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Title:
Mobile Phones, User Behaviour, Radiation Effects and Cognitive Performance

Mobile Phones, User Behaviour,

Radiation Effects and Cognitive performance

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A dissertation submitted to the University of Bristol in accordance with the requirements for award of the degree of Doctor of Philosophy in the Faculty of Science

August 2018

Word count 68,156

Authors Declaration

I declare that the work in this dissertation was carried out in accordance with the regulations of the University of Bristol. This work is original except where indicated by special reference in the text and no part of the dissertation has been submitted for any other degree.

Any views expressed are those of the author and in no way represent those of the University of Bristol.

The dissertation has not been presented to any other University for examination either in the United Kingdom or overseas

Signed ……………………………………………………………. Date ……………

Abstract

Rationale. Mobile phones have rapidly become an essential technology in people's lives. Despite the many benefits they offer, research shows there have been negative outcomes related to usage behaviour, and health.

Background. Dramatic shifts in science change world-views; and most recently in the digital technology revolution. The mobile phone is at the forefront of this. The research question of this thesis is concerned with whether the use of the mobile phone has created a dramatic shift in patterns of human behaviour and communication. It also investigates whether use is a health risk and if radiofrequency electromagnetic fields (RF EMFs) affect cognitive performance of the user.

Method. Usage patterns and health concerns in young people are explored through self-report enquiry of questionnaires and interviews. These are followed by experiments to find out if radiation effects from using a mobile phone affect attention and memory.

Results and Discussion. Results confirm many benefits of use, particularly for communication, but many detrimental effects, including a range of health concerns. Significant results are found for lateralised and mood effects of RF EMF exposure. A check list is proposed as a contribution towards a standardised protocol for experimental work in this area.

Conclusions. Functions that afford communication continue to be the main function of the mobile phone. The way in which users communicate has changed over the two-year period of this study. Two experiments investigating the effect of RF effects showed significant lateralised results in visual tasks. Despite the many benefits users experience with mobile phones, caution is recommended for use. This has relevance for users, mobile phone manufacturers and network providers. Guidance and regulation are essential to encourage and monitor 'safe' use of phones.

Acknowledgements

I have many thanks to give. Firstly, my gratitude to my supervisor, Jan Noyes, who has provided support from beginning to end. Her unwavering belief in me and reiteration of hypothesis direction to further me to clarify the goals of this thesis. I would like to thank Kit Pleydell- Pearce for his guidance and contribution to the experimental design of Experiment 5 (Chapter 5) and the Bristol Well-Being Group. Thanks go to Susie Fowler, Chris Kent, Rob Udale and Bobby Sjuitzland who have been amazing with their patience to guide me learning how to use SPSS. I know it was a tough task, but it worked. Thanks also goes to the children and young people who were involved in the questionnaires and interviews in the primary, secondary schools and colleges in Somerset, and students from the University of Bristol; their willing involvement and responses have been uplifting.

A big thank-you also goes to my two wonderful daughters, Erika Larsson-Fowler and Eloise Fowler. To Erika, age 26, for her thoughtfulness and care, and to Eloise, age 18, for working alongside me, completing her 'A' Levels and on the way, becoming inspired by Psychology. I would like to thank the Turkish community for their friendliness, and for accommodating me working on writing up the thesis in the cafes of Uzumlu. I have been lucky to enjoy the Turkish landscape whilst writing up; from early morning panoramic views, as Eloise captured beautiful sunrises for her Photography 'A' Level and the mountains outside my house, who my family and I have great affection for. Thanks goes to my sister, Susie Fowler for giving amazing support and helping me with 'dips' of confidence. Also, to my friends, Ann Opstrup, Lucille and Mike Ainsworth and Jackie Forsey for their support. My thanks also go to Siobhain Sharkey who made fantastic suggestions for pictorial input to make the questionnaires more child friendly at the start of the PhD. Also, to Ed Jeffrey, who guided me with IT support.

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"It's good and it's small and you can carry it with you wherever you go"

"Relationships, it's kind of what you have phones for"

"I think just the way we make plans have completely changed"

"People don't expect to have to say a place, stick to it, not to be able to say, I'm going to be able to say I'm 10 minutes late"


Chapter1
Mobilephone
smartphone
social
ubiquitous
unique
stress
revolution
thumb
learn
network
connection
multi-task
blackberry
concern
Chpater1
motivation
digitalimmigrants
digital
cyberbullying
email
live
affordant
flexibility
blindness
disrupt
dependence
interaction
popular
always
internet
media
music
inattentional
digitalnatives
process
calls
text
accessibility
addiction
organisation
think
games
reminder
GSM
love
radiation
impact
adoption
task
safety
behaviour
dual
work

Chapter 1. Introduction

1.1 Success of the Mobile Phone

The mobile phone has unique interest as a technology. It is a ubiquitous gadget and is used for daily use throughout the world. Usage of mobile phones has increased amongst all ages, but, especially amongst young people under 25 years old (Baron, 2010, Cotton, 2009). In 2017, a survey showed that 95% of 16-24 years old respondents owned a smartphone in the UK (Statistica, 2018). The use of the mobile phone has had a large impact in people's lives. It has been suggested that how people use technology and in particular, mobile phones, has stimulated a 'digital technological revolution' in the last decades of the twentieth century and early twenty first century. This has created changes in how users go about their daily lives, creating changes in many areas, for example, in jobs, with the family, and social interactions (Arbitron Inc and Jacobs Media, 2011) and also the way they learn, think, process information, and communicate with each other (Brown, 2011).

Prensky described young people that have never known a world without digital technology as 'Digital Natives' (Prensky, 2001). He comments on the advantages of a digital approach where young people are able to get information quickly, parallel process or multi-task, where instant gratification is the norm. Many behaviours of young people challenge the beliefs of 'Digital Immigrants', those who did not grow up with digital technology. For example, many young people learn and study successfully while watching television or listening to music. As Digital Immigrants did not do this, they often believe this is an inappropriate way to learn. Mobile phones allow young people to have their phone with them, so they are able to make contact with people instantly, access social media, play games, set reminders and many other things. Skog (2002) has commented on how younger users like to investigate mobile phones in a playful, explorative way and often teach their parents how to use their phones (2002).

The unbiquitous nature of the mobile phone is reflected by its multi-functional capacity, portability, and the affordance of constant 'accessibility' and 'reachability' of others for the user. The way users interact with this technology has created a culture of being 'always on' (Baron, 2008) and 'perpetual contact' (Katz and Aakhaus, 2002). The research questions of this thesis consider communication practices and user behaviour amongst young people and asks whether the use of the mobile phone has created a dramatic shift in patterns of human behaviour and communication.

A brief look at the history and development of the mobile phone provides context for this question and reveals some of the rapid changes in development that have occurred in a short space of time.

1.2 Development of the Mobile Phone

Research into mobile phones began in the 1940's when mounted phones were installed in cars and vehicles, for example, taxis and the emergency services, but it was not until 1973, that the first mobile call was made by Martin Cooper (Gregerson, 2017), using what is now thought of as the 'old brick' phone. This was a 1G phone, the first-generation phone, which used an analogue system of transmission. Since this time, the mobile phone has undergone dramatic technological changes. Changes from 1G through to the current 5G networks. The development of phones from the first to the third generation of phones, witnessed a decrease in size from the large and cumbersome 'brick phone' to a slim and compact device. Since the fourth generation of phones, however, the size of the phone has increased. This is in response to the greater use of some of the functions on the phone. A bigger screen means size makes it more possible for lengthy screen use, such as video conferencing, TV viewing, internet use including social media and You tube. This increase in size means these functions are easier to use for the function of media viewing. The following table provides a brief outline of the key developments in terms of different generations of phones.

Table 1.1

Key Factors in the Development of Mobile Phone Generations

Generation	Introduction	Developments	Key Advantages
First. 1G.	1980	Analogue radio signals.	Can make calls
Second. 2G.	1991	Group Special Mobile (GSM) introduced (a more efficient spectrum)	Greater penetration
		Data Services, like texting, picture messages, multi-media services (MMS).	Less costly
		Digitally encrypted calls	Private calls
Third. 3G	1998	Mobile broadband Increased Information Transfer rate	Access capability extended
Fourth. 4G	2009	Mobile broadband Internet Access to laptops with wireless modems to smartphones and other mobile devices Mobile Web Access High-definition mobile TV Video conferencing Gaming Services Cloud computing 3D television IP telephony	Enhanced possibilities
Fifth. 5G	Expected 2020	Increased Mb/s 1Gbit/s to be offered to a group of 10 workers on the same office floor Enhanced signaling and spectral efficiency Improved response to times of disaster	Improved service

With the use of digital technology, many more functions have become available. The mobile has diversified from a technologically focused professional tool to an everyday gadget used by most of the population. When the mobile phone was first introduced, the main use was for calls to communicate with people long distance, like the function of the traditional landline.

As mobile phone technology developed, the importance of functions changed and sometimes quite dramatically, for example, text messaging was introduced almost by accident. Texting came about when GSM, Group Special Mobile, was first established in 1992. There was a piece of leftover bandwidth and this was made available to users, so they could create short messages on the keypad by tapping the number keys between one and four times to create alphabetic characters (Baron, 2010). This was the beginning of texting and was used enthusiastically by young people, particularly adolescents. It was not a planned market development, just something that was possible because of some spare bandwidth space.

1.3 Development of this Thesis

The overarching aim of this thesis is to apply an objective research approach, using quantitative and qualitative research methods, to investigate dynamic changes in how young people use mobile phones. It attempts to answer the following research questions, each of which will be revisited in the General Discussion and Conclusion in Chapter 7:

1. Has use of the mobile phone created a dramatic shift in human behaviour and communication? (Chapter 3)
2. Do the effects of using a mobile phone pose health risks to users? (Chapter 4)
3. Does the effect of radio-frequency electromagnetic radiation (RF EMF) effect cognitive performance? (Chapter 5).

