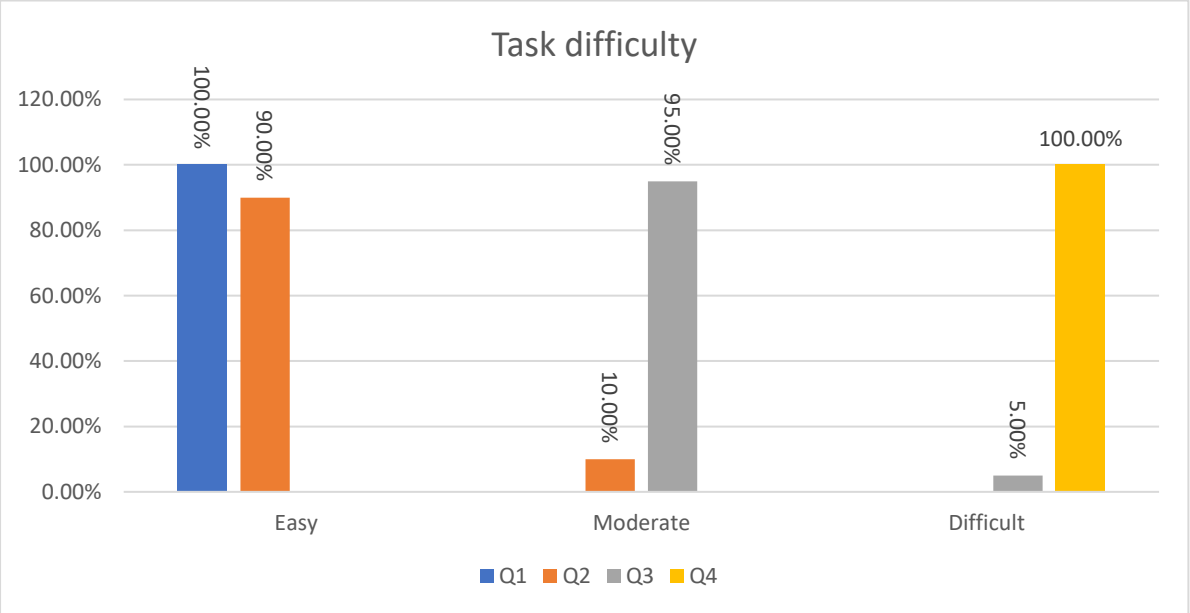


Figure A-1: Task difficulty.

Appendix B

Experiment I: Pre-experiment questionnaire, tasks requirements post-experiment questionnaire and data.

Name of Researcher: Rajab Ghandour
Title of study: **Social media multimodal review messages and ratings impact on e-commerce**

Participant Information Sheet

You are invited to take part in the research study: Investigation for achieving and evaluating the impact of multimodal social media review messages on e-commerce environment. Before you decide it is important for you to understand why the research is being done and what it will involve.

Which data will be collected?

The data that will be collected is the data from the attached questionnaire which involve some of these practices:

•The use of e-commerce environment.

•The shopping experience.

•Use of social media.

•Impact of multimodal presentation

How the data will be collected?

The data will be collected via answering the questionnaire that will be provided during the experiment. It is up to the participant to decide whether or not to take part.

Where the data will be stored?

The data will be stored electronically for research purposes. No personal information will be stored; only analysis of the data.

Who will have access to the data and for what purposes?

The data will be kept private so no access for the data. Anonymous results of the study will be used in my PhD thesis.

Consent Form

Please read and complete this form carefully. If you are willing to participate in this study, ring the appropriate responses and sign and date the declaration at the end. If you do not understand anything and would like more information, please ask.

• I have had the research satisfactorily explained to me in verbal and / or written form by the researcher.	**YES / NO**
• I understand that the research will involve to participate and test a system	**YES / NO**
• I understand that I may withdraw from this study at any time without having to give an explanation. This will not affect my future care or treatment.	**YES / NO**
• I understand that all information about me will be treated in strict confidence and that I will not be named in any written work arising from this study.	**YES / NO**
• I understand that any audiotape material of me will be used solely for research purposes and will be destroyed on completion of your research.	**YES / NO**
• I understand that you will be discussing the progress of your research with others at University of West London	**YES / NO**

I freely give my consent to participate in this research study and have been given a copy of this form for my own information.

Signature: ……..…….

Date: ……

Part 1	Pre-experiment questions

1. **What is your gender?**

   ☐ Male ☐ Female

2. **What is your age group?**

   ☐ 18-24 ☐25-34 ☐35-44 ☐45-54 ☐55+

3. **What is your education level?**

   ☐ High school ☐ Undergraduate ☐ Doctorate

   ☐ College ☐ Masters ☐ Other

   Area of study: ……

4. **How often do you use the computer per week in average?**

   ☐ Never ☐ 1-5 hours ☐ More than 10 hours

   ☐ Less than 1 hour ☐ 6-10 hours

5. **How many hours in average do you use the internet per week?**

   ☐ Never ☐ 1-5 hours ☐ More than 10 hours

   ☐ Less than 1 hour ☐ 6-10 hours

6. **Do you do online shopping?**

   ☐ Yes ☐ No

7. **How often do you buy product online?**

   ☐ Extremely often ☐ Quite often ☐ Moderately often

   ☐ Slightly often ☐ Not at all often

8. **When you want to buy product online, you:**

   ☐ Go to certain website ☐ Search for it

9. **Do you use social media/networking sites?**

   ☐ Yes ☐ No

10. **Which of the following social networking site you use often (you can select more than one)**

    ☐ Facebook ☐ Twitter ☐ Google +

    ☐ Instagram ☐ LinkedIn ☐ Pinterest

11. Are you familiar with Emoji's?

☐ Yes ☐ No

12. Do you use Emoji's

☐ Yes ☐ No

13. Do you write product reviews after you purchase online?

☐ Yes ☐ No

14. Do you read product reviews before buying online?

☐ Yes ☐ No

15. How much time do you spend reading reviews in average?

☐ None ☐1-3 minutes ☐ 4-6 minutes

☐ 7-9 minutes ☐ 10+ minutes

16. Please rate your agreement with each of the following statements:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I consider product reviews to be important when buying online					
I don't buy products with overall bad reviews					
I usually buy products with at least overall average review					
I totally trust the reviews posted online or on websites					
It is easy for me to find reviews about specific product					
I usually buy products online based on family or friend recommendations					

17. Are you familiar with facial expression avatar?

☐ Yes ☐ No

18. Are you familiar with earcons?

☐ Yes ☐ No

Part 2	Experiment Tasks and related questions

Please follow the instructions to complete each task:

Task 1

You are looking to buy a new laptop. After careful consideration you have identified the requirements you will be needing. The laptop should have the following specs preferences: The laptop price is less than £400. The laptop Hard drive at least 250GB. Also, it should have RAM of at least 2.0 GB.

For this you will be presented with list of laptops. Each laptop has its reviews; you have to click on the laptop to check the details and the reviews. Your choice should be according to the following requirements

Price	Less than 400
Hard disk	250 GB
RAM	2.0 GB
Rating	Overall 3

Post Task Questions

17. Which product did you choose?

☐ P1 ☐ P2 ☐ P3 ☐ P4

18. Have you read some reviews before your choice?

☐ Yes ☐ No

19. How many reviews have you read?

☐ None ☐1-3 ☐ 4-6 ☐ 7-9 ☐ more than 10

20. It was easy to find your choice?

☐ Yes ☐ No

Task 2

You are looking to buy a new laptop. After careful consideration you have identified the requirements you will be needing. The laptop should have the following specs preferences: The laptop price is less than £500. The laptop Hard drive at least 500GB. Also, it should have RAM of at least 2.0 GB.

For this you will be presented with list of laptops where you have **to compare two laptops** at a time. Your choice should be according to the following requirements:

Price	Less than 500
Hard disk	500 GB
RAM	2.0 GB
Rating	Overall 2
Rating source	Facebook

Post Task Questions

21. Which product did you choose?

☐ P1 ☐ P2 ☐ P3 ☐ P4

22. You have read some reviews before your choice?

☐ Yes ☐ No

23. How many reviews have you read?

☐ None ☐1-3 ☐ 4-6 ☐ 7-9 ☐ more than 10

24. It was easy to find your choice?

☐ Yes ☐ No

Task 3

You are looking to buy a new laptop. After careful consideration you have identified the requirements you will be needing. The laptop should have the following specs preferences: The laptop price is less than £600. The laptop Hard drive at least 1TB GB. Also, it should have RAM of at least 4.0 GB.