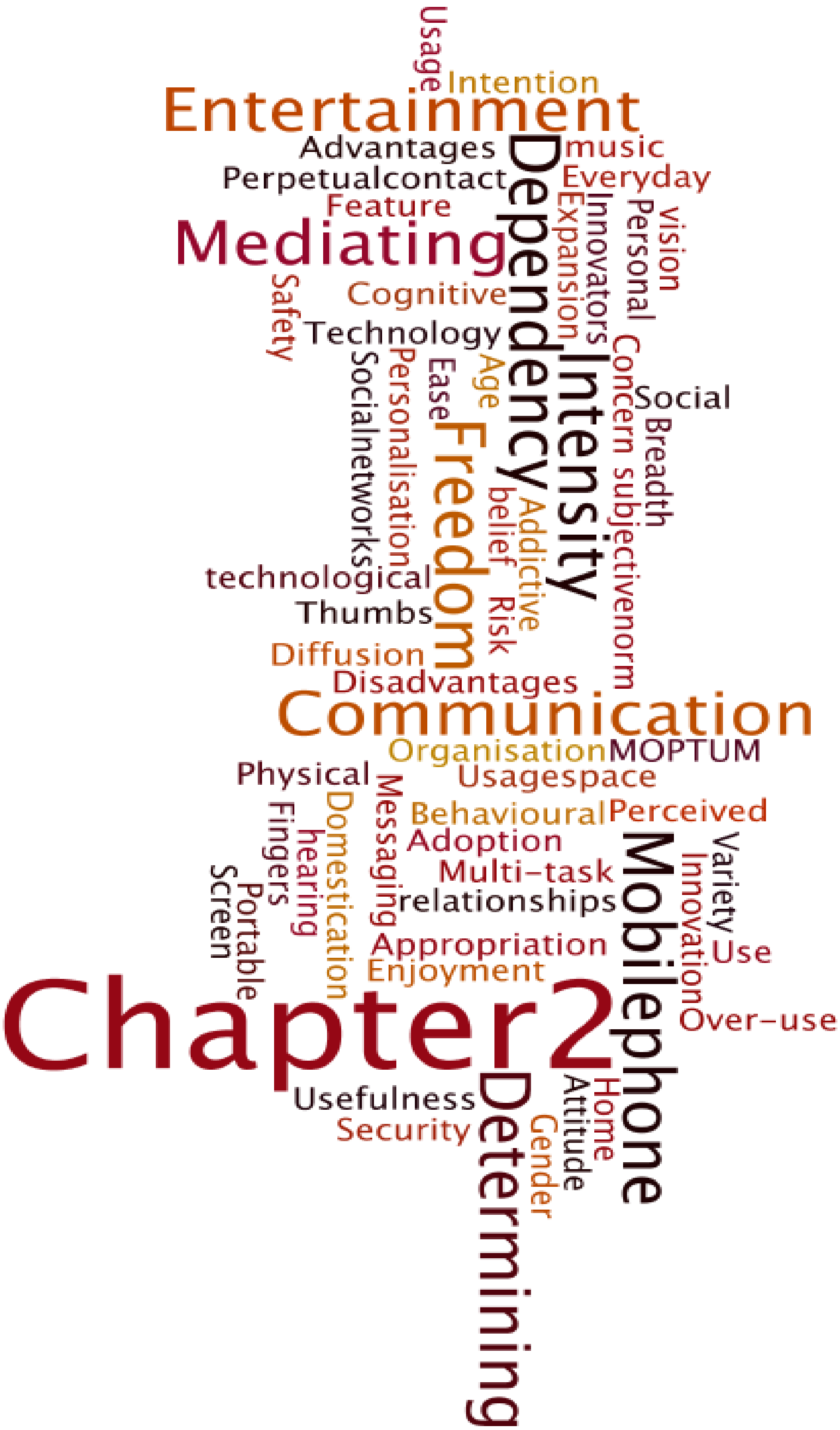
To answer the first research question of whether the use of the mobile phone has created a dramatic shift in human behaviour and communication, a literature survey was carried out and is presented in Chapter 2. The literature survey looks at ways in which new technology is adopted into society and identifies everyday concerns associated with mobile phone use.

Different models have been proposed to understand factors that are important for adoption and use. The Technology Acceptance Model (TAM) proposed by Davis (1989) and the Mobile Phone Technology Usage Model proposed by Van Bijon (2006), a model based on TAM but incorporating aspects of other models, are discussed. The aim of the latter model is to develop a functional model for understanding mobile phone usage. Following a consideration of everyday concerns associated with the mobile phone and technology adoption models, Chapter 3 outlines the research design of this thesis, and the development of questionnaire booklets and interviews to find out about mobile phone use in young people. The results of these are presented and discussed and attempts to answer the second research question of whether the mobile phone poses a health risk to young users.

Chapters 4 and 5 provide evidence to answer the third research question of whether the effect of radiofrequency electromagnetic radiation (RF EMF) exposure affects cognitive performance. Chapter 4 considers current health trends associated with phone use. Radiation concerns are identified, for example the effect of RF EMFs emitted from the phone. It is found that many studies had been carried out with varying results for the effect of RF EMFs in attention and memory tasks. A review of these studies is carried out and can be found in this chapter. Chapter 5 describe five experiments that are carried out to investigate the effect of RF EMFs on cognitive performance. These are a change detection task, the Stroop test, an n-back task, a word-recall task and a visual detection task. Results are presented and discussed In Chapter 6, a check list is created for future experimental investigations to contribute towards a standardised approach to experiments. Results are discussed in relation to the check list which includes general procedures for experimental work and specific procedures for considering the effects of RF EMFs effects from mobile phones. Chapter 7 sums up and addresses the three research questions put forward in this thesis.

1.4 Summary of Chapter 1

In this Chapter, the mobile phone is identified as a successful innovation that has become part of everyday life for young people. From the first call in 1973, it has changed into a multi-functional gadget going through five generations of phone development. It has provided many affordances of use through it's portability allowing constant accessibility and reachability. The research questions of this thesis ask whether the use of the mobile phone has created a dramatic shift in patterns of human behaviour and communication (Chapter 3), if the effects of using a mobile phone pose health risks to users (Chapter 3) and, if the effect of radio-frequency electromagnetic radiation affect cognitive performance (Chapter 4, 5, 6). The final chapter sums up and addresses the three research questions put forward in this thesis (Chapter 7).


Usage
Intention
Entertainment
Advantages
music
Perpetualcontact
Everyday
Feature
Mediating
Dependency
Expansion
Innovators
Personal
vision
Cognitive
Safety
Technology
Age
Ease
Personalisation
Socialnetworks
Intensity
Concern
Social
Breadth
Freedom
belief
Addictive
subjectivenorm
technological
Thumbs
Risk
Diffusion
Disadvantages
Communication
Organisation
MOPTUM
Physical
Usagespace
Messaging
Behavioural
Perceived
Domestication
Fingers
hearing
Adoption
Mobilephone
Variety
Multi-task
Innovation
Screen
Portable
relationships
Appropriation
Use
Enjoyment
Chapter2
Over-use
Usefulness
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Gender

Chapter 2. Mobile Phone Use

Chapter 2 discusses technology adoption and everyday concerns associated with mobile phone use. Technology adoption is of interest to understand the motivations users have for engaging with technology. Everyday concerns are of interest because, although there are many advantages to mobile phone use, users might be at risk from use of the mobile phone. Technology Adoption is discussed in Section 2.1 and Everyday Concerns are discussed in Section 2.4.

2.1 Technology Adoption and Use

There is an extensive literature on models whose aim is to facilitate understanding of how individuals decide to 'take up' and use technology, and specifically mobile phone adoption and use. The Mobile Phone Technology Usage Model (Van Bijon, 2006) is used to develop some of the questions for the questionnaires and interviews in this thesis. To understand how this model was developed, a brief outline of different models is given.

2.1.1 Models of Adoption

Different models are based on concepts of diffusion, domestication, appropriation and/or adoption (Pedersen & Ling, 2002) and sometimes, a combination of these concepts. For example, Wirth, Pape, and Karnowski (2008) created a model based on appropriation and adoption concepts whilst Van Bijon (2006) proposed a model drawing on different aspects of technology adoption concepts to propose the Mobile Phone Technology Usage Model (MOPTUM). The main concepts of different models are discussed in this chapter and then the development of the MOPTUM.

Innovation Diffusion Model

Rogers proposed the Innovation Diffusion Model (1995) which seeks to explain how innovation diffuses into society. He postulates five different user adopter groups. Each adopter group conveys a unique psychographic profile (Rogers, 1995). The groups show that some users are more open to adoption than others. The first group are the innovators, the ‘techies, who make up 2.5 per cent of the population. They consider technology to be an important topic in their lives. They like to explore new technology as soon it appears, regardless of what the function is. They familiarize themselves with new gadgets and the intricacies of the technology. The second group are the early adopters, who make up 13.5 per cent of the population. They have an interest in technology and are also keen to engage with professional problems and tasks. They exploit the new capability but are usually not technologists. The third group are the early majority, who make up about 34 per cent of the population. They are referred to as ‘pragmatists’ and focus on professional problems and tasks. They are fairly comfortable with technology but use it as a means to an end, to solve tasks and problems. They tend to adopt a ‘wait and see’ attitude to new technology by waiting to see how other people are getting on with the technology before they take the risk to adopt it. The next group are the late majority who make up 34 per cent of the population. They are described as the ‘sceptics.’ They regard the new technology in a similar way to the early majority. They prefer to wait and see until the technology has become an established standard before they take it on. The fifth group are the laggards who make up about 16 per cent of the population. The laggards might never adopt the technology. They are not interested in new technology and they will usually only buy technology products when they have some connection with other goods. The five stages are shown in Figure 2.1.

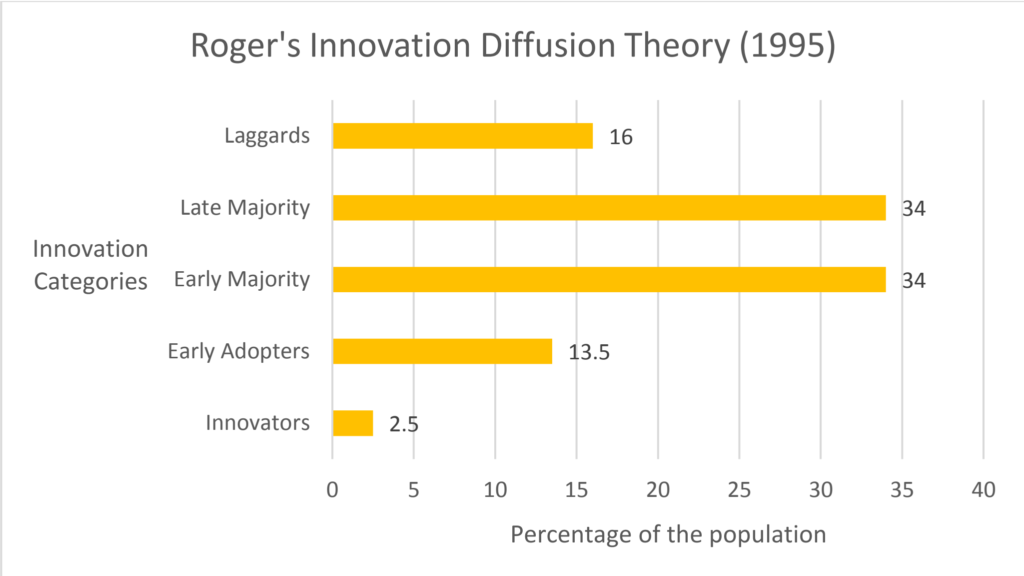


Figure 2.1

Roger's Innovation Adopter Groups shown as a percentage of the population

When an innovation is successful the first group, the innovators will take up the technology first. This will be followed by the early adopters, the early and late majority, and finally the laggards. It is of interest because it helps understand how technology becomes accepted into society. By studying the profile of the user, the motivations for use can be understood. There are limitations to this approach because users are categorized into particular types, whereas other theories, such as Domestication Theory perceive other factors important for understanding adoption.

Domestication Theory

Domestication theory was initially proposed by Silverstone and Haddon (1996). It refers to the shift of technology, particularly computers and the internet, from a work setting into a domestic setting, for personal and household purposes (Cummings & Kraut, 2001).

Technology is used in the home for pleasure and for personal use, rather than in the context of a job at a place of work. Adoption is seen as a continuing process. Domestication theory considers how technology integrates with the lives of household members. When the technology is ‘taken’ into the home, individuals invest the technology with its own significance. It then gains a personal meaning depending on the level of ‘personalisation’ that is imbued on it. In domestication theory, considerable attention is paid to the context in which the technology is used, and the attitudes of others are considered important in shaping individual’s viewpoints. The meaning of the technology is thus shaped by the life experience of the user and in turn, the technology has an impact on life experience. Studies carried out with a domestication approach can generate a more textured picture of a population than quantitative research; similar to an ethnographic approach.

Appropriation Theory

Appropriation theory adopts a uses and gratification approach. Originally, mass communication media are investigated in the context of appropriation. In the twenty first century, this approach has been applied to the gratifications of using video games, the internet, email and phones (Pedersen & Ling, 2002). Adopters seek gratification in technology use based upon their individual ‘needs’ or ‘motivations’ (Lin, 1996). With a uses and gratification approach, the researcher does not put forward a hypothesis about which gratifications will be important at the start of the study. Instead, an exploratory approach is implemented, and a qualitative approach is used. For example, participants can be observed or interviewed, and gratifications listed (Pedersen & Ling, 2003). Some studies investigate the relationship between identified gratification and usage and then test the explanatory power of the gratifications (Pedersen & Ling, 2003).

Adoption Theory

Mobile phone adoption theory encompasses the user, the technology and the context (Humphreys, 2005). Understanding the concepts of mobile phone adoption enables mobile phone users, mobile phones providers and manufacturers to base their decisions about products on user motivations, interests and needs. One model that has been influential is the Technology Acceptance Model (Davies, 1989). This provides a theoretical framework to explain and predict user attitudes toward and intention to use technology (Kim et al, 2008). The Technology Acceptance Model (TAM) suggests that beliefs about usefulness and ease of use are important beliefs for using a new technology (Davis, 1989). The TAM was developed from Fishbein and Ajzen's model of the Theory of Reasoned Action (TRA) in 1975. It has mainly been used to understand technology adoption in the workplace. The TRA model links attitude and subjective norm to an individual's behaviour as immediate determinants of intention to perform a behaviour (behavioural intention).

Behavioural intention is indicative of an individual's willingness to carry out the behaviour (Kim et al., 2008). The TAM takes the TRA concepts of attitude, subjective norm, behavioural intention and behaviour but also adds perceived ease of use and usefulness to the model to explain how users adopt technology

Box 1: What is Attitude, Subjective Norm and Behavioural Intention?

Attitude - An individual's positive or negative feelings about that behaviour.

Subjective Norm - An individual's perception of social pressure in doing or not doing a specific behaviour.

Behavioural Intention - Individuals will tend to perform a behaviour if they have strong beliefs that other people will expect them to perform the behaviour.

The TAM purports that perceived usefulness and ease of use of the technological device will affect the user's intention to use the system. This in turn will influence the actual behaviour. The constructs of TAM have been investigated in numerous studies and the results support the reliability of the constructs and the basic relations between them (Svensden et al., 2013).

Box 2: What is Perceived Ease of Use and Perceived Usefulness?

Perceived Ease of Use - defined as "the degree to which a person believes that using a particular system would be free of effort" (Davis, 1989, p.320).

Perceived Usefulness – defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" (Davis, 1989, p.320).

TAM has also been refined and extended by a range of empirical proposals. For example, an additional belief factor proposed by Davis is perceived enjoyment (Davis, 1992).

Box 3: What is Perceived Enjoyment?

Perceived Enjoyment - the extent to which the activity is enjoyable in its own right (Davies et al., 1992, P.1113)

Perceived enjoyment along with perceived usefulness are important concepts for explaining behavioural intention to use the technology. In turn, perceived ease of use will influence both perceived usefulness and enjoyment to use the technology. Many studies have shown empirical support for the relationships between perceived ease of use, usefulness and enjoyment in technology acceptance. (Kwon & Chidambaram, 2000; Nysveen, Pedersen & Thorbjornsen, 2005a; Nysveen, Pedersen, & Thorbjornsen, 2005b; Pagani, 2004, Rouibah &

Abbas, 2006). Perceived enjoyment was found to be the most important determinant for the social use of mobile phone camera usage (Rouibah & Abbas, 2006) and instant messaging (Rouibah & Rouibah, 2005). In applying TRA and TAM to young people's adoption of mobile phones in their lives, one can postulate that the adoption of mobile phones can be predicted and explained in terms of pre-established beliefs to mobile phones and mobile communication.

The TAM model has been used to explore technology adoption in many contexts. Studies found that perceived ease of use affected beliefs about perceived usefulness in mobile technology adoption (Nysveen, 2005a; 2005b). Kwon and Chidambaram (2000) suggested that perceived ease of was an important determining factor for perceived usefulness and perceived enjoyment to use mobile products. This indicates that individuals who find it easier to use mobile phones are more likely to think that using mobile phones will increase their enjoyment. Individual's overall attitudes towards a behaviour directly influences their views about performing their behaviour. Snowden, Spafford., Michaelides and Hopkins (2006) found that beliefs about usefulness of mobile communication are important determining factors of positive attitudes towards mobile services. Perceived usefulness and perceived enjoyment are found to have a positive effect on attitudes towards mobile services (Nysveen, 2005a). Thus, it can be seen that relationships between beliefs and attitudes can affect how technology is used by the individual.

Associated with perceived enjoyment is the concept of 'personalisation' but this is not considered in the TAM model. There has been much research into the importance of the 'personalisation' of the mobile phone and the identity that users gain from association with their phone. Choosing a phone can be an important decision for the user. In some cases, the mobile phone can be a ‘fashion’ statement and is important for self-image of the user (Wilska, 2003). Some researchers have also emphasised the ‘gift’ giving quality for young people when they send a text message to a friend (Taylor & Harper, 2002).

A further adoption theory is the Unified Theory of Acceptance and Use of Technology (UTAUT) model (Venkatesh, Morris, Davis & Davis, 2003). This was put forward to explicate user intentions and usage behaviour. Performance expectancy, effort expectancy, social influence and facilitating conditions are identified as the four key constructs for determining usage intention and behaviour. Gender, age, experience and voluntariness are identified as mediating factors, important for their effect on the determining factors

2.1.2. Models of Use

Mobile Phone Technology Usage Model (MOPTUM)

Van Bijon (2006) put forward the Mobile Phone Technology Usage Model (MOPTUM) to understand mobile phone usage variety in a population. The model is based on TAM, but it is developed for mobile phone usage rather than adoption. It uses the divisions of mediating and determining factors from UTAUT to purport a model for mobile phone usage. The MOPTUM model is shown in Figure 2.3. Mobile phone use (actual system use) is based on usage breadth, usage intensity and usage variety. Actual System Use in MOPTUM is determined by social influences, perceived ease of use, perceived usefulness, facilitating conditions and behavioural intention. Facilitating conditions refers to the infrastructure in which the phone is used. Determining factors are influenced by mediating factors. These are socio-economic, personal and demographic factors.

Usage breadth, Usage Intensity and Usage Variety are concepts proposed by Geser as a way to quantify usage behaviour (Geser, 2004). Usage variety is shaped by usage spaces, as proposed by Marcus and Chen (2002). Usage variety is then broken down into usage spaces as proposed by Marcus and Chen (2002). They found that identity of the user was important for mobile phone users and proposed an analytical framework to help organise the complexity of mobile user behaviour. This came about in response to a design brief which aimed to develop conceptual user interface designs for wireless information devices Through user diaries, observation, shadowing of user behaviour, prototyping, and scenario development, Marcus and Chen became aware of the significance of identity for using a mobile. From this central concept, usage spaces are proposed to represent user needs.