For this you will be presented with list of laptops where you have **to compare three laptops** at a time. Your choice should be according to the following requirements

Price	equal 600
Hard disk	1 TB
CPU	i5 processor
RAM	4.0 GB
Rating	Overall 4
Rating source	Twitter

Post Task Questions

25. Which product did you choose?

☐ P1 ☐ P2 ☐ P3 ☐ P4

26. Have you read some reviews before your choice?

☐ Yes ☐ No

27. How many reviews have you read?

☐ None ☐1-3 ☐ 4-6 ☐ 7-9 ☐ more than 10

28. It was easy to find your choice?

☐ Yes ☐ No

Task 4

You are looking to buy a new laptop. After careful consideration you have identified the requirements you will be needing. The laptop should have the following specs preferences: The laptop price is greater than £600. The laptop Hard drive at least 1TB GB. Also, it should have RAM of at least 4.0 GB.

For this you will **compare four laptops**. Your choice should be according to the following requirements

Price	Greater than £600
Hard disk	1 TB
CPU	i7 processor
RAM	6.0 GB
Rating	Overall 1

Post Task Questions

29. Which product did you choose?

☐ P1 ☐ P2 ☐ P3 ☐ P4

30. Have you read some reviews before your choice?

☐ Yes ☐ No

31. How many reviews have you read?

☐ None ☐1-3 ☐ 4-6 ☐ 7-9 ☐ more than 10

32. It was easy to find your choice?

☐ Yes ☐ No

Part 3	Post experiment Questionnaire

1. Please write the experiment time completion of all tasks: …… Minutes.

2. Please indicate the level of complexity of for each task

	Easy	Moderate	Difficult
Task 1 (single laptop comparison)			
Task 2 (two laptops comparison)			
Task 3 (three laptops comparison)			
Task 4 (four laptops comparison)			

3. Please indicate the level of your agreement or disagreement on the following

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
It was easy to complete all the tasks					
I made choices based on review source					
I found it easy to have text reviews with Emoji's					
I think the reviews presentation in all tasks was easy					
I find it difficult to have all reviews in product comparisons					
Tasks complexity increased as I'm moving from one task to another					
It was easy to read reviews and choose the laptop in the comparison of 3.					
It was easy to read reviews and choose the laptop in the comparison of 4.					

I find it easy to have plain text only as reviews					
Overall I'm satisfied with this ratings presentations					
I think this is a good review presentation					

4. Please write down one advantage and one disadvantage, on this review presentation?

……

……

Experiment Data (N=36)

User	Online Shop Often	Read Product Reviews	Write Product reviews	Time Spent Reading Reviews	Consider product review	Trust reviews	Usually buy product on recommendation
1	3	1	1	1	4	4	2
2	3	1	2	1	4	4	4
3	4	1	2	3	1	4	2
4	4	1	1	4	2	4	1
5	4	1	2	2	1	2	1
6	3	1	2	1	2	2	2
7	3	1	1	2	2	4	2
8	2	1	2	1	2	2	4
9	2	1	2	2	1	2	4
10	2	1	1	2	1	4	4
11	3	1	1	2	1	4	2
12	2	1	1	2	1	2	1
13	3	1	2	1	1	2	2
14	3	1	2	3	2	4	4
15	2	1	1	4	1	4	2
16	2	1	1	2	1	2	3
17	4	1	2	2	2	4	2
18	3	1	1	3	1	4	2
19	3	1	2	3	2	4	3
20	4	1	1	2	1	4	3
21	3	1	2	2	2	2	4
22	4	1	2	3	2	3	2
23	3	1	1	2	1	3	1
24	4	1	2	3	2	4	2

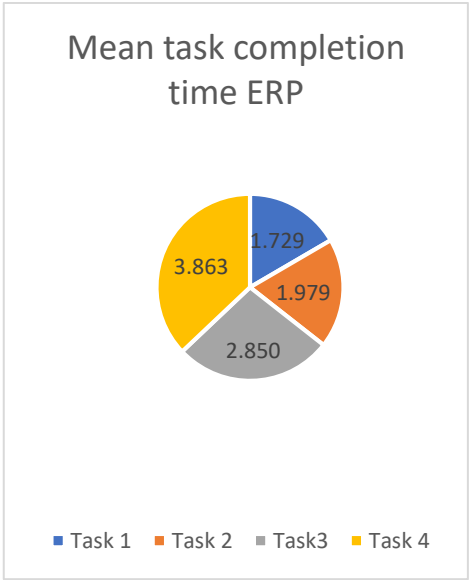
25	4	1	2	2	2	2	3
26	3	1	2	3	2	3	2
27	2	1	1	4	1	2	2
28	4	1	2	2	2	2	3
29	3	1	1	4	2	3	2
30	3	1	2	2	2	2	2
31	4	1	2	2	2	3	2
32	2	1	1	3	1	2	2
33	3	1	1	2	2	2	2
34	2	1	2	3	2	3	3
35	3	1	2	3	2	3	2
36	3	1	1	2	2	4	2

Three groups (n=12).

Tasks completion time TRP Group.

TRP Condition					
User	**Task 1**	**Task 2**	**Task3**	**Task 4**	**Total**
1	2.2	2.45	3	4.5	12.55
2	1.5	2.1	2.5	4	10.5
3	1.35	1.55	3.1	3.55	10.35
4	2.1	2	2.55	3.45	8.55
5	2.1	2.2	3.2	4.2	12.1
6	1.5	2	3	4.35	11.25
7	1.4	1.5	3	4.1	10.4
8	2	2.25	2.55	3.55	11.5
9	1.35	1.5	3.1	4	9.35
10	1.55	2	3.15	4	11.05
11	2.2	2.2	2.55	3.55	11.3
12	1.5	2	2.5	3.1	9.5
Avg.	1.729	1.979	2.85	3.862	10.7

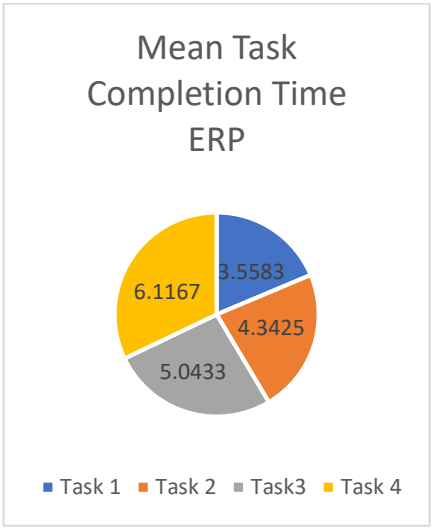
Table B-1: Tasks completion time TRP group.



Tasks completion time ERP Group.

ERP Condition					
User	**Task 1**	**Task 2**	**Task3**	**Task 4**	**Total**
1	3.45	4	4.55	5.55	18.35
2	3.35	4.15	5.2	5.5	19
3	4.2	5	5.1	6.1	20.4
4	3	4.5	5	5.45	18.35
5	3.55	4.3	4.55	6.25	19.45
6	3.45	4.35	5.35	6.2	20.15
7	3.35	3.55	5.42	6.35	19.47
8	3	4.2	5	6.45	19.05
9	3.35	4.15	4.55	5.5	18.35
10	3.45	4.16	5.45	7.1	20.56
11	4.2	4.55	5	6.5	21.05
12	4.35	5.2	5.35	6.45	22.15
Avg.	3.5583	4.342	5.043	6.116	19.694

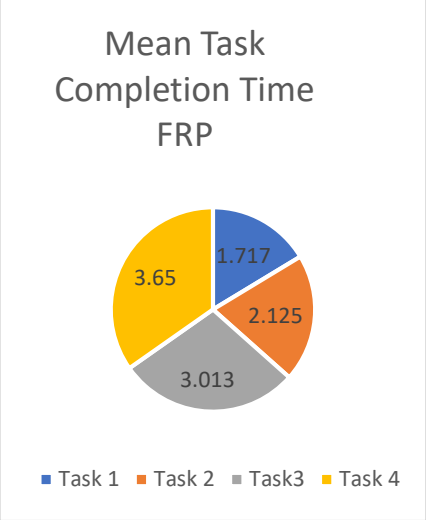
Table B-2: Tasks completion time ERP group.



Tasks completion time FRP Group.

FRP Condition					
User	**Task 1**	**Task 2**	**Task3**	**Task 4**	**Total**
1	1.15	2.5	3.2	5.2	12.45
2	1.3	2	3	3.45	10.15
3	1.35	2	2.55	3.5	10.2
4	2	2.1	3.35	3.5	11.35
5	1.4	2.2	2.3	3.5	10.2
6	1.55	2.15	3	3.2	10.3
7	2.1	1.55	3.2	3	10.05
8	2	2	3.35	4	11.35
9	2.35	2	2.55	3.45	11.15
10	2.4	2.45	3.15	3.5	12.3
11	1.5	2.2	3.1	3.5	11.1
12	1.5	2.35	3.4	4	11.25
Avg.	1.717	2.125	3.013	3.65	10.9875

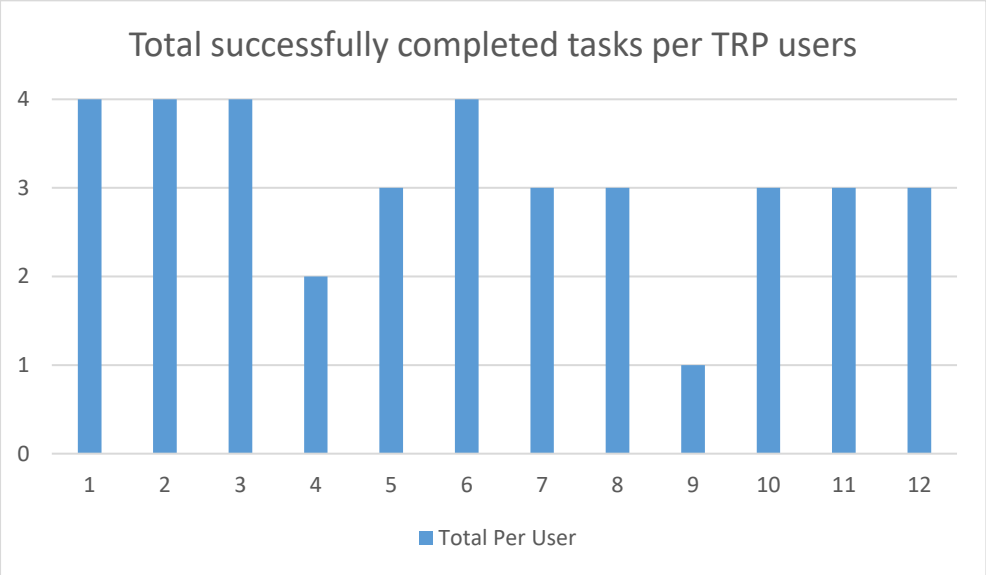
Table B-3: Tasks completion time FRP group.



Successfully Completed Tasks TRP Group

TRP Condition	Easy		Moderate	Difficult	
User	**Task 1**	**Task 2**	**Task 3**	**Task 4**	**Total Per User**
1	1	1	1	1	4
2	1	1	1	1	4
3	1	1	1	1	4
4	0	1	1	0	2
5	1	1	1	0	3
6	1	1	1	1	4
7	1	1	0	1	3
8	1	1	1	0	3
9	0	0	0	1	1
10	1	1	1	0	3
11	1	1	0	1	3
12	1	0	1	1	3
Total Per Task	10	10	9	8	37

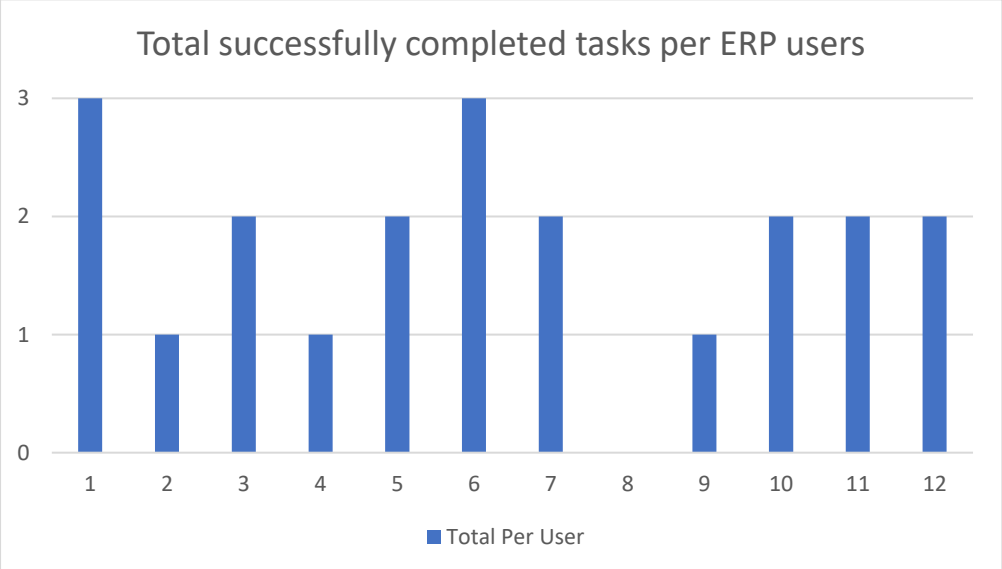
Table B-4: Successfully Completed Tasks TRP Group.



Successfully Completed Tasks ERP Group

ERP Condition	Easy		Moderate	Difficult	
User	**Task 1**	**Task 2**	**Task 3**	**Task 4**	**Total Per User**
1	1	1	1	0	3
2	0	1	0	0	1
3	1	1	0	0	2
4	1	0	0	0	1
5	1	1	0	0	2
6	1	1	1	0	3
7	1	0	1	0	2
8	0	0	0	0	0
9	0	0	0	1	1
10	1	1	0	0	2
11	1	1	0	0	2
12	1	1	0	0	2
Total per task	17		3	1	21

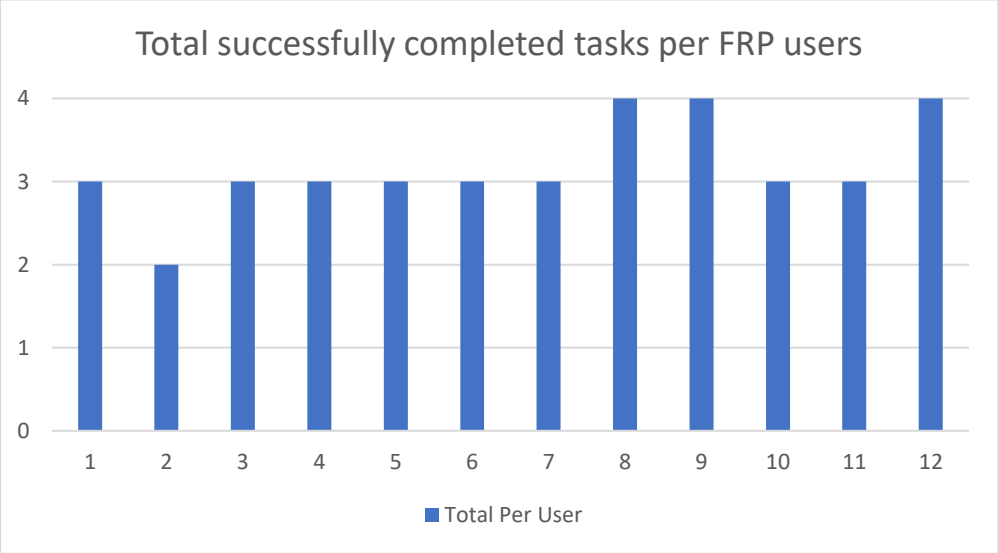
Table B-5: Successfully Completed Tasks ERP Group.

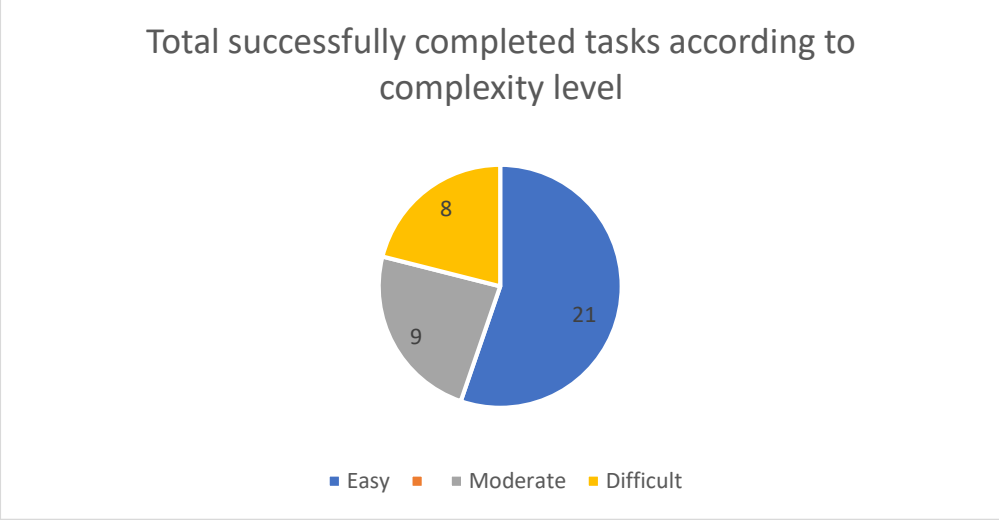


Successfully Completed Tasks FRP Group

FRP Condition	Easy		Moderate	Difficult	
User	Task 1	Task 2	Task 3	Task 4	Total Per User
1	1	1	1	0	3
2	1	0	0	1	2
3	1	1	1	0	3
4	1	1	1	0	3
5	1	1	0	1	3
6	1	1	0	1	3
7	1	0	1	1	3
8	1	1	1	1	4
9	1	1	1	1	4
10	1	1	1	0	3
11	0	1	1	1	3
12	1	1	1	1	4
Total per task	21		9	8	38

Table B-6: Successfully Completed Tasks FRP Group.