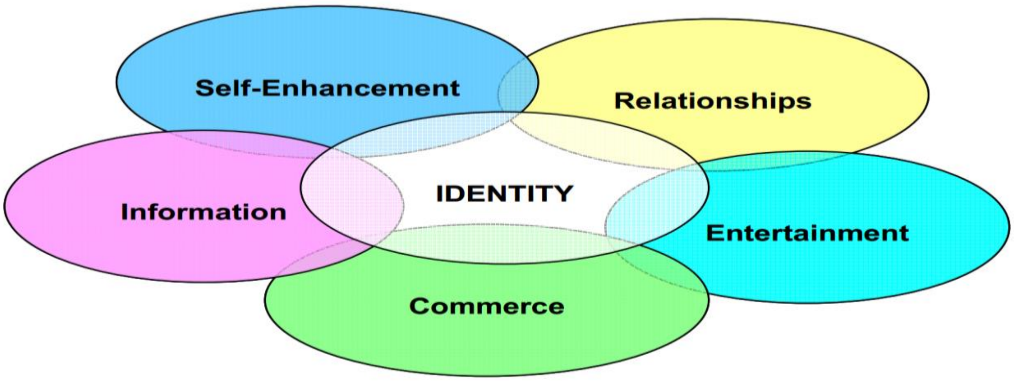


Figure 2:2
Usage Spaces (Marcus& Chen, *2002)*

The usage spaces proposed are shown in Figure 2.2. By framing user needs into usage spaces, it is intended that functions associated with user needs can be developed. At the centre of the usage spaces is the Identity Usage Space. This usage space provides knowledge about the owner and conveys a 'deep personalisation' with the owner (Marcus, 2002, p.39). The Self-enhancement space refers to the way in which an individual's 'normal capabilities' are extended (Marcus & Chen, 2002). These could be to do with enhancing personal safety, health monitoring or improving efficiency in organising personal life. The Information space can be divided into personal and non-personal information the latter includes information related to topics such as the weather, dictionaries, listings and business information. Personal information refers to personal saved numbers and organisation, for example, appointments. The Commerce Usage Space refers to e-spending through electronic money and e-coupons.

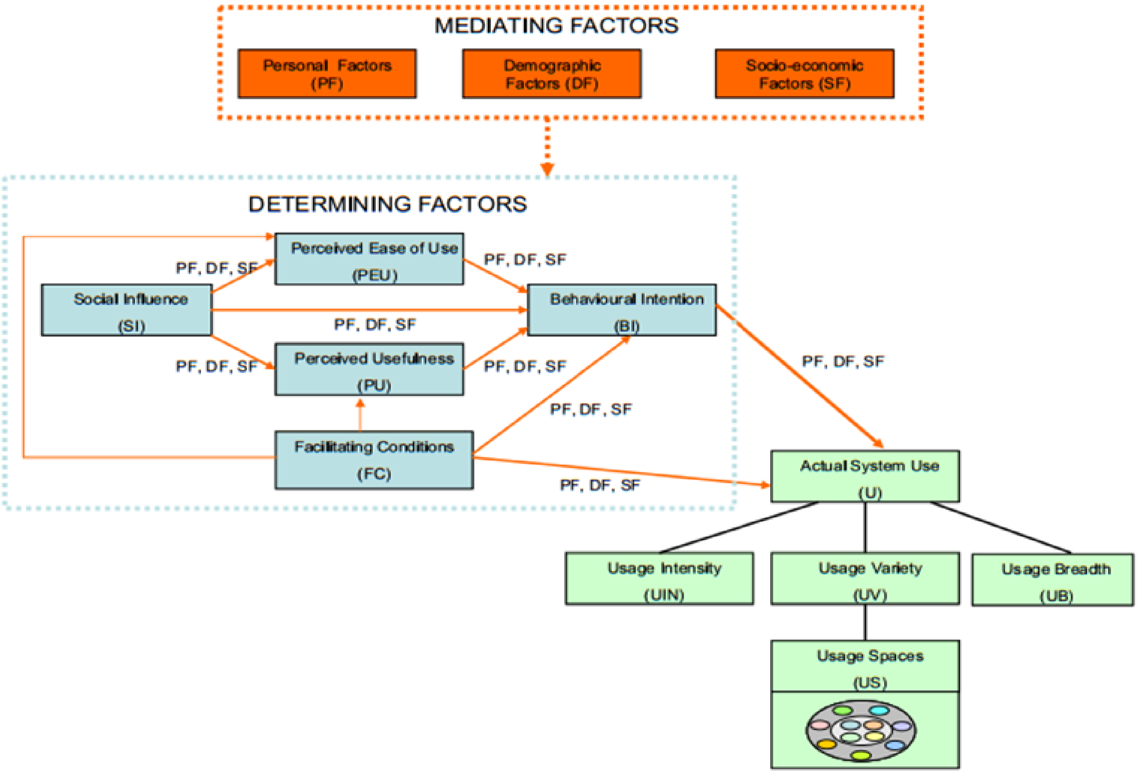


Figure 2:3
Mobile Phone Technology Usage Model (Van Bijon, 2006)

The Entertainment Usage Space includes 'enjoyment of portable media such as music, astrological readings, and jokes, or games involving multiple users. The Relationships Usage Space is based around the ability of the mobile to connect people and strengthen the intimacy between people.

The MOPTUM further developed the concept of usage spaces to consider a range of user needs. Two layers of needs are encapsulated; the inner core usage spaces of personal information, safety and security, relationships and organisation and the outer additional usage spaces. It is suggested that features related to core usage spaces satisfy basic mobile phone user needs. (Van Bijon, 2006). It is suggested that by focusing on these spaces, designers and mobile phone manufacturers can understand user needs, so that rather than adding new features that users are not going to use, features already being used can be identified. Current features can be adapted for specific motivational user needs (Van Bijon, 2006). The additional usage spaces are image, personal history, non-personal information, M-commerce, entertainment, expansion, and philanthropy. It is suggested that the additional usage spaces are important for influencing the user's satisfaction with the phone. Some users, for example, might be satisfied with only the core usage spaces being represented but others might need the core and additional usage spaces to be satisfied.

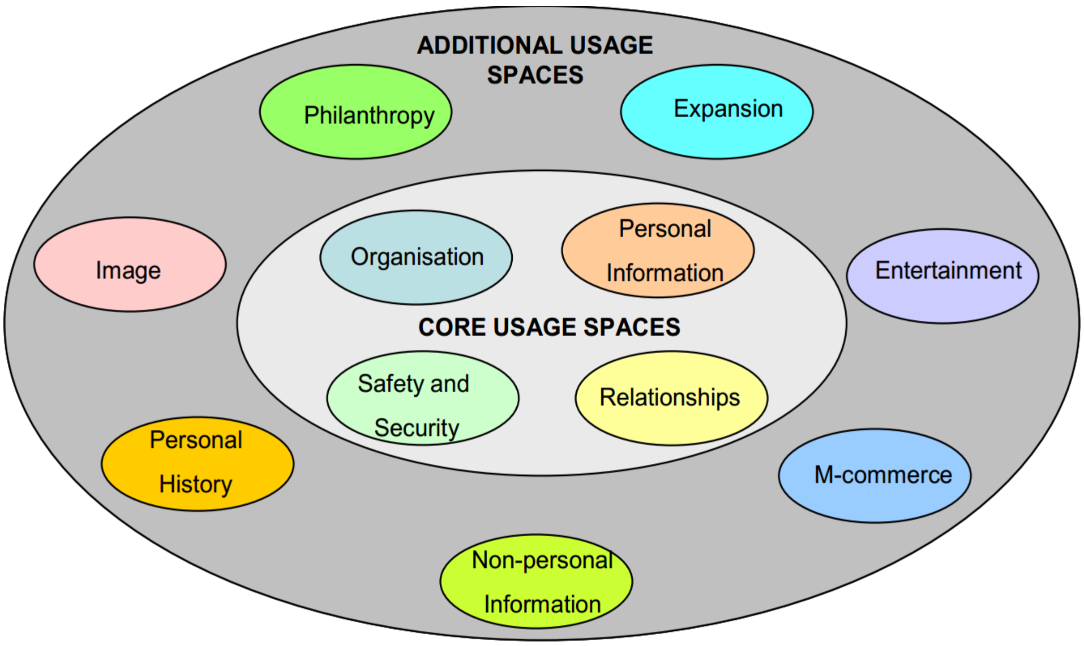


Figure 2:4
Usage Spaces for MOPTUM

The usage spaces proposed for MOPTUM are based on a population of young people under 30. This is shown in Figure 2.4.

Core usage spaces and additional usage spaces in MOPTUM are developed from a consideration of previous models of technology adoption and a literature reveal. Further details can be found in ‘A model for representing the motivational and cultural factors that influence Mobile phone usage variety’ (Van Bijon, 2006).

2.2 Evaluation of the Technology Acceptance Model (TAM)

Although the constructs of TAM have been investigated in many studies, the TAM has been criticised for not considering the effect of social influence (Davis et al., 1989; Malhotra & Galetta, 1999). Attitude is believed to be the result of personal and social influence, but this is not included in the TAM model. Malhotra and Galetta (1999) suggested social influence should be considered in a model of technology use. They propose a process of internalisation, identification and compliance to accommodate the effect of social influence. The findings of Malhotra and Galetta (1999) suggested that users’ attitudes are directly affected by social influence.

The TAM model was used to investigate mobile phone adoption by Kwon and Chidambaram (2000) who found that perceived ease of use affected the extrinsic and intrinsic motivation of users. Apprehensiveness about mobile phone technology had a negative effect on intrinsic motivation. Lee, Kim and Chung (2002) investigated user acceptance of mobile internet. They found that self-efficacy and social influence measures influenced perceived usefulness and perceive ease of use. Also, perceived ease of use and perceived usefulness affected actual usage frequency. Teo and Pok (2003) investigated the adoption of WAP-enabled mobile phones among internet users. They found that attitudinal and social factors including perceptions of usefulness (relative advantage), risk and image influenced the intentions of users to adopt a WAP-enabled mobile phone.

Box 4: What is Voluntariness?

Voluntariness – the degree to which use of the innovation is perceived as being of free will.

Kleijnen, De Ruyter and Andreassen (2004) investigated adoption of wireless finance. They found that there was an effect of perceived cost, system quality and social influence on attitude to use. Age, computer skills, social influence, mobile technology readiness and age had a moderating effect.