User's Satisfaction

TRP Condition											
User	**S1**	**S2**	**S3**	**S4**	**S5**	**S6**	**S7**	**S8**	**S9**	**S10**	**S11**
1	A	SA	A	A	A	SA	D	A	D	A	A
2	SA	A	A	N	A	A	D	A	A	A	A
3	A	A	D	A	A	A	A	D	SA	A	A
4	A	A	A	A	A	A	A	N	A	A	N
5	A	A	A	D	A	A	SA	SA	A	A	A
6	SA	A	A	SA	D	A	A	SA	SA	SA	A
7	A	A	A	A	A	A	A	A	A	A	N
8	SA	A	A	A	A	A	A	N	D	SA	A
9	SA	D	A	A	D	A	A	N	N	A	N
10	SA	A	A	A	A	A	D	A	A	SA	A
11	A	A	A	A	A	A	A	A	N	A	A
12	SA	SA	SA	A	A	A	A	D	A	A	A
ERP Condition											
1	D	A	A	SD	D	SA	A	D	A	D	D
2	D	A	A	N	A	A	N	D	N	A	A
3	D	A	D	D	D	SA	D	SD	A	A	A
4	N	A	D	N	A	A	D	D	A	D	D
5	D	D	D	D	A	SA	D	D	A	A	A
6	D	D	A	SD	A	SA	D	D	D	A	A
7	SD	A	A	N	D	A	D	D	A	A	A
8	D	A	A	D	A	SA	D	D	A	D	D
9	D	A	D	D	A	A	D	D	D	A	A
10	D	D	D	D	A	A	D	D	A	A	A
11	D	A	A	D	A	SA	D	D	D	D	D
12	SD	A	A	D	A	A	D	D	D	D	D

FRP Condition											
1	A	A	A	A	D	A	A	N	D	SA	A
2	SA	D	A	A	D	A	A	D	D	A	A
3	A	A	A	A	D	A	A	A	D	A	A
4	A	A	A	A	D	A	A	N	D	A	A
5	A	A	A	A	D	A	A	A	D	A	A
6	A	A	A	A	D	A	A	N	D	A	A
7	N	A	A	A	D	A	D	D	D	A	A
8	A	A	A	N	N	A	A	N	D	A	A
9	A	A	A	A	D	A	A	A	D	A	A
10	A	A	A	A	D	A	A	A	D	A	A
11	N	A	A	N	N	A	A	N	D	A	A
12	A	A	A	A	D	A	A	A	D	A	A

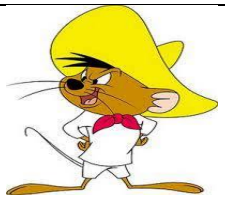
Table B-6: User's Satisfaction

Appendix C

Experiment II animation clip pre-design questionnaire, experiment scenario and data.

Amination Clip Pre-Design Questionnaire

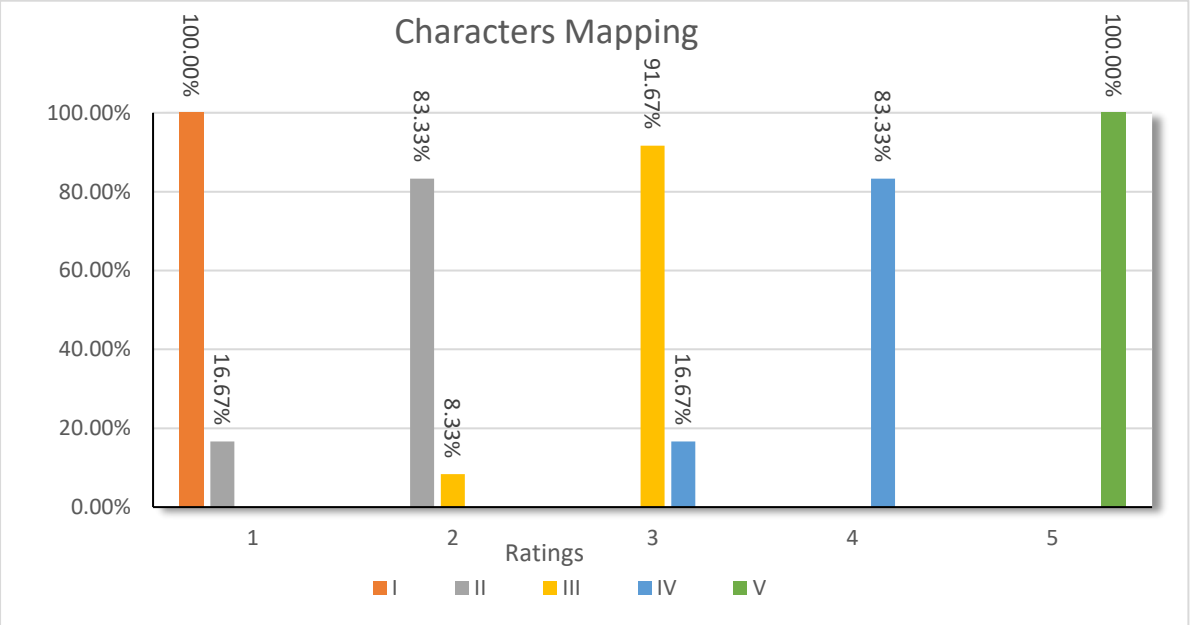
Rate the below characters according to their presences in scale between 1 to 5 (1=Angry;2=Sad;3=Neutral;4=Smiley;5=Happy).

Characters		Rate
I		----------
II		----------
III		----------
IV		----------
V		----------

Animation Pre-Design Data (N=12)

Character group\Rate	1	2	3	4	5
I	12				
II	2	10			
III		1	11		
IV			2	10	
V					12

Table C-1: Animation Characters Mapping



Part 1 Pre-experiment questions

1. **What is your gender?**
   ☐ Male ☐ Female
2. **What is your age group?**
   ☐ 18-24 ☐25-34 ☐35-44 ☐45-54 ☐55+
3. **What is your education level?**
   ☐ High school ☐ Undergraduate ☐ Doctorate
   ☐ College ☐ Masters ☐ Other

Area of study: ……

4. **How often do you use the computer per week in average?**
   ☐ Never ☐ 1-5 hours ☐ More than 10 hours
   ☐ Less than 1 hour ☐ 6-10 hours
5. **How many hours in average do you use the internet per week?**
   ☐ Never ☐ 1-5 hours ☐ More than 10 hours
   ☐ Less than 1 hour ☐ 6-10 hours
6. **Do you do online shopping?**
   ☐ Yes ☐ No
7. **How often do you buy product online?**
   ☐ Extremely often ☐ Quite often ☐ Moderately often
   ☐ Slightly often ☐ Not at all often
8. **Do you usually compare products?**
   ☐ Yes (Go to 9) ☐ No
9. **How many products do you usually compare at the same time?**
   ☐2 ☐ 3 ☐ 4
10. **Are you familiar with Emoji's?**
    ☐ Yes ☐ No
11. **Do you use Emoji's**
    ☐ Yes ☐ No
12. **Do you write product reviews after you purchase online?**
    ☐ Yes ☐ No

13. Do you read product reviews before buying online?

☐ Yes ☐ No

14. How much time do you spend reading reviews in average?

☐ None ☐1-3 minutes ☐ 4-6 minutes

☐ 7-9 minutes ☐ 10+ minutes

15. Please rate your agreement with each of the following

statements:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I consider product reviews to be important when buying online					
I don't buy products with overall bad reviews					
I usually buy products with at least overall average review					
I totally trust the reviews posted online or on websites					
It is easy for me to find reviews about specific product					
I usually buy products online based on family or friend recommendations					

16. Are you familiar with facial expression avatar?

☐ Yes ☐ No

17. Are you familiar with animation clips?

☐ Yes ☐ No

Part 2 Experiment Tasks and related questions

Please follow the instructions to complete each task:

Task 1

You are looking to buy a new laptop. After careful consideration you have identified the requirements you will be needing. The laptop should have the following specs preferences: The laptop price is less than £400. The laptop Hard drive at least 250GB. Also, it should have RAM of at least 2.0 GB.

For this you will be presented with list of laptops. Each laptop has its reviews; you have to click on the laptop to check the details and the reviews. Your choice should be according to the following requirements

Price	Less than 400
Hard disk	250 GB
RAM	2.0 GB
Rating	Overall 3

Post Task Questions/User Satisfaction (SUS)

18. Which product did you choose?

☐ P1 ☐ P2 ☐ P3 ☐ P4

19. Have you read some reviews before your choice?

☐ Yes ☐ No

20. How many reviews have you read?

☐ None ☐1-3 ☐ 4-6 ☐ 7-9 ☐ more than 10

21. It was easy to find your choice?

☐ Yes ☐ No

22. Please write the experiment time completion of the task: …… Minutes.

23. Determine your satisfaction using the Likert scale indicated below:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I think that I would like to use this system frequently					
I found the system unnecessarily complex					
I thought the system was easy to use					
I think that I would need the support of a technical person to be able to use this system					
I found the various functions in this system were well integrated					
I thought there was too much inconsistency in this system					
I would imagine that most people would learn to use this system very quickly					
I found the system very cumbersome to use					
I felt very confident using the system					
I needed to learn a lot of things before I could get going with this system					

24. Determine the Enjoyment level of completing the task using the scale (1=less enjoyable to 5=very enjoyable)

	1	2	3	4	5
I had fun using this presentation layout					
Using this presentation was pleasant					
I find using this presentation to be enjoyable					

23.Please write down one advantage and one disadvantage, on this review presentation?

……

……

Task 2

You are looking to buy a new laptop. After careful consideration you have identified the requirements you will be needing. The laptop should have the following specs preferences: The laptop price is less than £500. The laptop Hard drive at least 500GB. Also, it should have RAM of at least 2.0 GB.

For this you will be presented with list of laptops where you have **to compare two laptops** at a time. Your choice should be according to the following requirements:

Price	Less than 500
Hard disk	500 GB
RAM	2.0 GB
Rating	Overall 2
Rating source	Facebook

Post Task Questions

25. Which product did you choose?

☐ P1 ☐ P2 ☐ P3 ☐ P4

26. You have read some reviews before your choice?

☐ Yes ☐ No

27. How many reviews have you read?

☐ None ☐1-3 ☐ 4-6 ☐ 7-9 ☐ more than 10

28. It was easy to find your choice?

☐ Yes ☐ No

29. Please write the experiment time completion of the task: ……

Minutes.

30. Determine your satisfaction using the Likert scale indicated below:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I think that I would like to use this system frequently					
I found the system unnecessarily complex					
I thought the system was easy to use					
I think that I would need the support of a technical person to be able to use this system					
I found the various functions in this system were well integrated					
I thought there was too much inconsistency in this system					
I would imagine that most people would learn to use this system very quickly					
I found the system very cumbersome to use					
I felt very confident using the system					
I needed to learn a lot of things before I could get going with this system					

31. Determine the Enjoyment level of completing the task using the scale (1=less enjoyable to 5=very enjoyable)

	1	2	3	4	5
I had fun using this presentation layout					
Using this presentation was pleasant					
I find using this presentation to be enjoyable					

32. Please write down one advantage and one disadvantage, on this review presentation?

……

……

Task 3

You are looking to buy a new laptop. After careful consideration you have identified the requirements you will be needing. The laptop should have the following specs preferences: The laptop price is less than £600. The laptop Hard drive at least 1TB GB. Also, it should have RAM of at least 4.0 GB.

For this you will be presented with list of laptops where you have **to compare three laptops** at a time. Your choice should be according to the following requirements

Price	equal 600
Hard disk	1 TB
CPU	i5 processor
RAM	4.0 GB
Rating	Overall 4
Rating source	Twitter

Post Task Questions

33. Which product did you choose?

☐ P1 ☐ P2 ☐ P3 ☐ P4

34. Have you read some reviews before your choice?

☐ Yes ☐ No

35. How many reviews have you read?

☐ None ☐1-3 ☐ 4-6 ☐ 7-9 ☐ more than 10

36. It was easy to find your choice?

☐ Yes ☐ No

37. Please write the experiment time completion of the task: …… Minutes.

38. Determine your satisfaction using the Likert scale indicated below:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I think that I would like to use this system frequently					
I found the system unnecessarily complex					
I thought the system was easy to use					
I think that I would need the support of a technical person to be able to use this system					
I found the various functions in this system were well integrated					
I thought there was too much inconsistency in this system					
I would imagine that most people would learn to use this system very quickly					
I found the system very cumbersome to use					
I felt very confident using the system					
I needed to learn a lot of things before I could get going with this system					

39. Determine the Enjoyment level of completing the task using the scale (1=less enjoyable to 5=very enjoyable)

	1	2	3	4	5
I had fun using this presentation layout					
Using this presentation was pleasant					
I find using this presentation to be enjoyable					

40. Please write down one advantage and one disadvantage, on this review presentation?

……

……

Task 4

You are looking to buy a new laptop. After careful consideration you have identified the requirements you will be needing. The laptop should have the following specs preferences: The laptop price is greater than £600. The laptop Hard drive at least 1TB GB. Also, it should have RAM of at least 4.0 GB.

For this you will **compare four laptops**. Your choice should be according to the following requirements

Price	Greater than £600
Hard disk	1 TB
CPU	i7 processor
RAM	6.0 GB
Rating	Overall 1

Post Task Questions

41. Which product did you choose?

☐ P1 ☐ P2 ☐ P3 ☐ P4

42. Have you read some reviews before your choice?

☐ Yes ☐ No

43. How many reviews have you read?

☐ None ☐1-3 ☐ 4-6 ☐ 7-9 ☐ more than 10

44. It was easy to find your choice?

☐ Yes ☐ No

45. Please write the experiment time completion of the task: …… Minutes.

46. Determine your satisfaction using the Likert scale indicated below:

	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
I think that I would like to use this system frequently					
I found the system unnecessarily complex					
I thought the system was easy to use					
I think that I would need the support of a technical person to be able to use this system					
I found the various functions in this system were well integrated					
I thought there was too much inconsistency in this system					
I would imagine that most people would learn to use this system very quickly					
I found the system very cumbersome to use					
I felt very confident using the system					
I needed to learn a lot of things before I could get going with this system					

47. Determine the Enjoyment level of completing the task using the scale (1=less enjoyable to 5=very enjoyable)

	1	2	3	4	5
I had fun using this presentation layout					
Using this presentation was pleasant					
I find using this presentation to be enjoyable					

48. **Please write down one advantage and one disadvantage, on this review presentation**?

……

……

[Thank you for your Time].

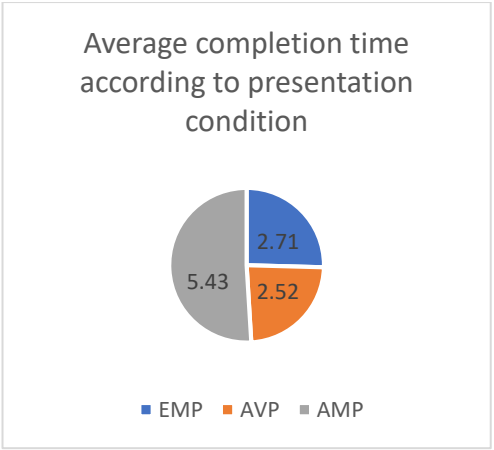
Experiment Data (N=48)

User	Gender	Online Shop Often	Time Spent Reading Reviews	Consider product review	Trust reviews	Usually buy product on recommendation
1	Male	Moderate	1-3	D	D	A
2	Male	Moderate	1-3	D	D	D
3	Female	Slightly	7-9	SA	D	A
4	Male	Slightly	10+	A	D	SA
5	Male	Slightly	4-6	SA	A	SA
6	Male	Moderate	1-3	A	A	A
7	Male	Moderate	4-6	A	D	A
8	Female	Quite	1-3	A	A	D
9	Male	Quite	4-6	SA	A	D
10	Male	Quite	4-6	SA	D	D
11	Male	Moderate	1-3	SA	D	A
12	Female	Quite	1-3	SA	A	SA
13	Male	Moderate	1-3	SA	A	A
14	Male	Moderate	7-9	A	D	D
15	Male	Quite	10+	SA	D	A
16	Female	Quite	4-6	SA	A	N
17	Male	Slightly	4-6	A	D	A
18	Female	Moderate	7-9	SA	D	A
19	Female	Moderate	7-9	A	D	N
20	Male	Slightly	4-6	SA	D	N
21	Male	Moderate	4-6	A	A	D
22	Female	Slightly	7-9	N	N	A
23	Male	Moderate	4-6	SA	N	SA
24	Male	Slightly	7-9	A	D	A

25	Male	Slightly	4-6	N	A	N
26	Male	Moderate	7-9	A	N	A
27	Female	Quite	10+	SA	A	A
28	Male	Slightly	4-6	A	A	N
29	Male	Moderate	1-3	A	N	A
30	Male	Moderate	4-6	A	A	A
31	Male	Slightly	4-6	A	N	A
32	Male	Quite	7-9	SA	A	A
33	Male	Moderate	4-6	A	A	A
34	Female	Quite	7-9	A	N	N
35	Male	Moderate	7-9	A	N	A
36	Male	Moderate	4-6	A	D	A
37	Female	Quite	1-3	D	N	A
38	Male	Quite	7-9	A	N	SA
39	Male	Slightly	7-9	SA	N	A
40	Female	Moderate	7-9	A	N	SA
41	Female	Moderate	4-6	SA	D	SA
42	Male	Slightly	7-9	A	D	A
43	Male	Quite	7-9	A	N	A
44	Male	Moderate	4-6	A	D	A
45	Male	Quite	7-9	A	N	A
46	Male	Quite	7-9	SA	D	A
47	Male	Moderate	4-6	A	N	SA
48	Male	Moderate	7-9	A	N	A