Different models put a greater emphasis on varying factors to understand mobile phone adoption and use. It is important to consider the context of mobile phone adoption and use. This thesis considers the use of the mobile phone in the everyday lives of young people, so it differs from many previous studies that considered mobile adoption and use in large organisations with varying infrastructures.

2.3 Everyday Concerns

Many concerns have been identified with mobile phone use in everyday life, both physical and cognitive, as well as social. The literature review discusses these concerns.

2.3.1 Physical Concerns

Physical concerns include hearing and vision problems. High frequency hearing loss (Velayutham, Govindasamy, Raman & Prepageran, 2014) and damage to the inner ear

(Panda, Jain, Bakshi, & Munjal, 2010), eyestrain (Bababekova, Rosenfield, Hue & Huang, 2011), vision disturbance (Balik, Turgut-Balik, Balicki & Ozcan, 2005) and blurred vision (Kucer, 2008) have been identified. Heinrich, Thomas, Heumann, von Kries, and Radon (2010) found that using a mobile phone in the morning amongst teenagers meant they had a higher intensity of headache. Musculoskeletal effects have also been identified in users adopting unnatural postures. Symptoms include upper back and neck problems, flexed neck and right and left-hand pain (Gustafsson, Johnson, & Hagberg, 2010) and pain at the base of thumb (Berolo, Wells & Amick, 2011) have been shown to be linked to mobile phone use. A review of published scientific literature found 10 human studies that had identified changes in sperm exposed to phone radiation. Lower sperm count and/or inactive sperm are found for men who carried their phone in a pocket or slung on a belt. (Ruediger, 2009).

2.3.2 Cognitive Concerns

Cognitive concerns have led the UK Department of Health to commission a study assessing the cognitive abilities of 2,500 children, aged 11-14 (Welland, 2014) in a Study of Cognition, Adolescents and Mobile Phones (SCAMP). The children are carrying out computerised tasks designed to measure cognitive abilities such as memory and attention. The experiments of Hyman, Boss, Wise and Caggiano (2009) showed that attention was affected when students are walking and using their phones at the same time. Nearly half of the students on their phone did not notice a uni-cycling clown, an unusual activity. It took students 83 seconds to cross the campus area if they are on their phone compared to 79 seconds if they are not. Thus, the cognitive implications of mobile phone use are also important when users carry out a secondary task, such as driving or walking while texting, talking on the phone or listening to music.

Multitasking

There has been concern surrounding the implications on cognitive performance from dual or multitasking when using a mobile phone. When multitasking behaviour involves another technology, the behaviour is referred to as media multitasking. Alzahabi and Beker (2013) investigated the ability of participants to switch between two tasks and to perform two tasks associated with media multitasking experience simultaneously. They found that heavy multitaskers are better at switching between two tasks, although similar results are found for light and heavy multitasking users in a dual task. The effect of media multitasking was also investigated by Baumgartner, Wouter and Weeder (2014) who found that 11-15 years old users experienced difficulties with executive control in everyday life. However, cognitive tasks carried out did not show performance deficits and it was found that users are better able to ignore irrelevant distractions of the Eriksen Flankers task.

The implications of media multitasking on attentional control have shown varying results. Many studies have used the Media Multi-tasking Index (MMI). This is a scale that is gaged by responses to a Media Use Questionnaire, a self-report questionnaire used to assess an individual's media multi-tasking habits (Ophir, Nass & Wagner, 2009). Studies using this index have found poorer control over attention with media multi-tasking (Ophir et al., 2009, Moisala, et al., 2016) and mobile phone use. A further study (Theoretical review, 2016) amongst 12-16 age users found that those who multitasked more had poorer executive function ability. This was shown by performance in standardised achievement tests in Maths and English, traits of greater impulsivity and poorer results in working memory measures of executive function. However, performance measures of cognitive processing speed, implicit learning, manual dexterity, and traits of grit (the ability to persevere in difficult or even impossible tasks) or conscientiousness are not related to those who media-multitasked frequently. In contrast, Lui and Wong (2012) found that those users scoring highly on the MMI index performed better on some attentionally demanding tasks, for example, the ability to integrate information coming from different modalities (Wilmer, 2017) found that users who played video games frequently had improved multitasking performance.

2.3.3 Social Concerns

Communication

In 2018, the multi-faceted functions of the phone continue to proliferate, and the ubiquitous nature of the mobile phone persists. Using the mobile for communication and for social purposes is an important function of the phone. Call and text use are high and has found to be the most important use amongst teenagers (Madell & Muncer, 2004). In 2013, The Pew Research Report 'Teens, Social Media and Privacy' found texting was the main form of communication amongst 12-17 years old users (Madden, 2013). One third of users sent more than 100 texts a day and half sent at least fifty text messages a day (Madden, 2013).

Cross-cultural studies have been carried out in Bulgaria, Israel, Korea, France, the Netherlands and the USA and similarities in communication habits related to mobile phone use have been identified. (Baron, 2009; Katz & Aakhus; Scott & Campbell, 2007). Katz and Aakhus (2002) postulated the concept of 'apparatgeist' which is embedded in the context of 'perpetual contact'. Apparatgeist refers to "the spirit'of the machine that influences both the design of the technology as well as the initial and subsequent significance accorded them by the users, non-users and anti-users" (2002, p. 305). Technological and social factors influence user perceptions of the mobile phone. With reference to technological factors, Katz and Aakhus (2002) suggest that technological factors, like ease of use, the handset design and size, influence how people think about and use the technology. These factors, along with social factors, they suggest, make up the ‘spirit’ that creates common perceptions of the phone across cultures. The socio-logic created from ‘perpetual contact’ is based in a human motivation for social connection. As mobile phones afford perpetual contact, it is suggested that users tend to conceptualise the technology in a common way across cultures (Katz & Aakhus, 2002). Whilst Katz and Aakhus (2002) identify cultural differences, the concept of apparatgeist draws on the factors that are common amongst cultures.

Research has shown that although there are many advantages associated with using mobiles, there are also many disadvantages (Baron, 2009). This has led to mobile telephony being described as a Janus-faced technology (Baron, 2010). The features that users like are also the features that have negative qualities. There are many benefits from instant communication the mobile makes possible and immense freedom can be experienced from ‘any time, any place’ contact. The mobile phone offers young people a tool for easy contact with friends through texting, calling, email, social networking, and other social media but on the other hand, young people can feel overwhelmed by being ‘always on’ (Baron, 2008).

Many disadvantages of mobile phone use are identified in the literature review from mild irritation with conversations being interrupted to more serious problems associated with over use. Enthusiastic use of mobiles has led to problems with excessive screen use, sleep, dependence and addiction and issues with multi-tasking. These are considered.

Screen Use, Sleep, Dependence and Addiction

Screen-Use

In the opening ceremony of the Rio Olympics 2016, many individuals, including the athletes, are on their phones, probably either texting, taking photographs or using social media

(Fowler & Noyes, 2016). Regular screen use has become common place throughout the world, and screen use by children has increased. A survey by Childwise (2015) found that children aged seven to 16 years use screens approximately 6.5 hours compared with 3 hours in 1995. ‘Screen time’ refers to time spent playing games consoles, using a mobile, computer, tablet or other hand-held devices and watching TV (Childwise, 2015). Ofcom (2010) found that 16-24 years old young users spent 6 hours 35 minutes on screens. Nearly a third of this time is spent using more than one ‘screen’, so that the total time spent on screens is 9 hours 32 minutes.

The National Institute for Health and Care Excellence (NICE) recommends that children should have TV-free days and limit their screen use to 2 hours in a day (NICE, 2017). In 2013, The USA Department of Health (2013) recommended that children under two years old should not be in front of a screen at all (Jary, 2016). No medical or governmental guidelines have been provided for screen time use in the UK.

Research suggests that too much screen time can affect academic attainment and physical health (Torsheim & Eriksson, 2010). Excessive use has been associated with lower self esteem, higher interpersonal anxiety and depressive symptoms (Ha, Chin, Park, Ryu, & Yu, 2008). Too much internet use has been associated with feelings of sadness and depression and perceived poorer school grades of adolescents (Mythily, Qui & Winslow, 2008). sleep (Mak, Wu, Hui, Lam & Tse, 2014) and emotional development (Napier, 2014). Last year, researchers at Cambridge University kept a record of activities of more than 800 14 years old. GCSE results are then analysed at 16. GCSE results equivalent to two grades are found in those who spent an extra hour a day using a range of screens (Jary, 2016). Problems associated with too much screen time are emphasised in an annual report, ‘Our Children

Deserve Better: Prevention Pays' (Davies, 2012) which looks at the effects on health including Type 2 diabetes, hypertension, obesity and attention deficit hyperactivity disorder (ADHD). There is also a further problem in that many people seem to become addicted to screens. Hines (2005) has written about how hits of dopamine are released when playing games and using social networks, thus creating an addictive element in screen use. Sigman (2014) reports on the rising number of children involved in addictive and problematic use of screens.

There has been much discussion about how much time a child should use technological gadgets with a screen. A recent report from Public Health England (2013) raises concern about the sedentary lifestyle children in the UK. Children are spending a lot of time using screens. Concern is raised about children watching television for long periods of time. There is also concern about the amount of time children spend using computers and playing video games. This is affecting health and well being, resulting in lower self-reported happiness, lower self-worth and lower self-esteem. Higher levels of emotional distress, anxiety and depression have also been found. The effects of digital technology on infant brain development has been studied. It is suggested there are no reason for infants under two to use technology (Steiner-Adair, 2014).

Furthermore, an Australian study recommends a lifestyle that involves physical activity and outdoor time with nature to encourage mental and physical health well being. It was found that those children spending a lot of time on screens had poor health and well-being. (Martin, 2011). The importance of children having time outdoors in a play environment has also been endorsed by the British Association for Community Child Health (Sigman, 2015).