User	Easy		Moderate	Difficult	Presentation Condition			
	T1	T2	T3	T4	EMP	AVP	AMP	Total
1	1.2	2	2.1	5.25	2.1	3.2	4.4	10.1
2	1.3	1.45	2.2	5.6	2.2	3.15	4	10.35
3	1.35	1.55	2.1	5.2	2.1	3.4	4.55	10.35
4	1.1	2.3	2	3.45	2	4.3	3.45	9.25
5	1.55	2.35	2.25	4.45	2.25	3.5	4.45	11.35
6	1.5	2	1.55	4.35	1.55	3.5	4.35	10.2
7	1.4	1.5	2.1	4.25	2.1	3.3	4.1	9.5
8	2	2.25	2.3	6.5	2.3	4.25	4.55	11.5
9	1.35	1.5	4.25	3	3	3.15	4	10.35
10	1.5	2	5.2	2.55	2.55	3.5	4.25	11.1
11	1.4	2.2	5.1	2.25	2.25	4	5.1	11.35
12	1.5	2	4.25	2.1	2.1	3.5	4.35	10.35
13	1.15	1.5	4.5	2.3	2.3	3.05	4.5	10.25
14	1.4	2.2	4.35	1.55	1.55	4	4.15	10.1
15	1.5	2.1	5.5	2.32	2.32	4	5.5	12.22
16	1.57	2.35	4.18	2.46	2.46	4.32	4.18	11.36
17	3.55	4.3	2	2.5	2.5	2	5.25	13.15
18	3	4	2.15	3	3	2.15	7	12.15
19	2.5	3.25	2.5	3.25	3.25	2.5	6.15	12.3
20	3	4.2	1.25	2.25	2.25	1.25	7.2	11.15
21	3.35	4.15	1.5	2.5	2.5	1.5	7.5	12.3
22	3.42	4.16	2.1	2.3	2.3	2.1	7.58	12.38
23	3.45	4.2	1.45	2.15	2.15	1.45	8.05	11.05
24	3.5	4.25	1.5	2.45	2.45	1.5	8.15	12.5
25	3.1	4	2	2.25	2	2.25	7.1	11.35
26	3.4	4.25	1.5	2	1.5	2	8.05	11.55
27	3.2	4.15	1.55	2.2	1.55	2.2	7.35	11.4

28	2.55	3.55	1.5	1.55	1.5	1.55	6.5	10.35
29	4	5	2.3	2.5	2.3	2.5	9	10.2
0	4.25	5.15	1.15	2	1.15	2	9.4	12.55
31	3.2	4.55	1.5	1.55	1.5	1.55	8.15	12
32	3.35	4.55	2	2.1	2	2.1	8.3	12.4
33	2.25	2	4.15	1.45	4.25	1.45	4.15	10.15
34	1.4	2.15	3.55	2.15	3.55	2.15	3.55	9.05
35	1.5	2	4.55	2.25	3.5	2.25	4.55	11.1
36	1.5	2.35	4.55	2.15	4.25	2.15	4.55	11.35
37	1.45	2.35	4.5	2.2	4.2	2.2	4.5	11.3
38	1.5	2.15	3.55	1.45	3.05	1.45	3.55	9.45
39	2.1	2	5.15	1.35	4.1	1.35	5.15	11
40	1.5	2	4.45	2	3.5	2	4.45	10.35
41	1.45	2.1	2	4.5	3.55	2	4.5	11.45
42	1.5	2.15	2.2	4.2	4.05	2.2	4.2	10.45
43	1.5	2.35	2.2	4.55	4.25	2.2	4.55	11.4
44	2	2.5	1.55	5.1	4.5	1.55	5.1	11.55
45	1.5	2.35	2.3	4.5	4.25	2.3	4.5	11.45
46	1.25	2	2.2	5.2	3.25	2.2	5.2	11.05
47	1.3	2.1	2.3	3.5	3.4	2.3	3.5	10
48	1.25	2.1	2.25	4	3.35	2.25	4	10.1
Average	2.09	2.78	2.78	3.01	2.71	2.52	5.43	11.03



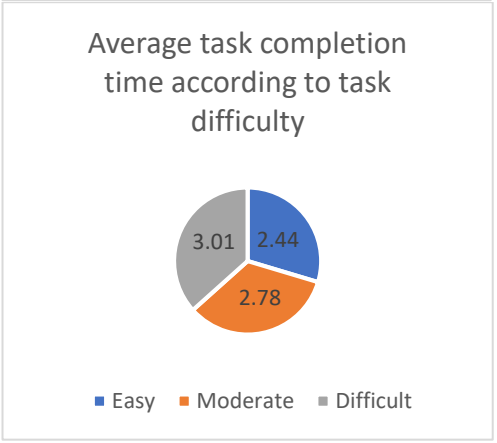


Table C-2: Task completion time.

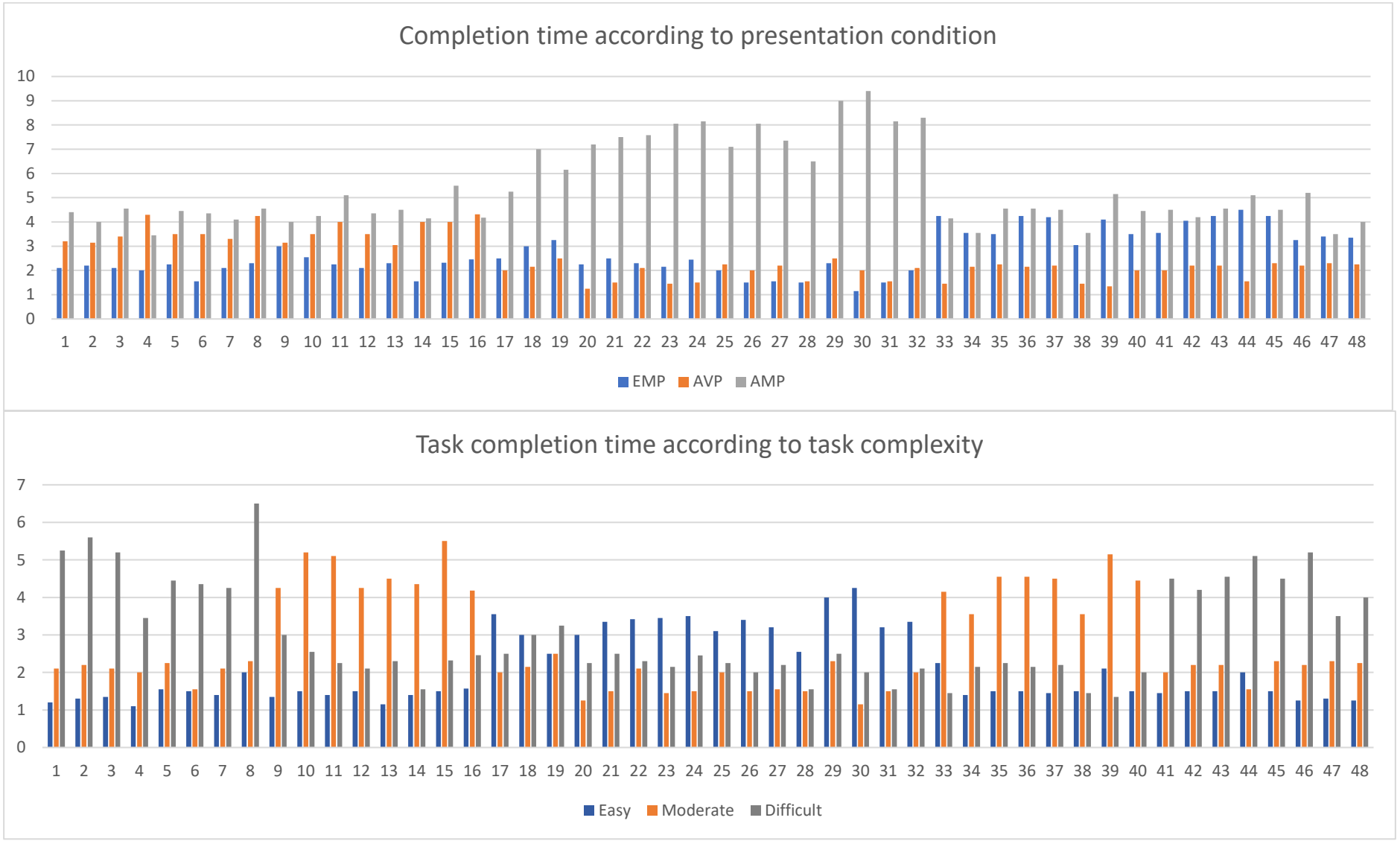


Figure C-1: Task completion time according to condition and task complexity.