Problems have been identified with young people using their phone before going to bed and also delaying the time they go to bed because of using their phone. In 2011, the National Sleep Foundation found that more than half of teenagers use electronic media on most evenings during the last hours before they go to bed and for more than two thirds of teenagers, the use of electronic media was the last activity of the day at least 3 times per week (Kubiszewski, Fontaine, Rusch, & Hazousard, 2013). Greater use of smartphones by young people has also meant there are more possibilities of use, for example, surfing the internet while lying in bed, watching movies or Youtube videos, or sharing photos with friendship groups. Smartphones are also lighter and handier than tablets or laptops, making it easier to use in bed, before sleep. If phones are left on over-night, there is also the possibility of sleep disturbance during the night. It has also been suggested that mobile phone use during the night might lead to over-excitement and interfere with or shorten sleep time (Cain & Gradisar, 2010; Van den Bulck, 2010).

Many studies have reported on sleep disturbance from mobile phones at night (Salama & Abou El Naga, 2004, Al-Khlaiwi & Meo, 2004). Punamaki, Wallenius, Nygard, Saarni and Rimpela (2007) found that intense mobile phone usage was associated with negative sleep effects and day time fatigue. In 2011, the National Sleep Foundation (National Sleep Foundation, 2011) carried out a survey in America which revealed that 18% of teenagers between 13 and 18 years used electronic gadgets before going to bed. Kubiszewki et al. (2013) found that many teenagers are woken up by text messages in the night. In addition, Munazawa, et al. (2011) found that many users called and/or text when they were in bed. Those that called or text in this way experienced less time sleeping, insomnia, poorer subjective sleep quality, and daytime sleepiness.

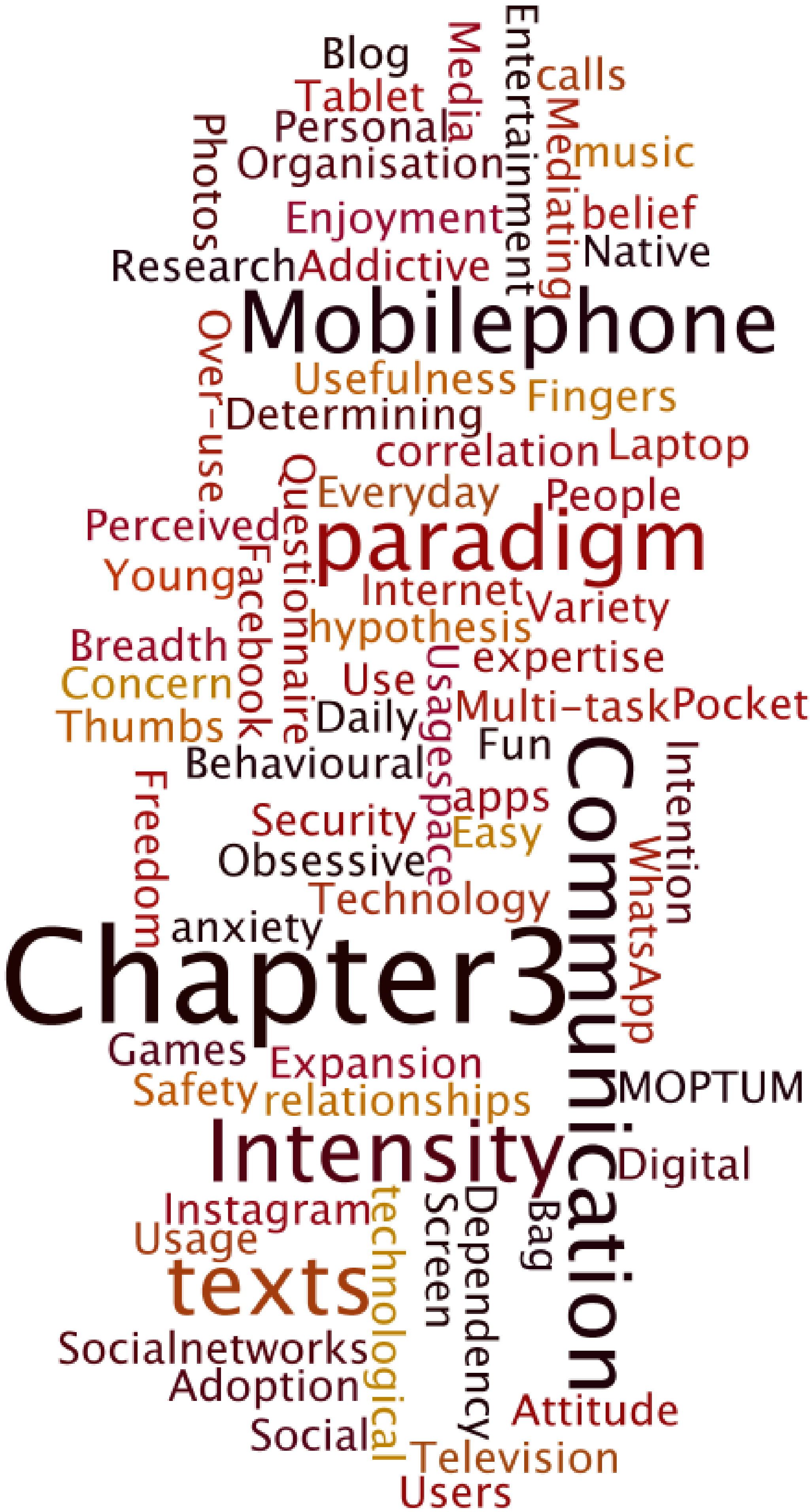
To maintain healthy development, it is important for users to get enough sleep. Sleep related disturbance from mobile phones can result in poor sleep patterns developing. Users can be more likely to develop poor mental health or depression when they are sleep deprived. For example, Short, Gradisar, Lack, Wright, & Dohnt (2013) and Lemola, et al. (2011) found that there are significant correlations between disturbed sleep and symptoms of depression symptoms in teenagers. Goldstein, Bridge and Brent (2008) found significant associations between disturbed sleep and completed suicide in adolescents. Oshima, et al. (2012) suggested an association between mobile phone use after lights out and poor mental health, suicidal feelings and self-injury in both early and late adolescence. Lemola, et al. (2015), found that users who used electronic media before going to sleep experienced less sleep, depressive symptoms and had difficulties related to sleeping. These findings are also similar to earlier findings of Cain and Gradisar (2010). Watching TV or videos, calling or texting or spending time online are related to sleep difficulties; the latter, for example using Facebook or chatrooms, was the most problematic.

Many researchers have reported on ‘addictive’ type behaviours with mobile phone use. Walsh, White, and Young, 2008 report on descriptions of mobile phone use from a study in Australia that revealed symptoms of behavioural addiction. The study suggested that characteristics of mobile phone behaviour were contributing to addictive behaviour rather than a propensity to addictive behaviour *per se*. Dimonte and Richchuito (2006) reported addictive behaviour in an Italian study of 9 to 18 years old users. Halayem, Nouira, Bourgou, Bouden and Othman, (2010) found that over a quarter of participants suffered from excessive mobile phone use. The authors described this behaviour as “addiction”. Lee, Kim, Son, Ahn and Kim (2007) reported that nearly a fifth of middle school students were ‘addicted’ to their phones and suggested that in extreme cases, addiction might be possible. Hanley and Wilhem

(1992) suggest that addiction can be defined as “any activity, substance, object or behaviour that has become the main focus of a person’s life to the exclusion of all other activities or that has begun to harm the individual or others physically, mentally or socially”. Hooper and Zhou (2007) comment on how addictive-type behaviours often stem from low self-esteem and a sense of powerlessness (Maslow, 1943); the behaviour is a way of releasing this (O’Guinn & Faber, 1989). The relationship of the mobile phone to the user reflects a dependency, but Hooper and Zhou suggest that the type of dependent behaviour with a mobile phone is different to ‘commonly described behaviours’ assicated with ‘addiction’. The dependent relationship is motivated by the way in which the attachment to the social norm, in this case communication, is given importance (Becker & Murphy, 1988). Brod (1984) describes the overuse of the mobile phone in this way as a type of technostress.

2.4. Summary of Chapter 2

In this chapter, a literature review is carried out. Models of technology diffusion, domestication, appropriation and adoption are discussed and then the Technology Acceptance Model. This, and other concepts led to the development of the Mobile Technology Usage Model (MOPTUM) which this thesis uses to ask questions about mobile phone usage patterns. Physical, cognitive, and social concerns are identified from the literature review. Physical concerns are headaches, hearing, vision, musculoskeletal and fertility issues. Cognitive concerns are to do with attention and multi-tasking. Social concerns are to do with communication and the effects of ‘always on’ behaviour with reference to lengthy screen use, disruptive sleep, dependence, and possible addiction.


Blog
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Fingers
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Everyday
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Multi-task
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Chapter3
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MOPTUM
Safety
relationships
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Attitude
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Television
Users

Chapter 3. Mobile Phone Attitudes to Use

3.1. Introduction

Following the literature survey on everyday concerns regarding the use of mobile phones and a consideration of technology adoption and use, three questionnaires were designed to find out about the user behaviour of young people with mobile phones. Two time periods were selected in 2013 and 2015, so that a longitudinal study could be executed. The reason for looking at use in young people was because young people are the individuals who have been the most prolific users of mobile phones. They are ‘digital natives’ (for clarification of this term, see Chapter 1, p. 3) and are users who have been diverse innovators in how they use the mobile.

3.2 Design

A mixed method research design approach was used so that different methods of qualitative and quantitative methods of enquiry could be conducted. Many previous studies have carried out either quantitative or qualitative research studies, but a mixed methods approach allows for scope and depth in a study.

The motivation for the questionnaires came about to gather data from a large sample of participants and to evaluate how the mobile phone impacts on behaviour in the everyday life of young people. The questionnaires were created from concerns to do with mobile phone use and the constructs of the Mobile Phone Technology Usage Model (MOPTUM), put forward by Van Bijon (2006). Questions also asked about levels of technology advancement based on Roger’s diffusion model, as described in Chapter 2. Questions vary in how they were structured and range from open ended, closed, and multiple-choice questions depending on the sort of response that is required. Some questions required a direct response whereas other questions offered a choice of response. A wide range of ages of young people were involved, so questions were designed to accommodate users from age 8-25. The categories were based on age. These are 8-11, 11-14, 14-18 and 18-25. The questionnaire design was age appropriate. A five-point likert choice was offered to 11-25 years old users in the ‘scalar’ questions whereas a three-point likert scale was offered to 8-11 years old users. A small choice was thought to be appropriate for 8-11 years old participants, so decisions could be made in a simple and straightforward way. It was decided that a more limited choice would be easier for them to manage. The questionnaires for 8-11 years old users have only minor (but essential) differences from those designed for the 11-14 years old children. For example, when asked what they used their mobile phone for, the 8-11 version made no reference to social networking sites, like Facebook (because of the consent age for using Facebook) but these are mentioned in the questionnaires designed for 11-14 years old children and older users. Likewise, there are small but necessary differences in the questionnaires for the older users.

Mediating factors

Questions in the questionnaire, as discussed in Chapter 2, are based on MOPTUM and describe the mediating and determining factors. Mediating factors refer to the demographics, personal and socio-economic status of users and are thought to be important in influencing determining factors. In this thesis, demographic factors ask about gender and age of the users (Questions 14 and 15 in Questionnaire Booklet 1). Personal factors ask users about the level of expertise at using technology, mobile phones, laptops, the internet and tablets (Questionnaire Booklet 1, questions 1b1, 2 and 3 and Questionnaire Booklet 3). These are discussed at the beginning of the results section in Section 3.5.1.1. Socio-economic factors are not explored due to the age of some of the younger users and ethical considerations.

Personal Factors

To create a personal technological profile of participants, relationships between expertise and attitudes to technology are investigated. Previous research has shown a relationship between perceived attitudes of technology expertise and anxiety. For example, an association was found for low computer experience, negative computer attitude and high computer anxiety (Morahan-Martin & Schumacher, 1997). In turn, research has found that those experiencing high computer confidence and low computer anxiety also showed an association betweent high internet use and positive internet attitude (Durndell & Haag, 2002). Rees and Noyes (2007) found significant relationships between computer and internet measures (computer use, computer anxiety, internet use and internet attitude). Expertise with a mobile phone is assessed through questions adapted from a self-rated expertise survey, created by North and Noyes (2001), and has also been used by Rees and Noyes (2007). Participants gave one answer from choices in a five-point Likert type scale. Answers are either strongly agree, agree, neither agree nor disagree, disagree to strongly disagree. (The questions are Question 3a to 3g in Booklet 1, Part B and can be viewed in Appendix A) A further way of assessing expertise wats through two questions, created from the categories suggested by Roger's innovation diffusion model (1997)**,** whereby a range of users are identified on a five-point Likert type scale ranging from highly advanced users, 'techies' to less advanced users, 'laggards'. This has been previously outlined in Chapter 2. The questions are described as questions related to technological advancement and technological orientation. A five-point Likert type scale is used, and users are asked to identify which statement matches the type of user they believe they are. As with the other questions, a three-point lickert scale was offered to 8-11 years old users. Following this, the level of anxiety experienced by participants was investigated. Questions in Booklet 3, 3h to 3s are adapted from the Computer Anxiety Rating Scale (CARS) used by Heinssen, Glass and Knight (1987) and are adapted for mobile phone use, creating a Mobile Phone Anxiety Rating Scale (MARS). Adapted versions of (CARS) have also been used by North and Noyes (2001) for assessing technological anxiety with computers, and Rees and Noyes (2006) for assessing mobile phone anxiety. Relationships are investigated with laptops, the internet, and tablets. Participants rated their expertise for technology, laptops, the internet, and tablets along with questions related to anxiety with reference to laptops (LARS), the internet (IARS) and tablets (TARS). These can be viewed in Appendix A (Questionnaire 1b1 and 1b2).

MOPTUM Constructs

Table 3.1 shows where questions that are based from the constructs in MOPTUM can be found in Booklets 1, 2 and 3.

Determining factors

Three questions or more for each construct of use are asked. These include Perceived Ease of Use, Attitude, Perceived Usefulness and Behavioural Intention. The questions use a similar format to van Bijon's study but as mentioned earlier, due to the age of the participants (8-11) the content of the questions is adjusted to be age appropriate for the younger users. Additional questions are created to represent other constructs, for example, Perceived Enjoyment (attitudes to usage behaviour) as this had been identified as being important in the literature review. The positioning of the questions in the booklets are outlined in Table 3.1.

Table 3.1
Questions related to the Constructs of MOPTUM

Dimension	Question
Mediating factors	
Demographic factors (DF)	Booklet 1a 14. Age by Year group 15. Gender Booklet 1b 1. Mobile advancement 2. Mobile technological orientation 3a-g. Mobile self-rated expertise 3h-3s. Mobile self-rated anxiety 3B2a-g. Laptop self-rated expertise 3B2h-o. Laptop self-rated anxiety 3C2a-g. Internet self-rated expertise 3C2h-o. Internet self-rated anxiety 3D2a-g. Tablet self-rated expertise 3D2h-o. Tablet self-rated anxiety
Personal factors (PF)	Booklet 3b1. Technology advancement levels
Determining factors	
Perceived ease of use (PEU)	Booklet 2b 1. I find mobile phones easy to use. 7. I find it easy to get a mobile phone to do what I want. 13. A mobile phone helps me get things done quickly. 26. Learning to operate a mobile was easy for me.
Perceived usefulness (PU)	Booklet 2b 10. Using a mobile phone helps me learn well. 13. A mobile phone helps me get things done quickly. 15. I use my mobile phone to manage my school work. 16. I use my mobile to find out information. 28. I use my mobile phone to help me with my homework.
Social influence (SI)	Booklet 2b 1-32.
Behavioural intention (BI)	Booklet 2a 13. The importance of each usage space.
Attitude (A)	Booklet 2b 2. I think using a mobile phone is a bad idea 8. I think using a mobile phone is a good idea.
Facilitating conditions (FC) (Infrastructure)	Educational establishment either school, college or university (not explored)

Actual Usage	
Usage intensity (UI)	Booklet 2a. 7. How many calls do you make on a mobile in a day? 9. How many texts do you make on a mobile in a day? 11. Do you use applications on a mobile? 12. If yes, what apps do you download?
Usage breadth (UB)	Booklet 2a 3. How many phone numbers do you have saved on your mobile?
Usage variety (UV)	Booklet 2a 6. What do you use a mobile for? Booklet 2b 13. Usage Space questions.
Usage Space Order (USO)	Booklet 2a. 14. Ordering usage spaces.
Additional Constructs or Questions	
Buying importance	Booklet 2a How important do you think these things are if you buy a mobile phone? Brand, Model, ‘Look and feel’, Easy to use. Cost, Network Coverage, Accessories, Quality.
Perceived enjoyment (PEnj)	Booklet 2b 3. I feel happy when I get a text. 5. I feel bad when no-one rings me. 11. I feel happy when my mobile rings. 14. I feel bad when no-one texts me.
Self Image	Booklet 2b 4. The mobile I use and the way I use it is a Way of showing who I am. 22. I choose a particular mobile to be cool. 24. My mobile is useful in improving my self-image 27. My mobile says something about my image. 29. Having a funky or cool phone makes me feel good

Table 3:2

Questions representing Usage Spaces and Motivational Needs

Usage Space	Motivational Needs	Questions
Safety and security	Safety and Security	2b6. I like to have my phone with me in case of emergency. 2b12. Having my mobile phone with me makes me feel safe. 2b21. I use a mobile when I go shopping with a friend. 2a13i. I feel safe because of being able to use the mobile phone in an emergency.
Relationships	Sense of belonging, Community, Acceptance	2b18. I use my mobile phone to arrange when and where to meet my friends. 2b20. I sometimes call friends to change the time I am meeting them. 2a13a I talk or text with friends and family.
Organisation	Cognitive, Expansion	2b17. I like to be able to use my mobile to change plans quickly. 2b18. I use my phone to arrange when and where I am going to meet my friends. 2b20. I sometimes call friends to change the time I am meeting them. 2b21. I use a mobile when I go shopping with a friend. 2a13b. I organise and arrange meetings with friends and family.
Personal information	Security, Cognitive, Expression.	2b16. I use my mobile to find out information. 2b19. I use a mobile to sore phone to store phone numbers and birthdays. 2b30. I collect photos, letters, notes on my mobile. 2a13j. I save personal messages and photos on my phone.
Non-personal information	Cognitive, Expression	2b10. Using a mobile phone helps me learn well. 2b15. I use my mobile phone to manage my school/college work. 2b16. I use a mobile to find out information. 2b32. I use a mobile to find out things. 2a13. I find out non-personal information on my phone.
Self-image	Self-esteem, Expression, Acceptance	2b4. The mobile phone I choose and the way I use it is a way of showing who I am. 2b22. I choose a particular mobile to be cool. 2b14. My mobile phone is useful in improving my self-image. 2b27. My mobile says something about my image.

		2b29. Having a funky or cool phone helps me feel good. 2a13. Having a cool phone makes me look good.
Entertainment	Cognitive	2b23. I use a mobile phone to listen to music or play games. 2a13h. I use my phone for entertainment, for example, listening to music or playing games.
Personal History	Expression, self-esteem.	2b19. I use a mobile phone to store phone numbers and birthdays. 2b25. I collect photos, letters, notes on my mobile. 2b30. I use my mobile to save messages and photos. 2b31. I find the call log on my mobile to see who has called me. 2A13d. I save personal messages and photos.
Expansion	Expansion, Adventure	2b16 I use my mobile to find out information 2b32. I use a mobile to find out things. 2a13c. I find out travel directions on my phone.

Actual system use refers to usage breadth, usage intensity and usage variety, as previously discussed in Chapter 2, which are in turn, based on usage spaces. Usage spaces are relationships, safety and security, image, expansion, entertainment, organisation, personal history, personal and non-personal information. The usage space of e-commerce is not considered because of the age of the younger participants. Table 3.2 shows questions from the booklets that represent usage spaces.