User	Easy	Moderate	Difficult	Presentation Condition			
	T1&T2	T3	T4	EMP	AVP	AMP	Total
1	2	1	0	1	2	0	3
2	2	1	1	1	2	1	4
3	2	1	0	1	2	0	3
4	1	1	1	1	1	1	3
5	2	1	0	1	2	0	3
6	2	1	1	1	2	1	4
7	2	1	1	1	2	1	4
8	2	1	0	1	2	0	3
9	1	1	1	1	1	1	3
10	2	1	0	0	2	1	3
11	2	0	1	1	2	0	3
12	1	1	1	1	1	1	3
13	2	1	1	1	2	1	4
14	2	1	1	1	2	1	4
15	1	0	1	1	1	0	2
16	1	0	0	0	1	0	1
17	1	0	1	1	0	1	2
18	2	1	1	1	1	2	4
19	1	1	1	1	1	1	3
20	0	1	1	1	1	0	2
21	0	1	1	1	1	0	2
22	2	1	1	1	1	2	4
23	1	0	1	1	0	1	2
24	2	0	1	1	0	2	3
25	1	1	1	1	1	1	3
26	1	0	1	0	1	1	2
27	2	1	0	1	0	2	3
28	1	1	0	1	0	1	2
29	2	1	1	1	1	2	4
30	0	0	1	0	1	0	1
31	1	1	1	1	1	1	3
32	2	1	1	1	1	2	4
33	2	1	0	2	0	1	3
34	2	1	1	2	1	1	4
35	1	0	1	1	1	0	2
36	2	1	1	2	1	1	4
37	2	0	1	2	1	0	3
38	2	1	1	2	1	1	4
39	2	1	1	2	1	1	4
40	2	0	1	2	1	0	3
41	2	1	0	2	1	0	3

42	2	1	1	2	1	1	4
43	2	1	1	2	1	1	4
44	2	1	0	2	1	0	3
45	2	1	1	2	1	1	4
46	2	1	0	2	1	0	3
47	2	1	1	2	1	1	4
48	2	1	0	2	1	0	3
Average	1.60	0.77	0.73	1.23	1.10	0.77	3.10

Table C-3: Successfully completed Tasks.

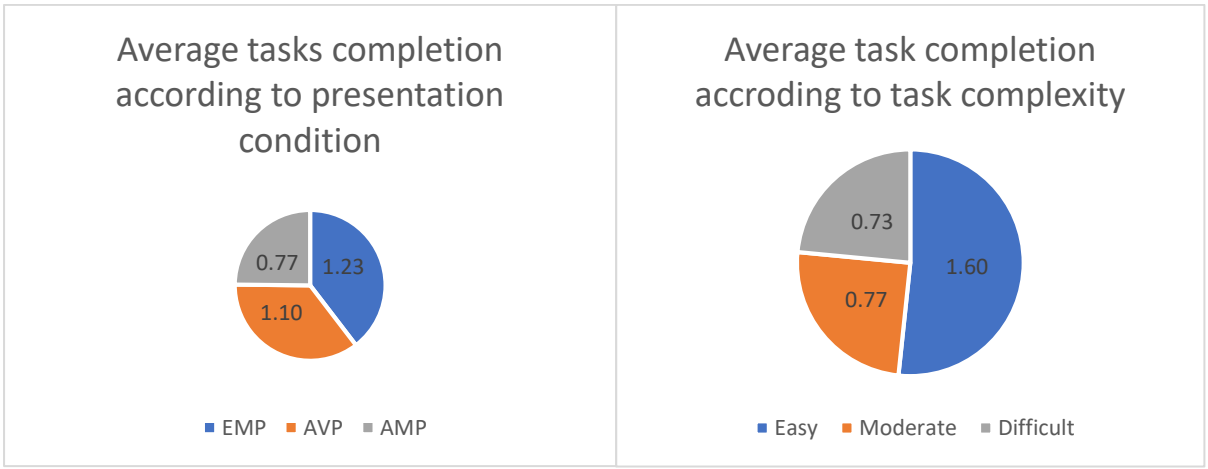


Figure C-2: Average Tasks completion according to presentation and task complexity.

Appendix D

Guidelines Validation

1. If I have the option to choose the source of e-commerce reviews I would choose the source to be:
   - ☐ Twitter
   - ☐ Facebook
   - ☐ Both Facebook and Twitter.

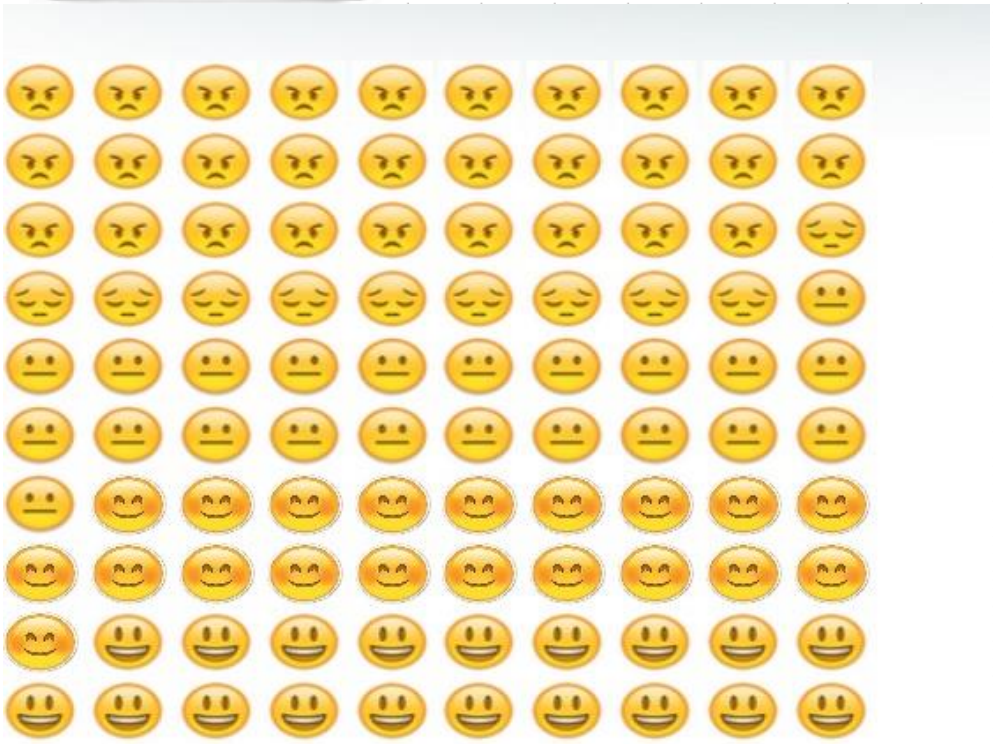
2. The reviews and ratings I would prefer to choose is the (check the pictures of different interfaces):
   - ☐ Emoji
   - ☐ Facial Expression Avatar
   - ☐ Option to choose between different interfaces.

3. Which Facial Expression Avatar would you prefer to use for the interface:

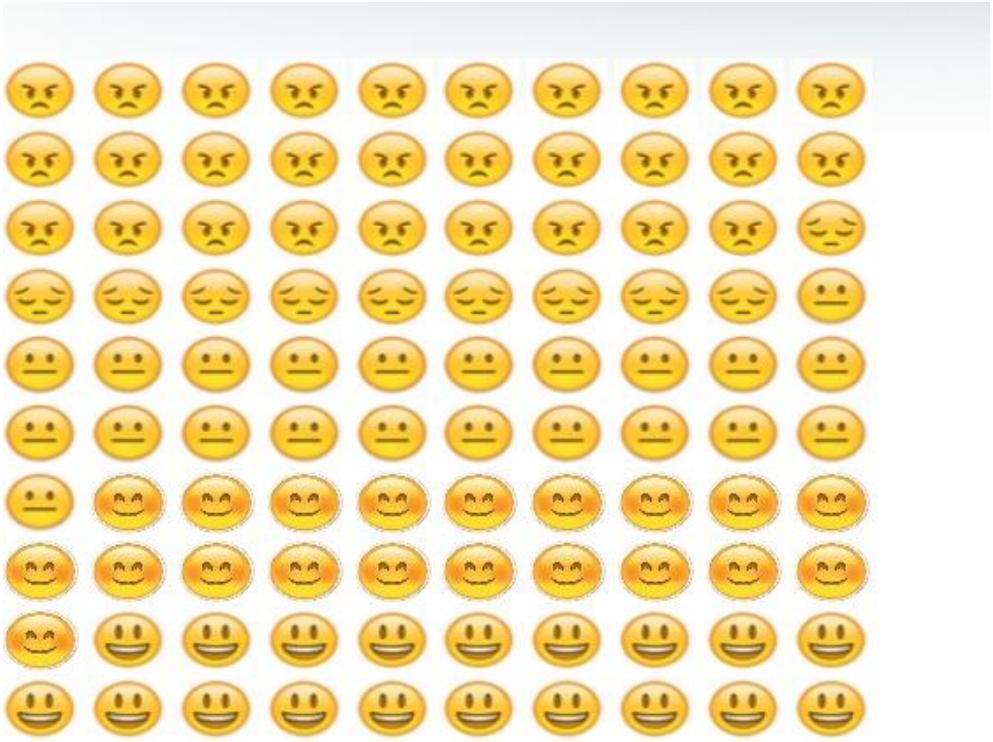
☐ ☐ ☐

4. Having the option to modify my reviews and ratings presentation by creating my own avatar (choosing generical and style) would increase my usability and loyalty to the e-commerce page. **Choose your agreement to the statement**
   - ☐ Strongly Agree
   - ☐ Agree
   - ☐ Does not matter
   - ☐ Disagree
   - ☐ Strongly Disagree.

[Thank You].



☑ 😐 ☐



Users	Q1			Q2			Q3			Q4				
	Facebook	Twitter	Both	Emoji	Facial Expressive	Choose option	A	B	C	Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree
1	1				1			1		1				
2	1					1	1				1			
3		1		1					1	1				
4	1			1				1		1				
5		1			1			1			1			
6	1					1			1		1			
7		1		1			1			1				
8	1				1			1			1			
9	1					1			1		1			
10			1	1			1				1			
11	1				1			1			1			
12			1			1		1		1				
13			1	1			1				1			
14	1					1	1				1			
15			1		1			1				1		
16		1		1			1				1			
17	1					1		1		1				
18			1			1	1				1			

19			1			1		1			1			
20		1		1				1				1		

Table D-1: Users responses data.

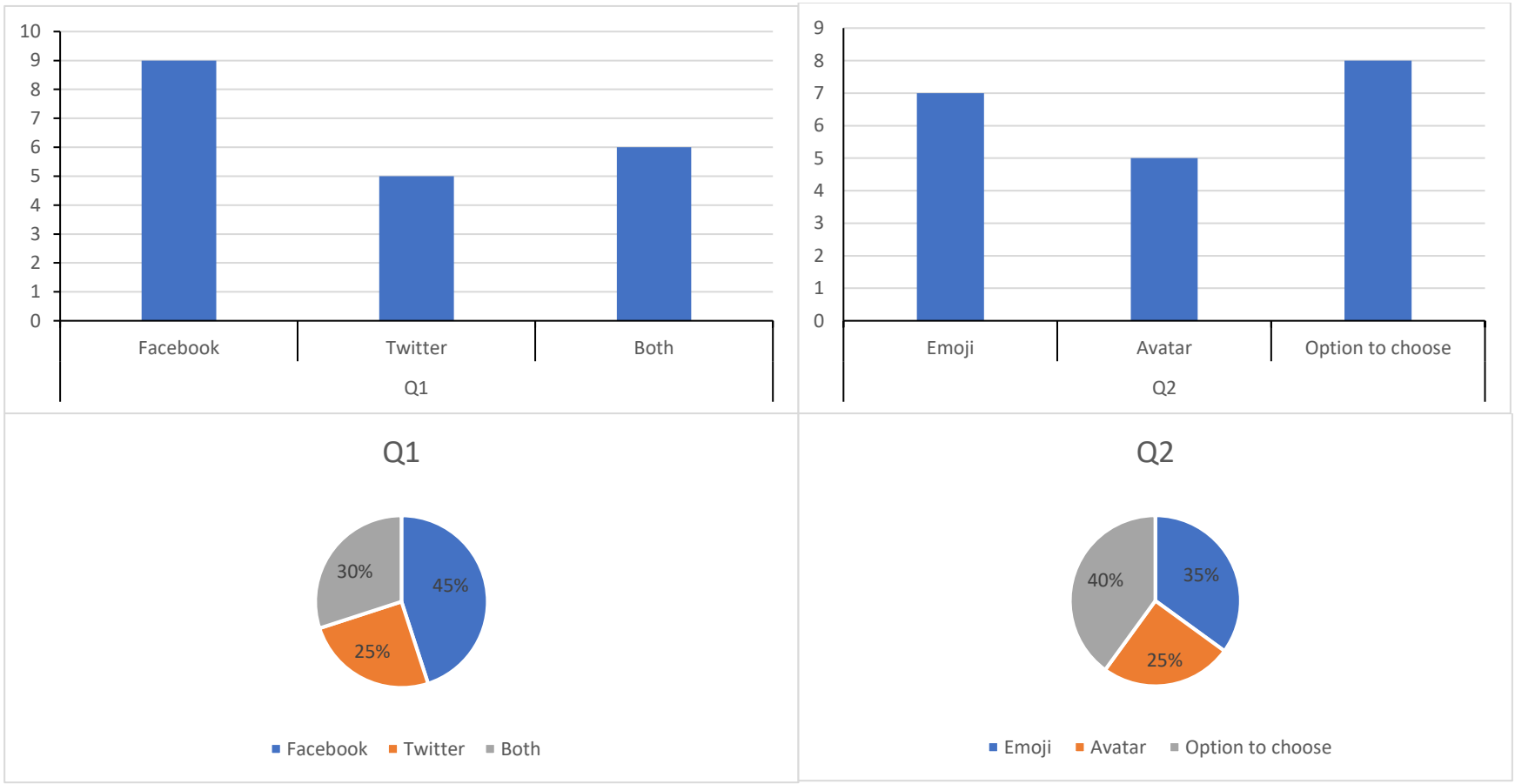


Figure D-1: Users data response question 1 and question 2.

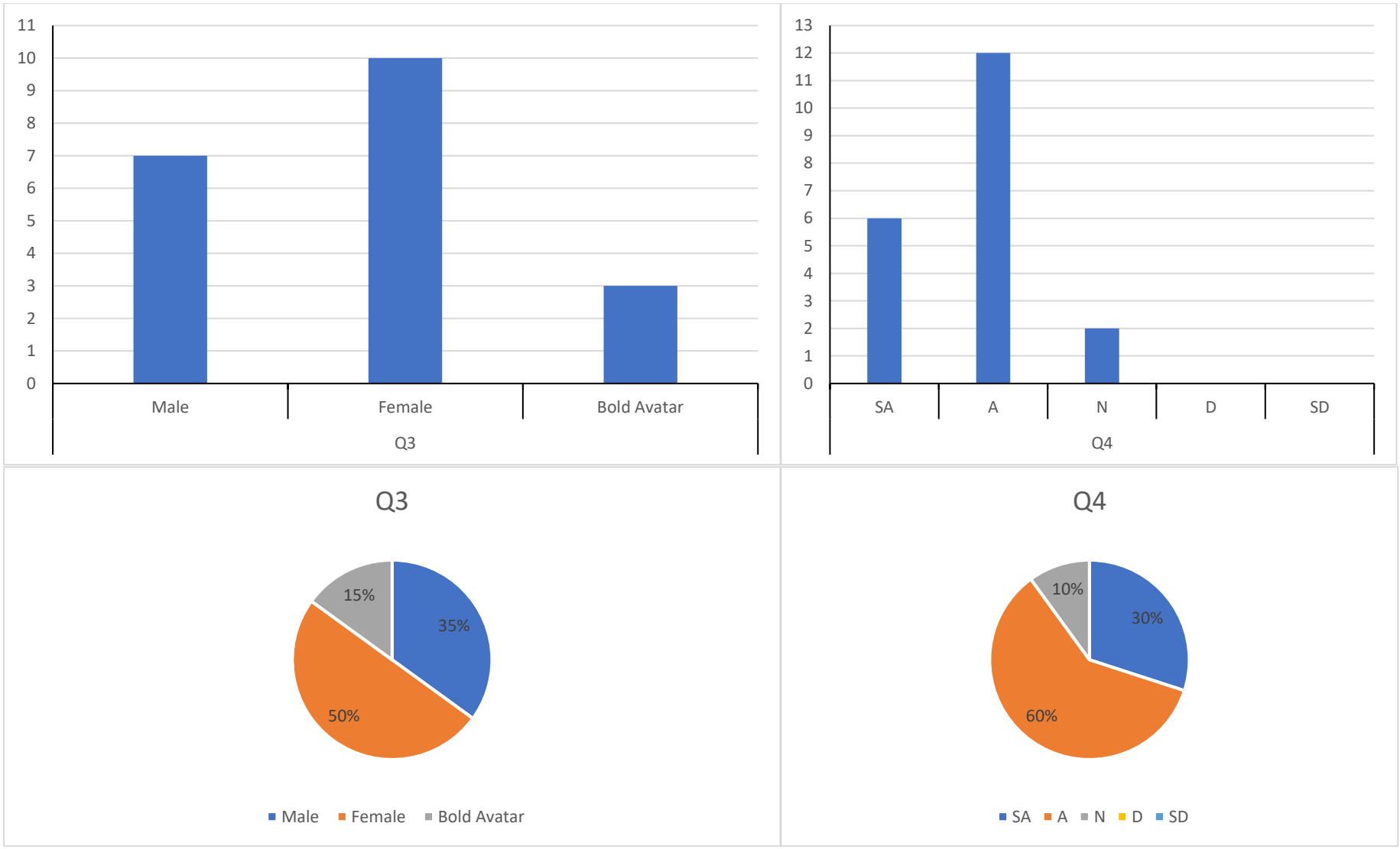


Figure D-2: Users response question 3 and question 4.