The study was longitudinal, and questionnaires were carried out in 2013 and then two years later in 2015. Seven primary schools were involved in completing the questionnaires in 2013. Two of these schools did not want to participate in the second stage of the questionnaires in 2015. This was because the schools did not want their pupils missing school curriculum time. Five schools were happy to participate in the second stage. Therefore, two other schools were invited to participate, so the same number of schools could be involved in both years. The response rate varied amongst schools. The lowest response rate was 15% in School B and the highest response rate was 95% in School F. In cases where the same school was involved in both years, different pupils completed the questionnaires in 2013 and 2015. This was because the same class teacher and year group were involved, so the children involved in 2013 would be in a higher year group in 2015. The same schools and colleges were involved in the completion of questionnaires by 11-14s and 14-18s. The lowest response rate was 22% and the highest response rate was 68% for the 11-14s. For the 14-18s, the lowest response rate was 26% and the highest response rate was 57%. The university students completed the online surveys as part of the Experimental Hours Scheme. Students have a mandatory commitment to taking part in the Experimental Hours Scheme, but they can choose which studies they participate in.

It is noted that the different methods of data collection were not ideal, with the younger users completing paper questionnaires and the older users completing online surveys. The implications of this is that it could affect the ecological validity of the data collection but working with participants in schools, colleges and university educational establishments, it is appropriate for the researcher to respond to the requirements of different educational establishments.

3.2.1 Questionnaires in 2013

The questionnaires covered a wide range of ages, so questions were designed to accommodate all users from age 8-25. Three questionnaire booklets were created. The first questionnaire had questions about how participants use mobile phones and their attitudes towards use. The second questionnaire asked about mobile phone usage with reference to voice and text questions are designed to find out reasons for contact and preferences for talking or texting. The third questionnaire gathered data on the level of technological competence in different mobile technology. The complete questionnaires can be viewed in Appendix A.

3.2.2 Questionnaires in 2015

The same questionnaire booklets were used in 2015.

3.2.3 The Interviews

The aim of the face to face semi-structured interviews is to gather personal opinions from participants and elicit rich, in depth information. The first question is open ended, inviting participants to tell the interviewer what they think about mobile phones. This is followed by a question "Why do you think the mobile phone has become such an important part of everyday life?" This question is adapted from Madell and Muncer's study (2007) where a focus group of seven teenagers are asked, "Why do you use different communication media, such as the internet and mobiles phones in your social lives?" It is important to gain a broad view of how users perceive mobile phones in their everyday lives rather than just their social lives. Asking users about their everyday lives would include their social life but not restrict their consideration of the use of their mobile phone only to their social lives. Interactions with their family could also be considered. Further questions asked in the interviews can be viewed in Appendix G.

The interviews were carried out in an informal setting in a small study room or space in the school, college or university. The interviews were audi-recorded and transcribed verbatim and can be seen in Appendix G. Interpretative Phenomenological Analysis (Smith & Osborn, 2003) was then used to analyse the data.

3.3 Participants

Male and female young users participated in the interviews. Participants were recruited from participants who had completed the first stage of the questionaires in 2013. The interviews were made up of groups of three participants, to create a sense of safety. This group size was also large enough to facilitate dynamic interaction between the participants but small enough for each individual's voice to be heard. The groups were facilitated by the researcher to ensure each child participated in the interviews. Interviewing children in groups of three was a group size endorsed by Foolproof (User Centred Designe conference, November 2012) who regularly worked with children for assessing user centred design products. Five groups of interviews were carried out for each age category. Table 3:3 shows the number of participants in each age category, the distribution of gender and the number of educational establishments involved.

Table 3:3
Participant Groups and Educational Establishments

	2013			2015		
	N	Gender	Location	N	Gender	Location
8-11	136	64F 72M	7 primary schools	177	50F 86M	7 primary schools*
11-14	168	95F 73M	4 secondary schools	208	105F 103M	4 secondary schools
14-18	165	127F 38M	1 secondary school and 1 College	168	134 F 34M	1 secondary school and 1 College
18-25	223	166F 57M	University	223	177F 46M	University

* Some of the schools in 2013 were different to those in 2015.

3.4 Materials

Questionnaire booklets about mobile phones were presented to young users. These can be seen in Appendix A.

3.5 Procedure

3.5.1 The Questionnaires

A pilot study was carried out with ten primary school pupils. Children in each year group were asked whether they thought any of the questions or the language in the questions should be changed. As a result, some changes were made. For example, the question, “What technological devices do you own?” was changed to “What electronic gadgets do you own?” The Year 4 children said they found this easier to understand. It was important to make sure the questionnaires were suitable for the ages of children and university students. Discussion was carried out with pupils. The Year 6 pupils (age 10/11) thought that the questionnaires were suitable for the 8-11 age group. The Year 6 pupils also suggested that it would be easier if the questionnaires had ‘boxes’ for children to put their answer in, so they knew where to put their responses. The questionnaires were originally on A4 paper. Year 4 pupils suggested that the questionnaires would be easier to fill in if they were in the form of a booklet.

3.5.2 Ethical Considerations

Ethical procedures were followed; approval was given by the University of Bristol Ethics Committee. Schools were contacted by email or telephone and invited to participate in the study. Many schools were known to the researcher because of previous teaching in the school. A member of staff in the school, either the Headteacher or Deputy Head gave approval for the study and asked the class teacher if they would like their class to participate. The class teacher then introduced the study to pupils and gave the pupils a letter to take home to parents. The letter gave a summary of the study and asked for parental consent for their child to take part. The letter was written by the researcher. Letters of Consent were returned to the class teacher and then given to the researcher. All pupils who consented took part.

Respondents had the opportunity to ask questions and could decide to leave the study at any point if they did not wish to continue. Parents also had the opportunity to ask the researcher any questions. Participants completed the questionnaires in small groups in their year groups with the researcher or the class teacher. It took around 20 minutes to complete each questionnaire and as the researcher or class teacher were working with the pupils, the pupils were encouraged to complete all questions. Participants also had the chance to ask questions. The questionnaires with university students were completed online using the Bristol Online Survey; participants could not go onto the next question unless they had completed the previous question.

3.6 Data Analysis

3.6.1 Perceived Ease of Use and Perceived Usefulness

A reliability analysis was carried out to verify the structure of the constructs in the MOPTUM model (2006) for the four age groups. The results of this are shown in Table 3.4. Following this, correlations between the questions representing the constructs were calculated.

Table 3.4
Reliability Analysis for Perceived Ease of Use and Perceived Usefulness with Cronbach's Alpha

	8-11		11-14		14-18		18-25	
	2013	2015	2013	2015	2013	2015	2013	2015
Perceived ease of use	0.38	0.73	0.82	0.69	0.58	0.79	0.54	0.48
Perceived Usefulness	0.58	0.76	0.76	0.66	0.76	0.70	0.47	0.53

3.6.2 Perceived Ease of Use (PEU)

The results of the reliability analysis show that the constructs for Perceived Ease of Use have high reliability for 11-14s and good reliability for 14-18s in all years except 2013. Reliability for 8-11s in both 2013 and 2015 and for 18-25s in 2013 and 2015 was low. For 8-11s, for example, this was lower in 2013, with a Cronbach's alpha of 0.38. Deleting a question does not increase the reliability to the accepted level to the accepted threshold of 0.7. The highest level this improved to was 5.5, and the lowest value was 4.3. All questions representing PEU correlate with other questions and were significant at $p<0.01$ level (2 tailed). For example, the effect size for 11-14s range from a large effect of 0.71 to a medium effect of 0.42 in 2013 and a large effect of 0.60 to a small effect of 0.12 in 2015. For the 14-18s, the construct of Perceived Ease of Use was reliable in 2015, but not in 2013 where a Cronbach's alpha of 0.58 was calculated. Deleting an item, improved the reliability to 0.61. All questions correlated with other questions representing PEU and were significant at $p<0.01$ level (2 tailed). The results of the Pearsons Product Moment Correlations are shown in Appendix B.

3.6.3 Perceived Usefulness (PU)

The reliability analysis was better for Perceived Usefulness overall than Perceived Ease of Use. This means the questions for PU represents the construct of PU more effectively than PEU. Table 3.4. shows that the reliability for Perceived Usefulness was good for 11-14s and 14-18s in 2013 and 2015. For example, the Cronbach' s alpha for 11-14s is 0.76 in 2013 and 0.66 in 2015. If question 10 is deleted, the Cronbach's alpha becomes 0.82. Perceived usefulness can be accepted as a reliable measure for 11-14s and 14-18s. It was poor for 8-11s and 18-25s. Pearsons Product moment correlations were carried out for all relationships. It was found that all questions correlate with other questions representing Perceived Usefulness. They were significant at $p<0.01$ level (2 tailed) and can be seen in Tables 1-8 in Appendix C.

For example, the effect sizes range from a large effect of 0.71 to a medium effect of 0.42 in 2013 and a large effect of 0.6 to a small effect of 0.12 in 2015 for 11-14s. The reliability for Perceived Usefulness was also good for 14-18 years old participants but not for 18-25s.

3.6.4 Attitude and Perceived Enjoyment

A reliability analysis was carried out for the questions representing the constructs of Attitude and Perceived enjoyment. Both were found to be unreliable. Van Bijon (2006) also found that questions related to Attitude in MOPTUM were not reliable. This is supported the decision by Venkatesh not to include attitude in the TAM model and thus UTAUT was suggested as a preferable model to understand technology adoption and usage. As mentioned earlier, MOPTUM uses aspects of UTAUT to create the MOPTUM model and attitude is included in the MOPTUM model.

3.6.5 Self Image

A reliability analysis was carried out for the questions representing Self Image. The 14-18s were selected as a representative sample for this. There was high reliability for these questions with a Cronbach's Alpha of 0.82 in 2013 and 0.83 in 2015.

3.6.6 Usage Spaces

A reliability analysis was carried out to find out the level of Cronbach's alpha among the questions for each usage space. For this, the 11-14 age group was used as a representative sample. Most questions reported a Cronbach value of over 0.7, the level required to ensure reliability. Table 3.5 shows that the Cronbach value for Self Image for Usage Spaces was 0.81 in 2013 and 0.82 in 2015 for 11-14s.

Table 3.5.
Reliability Analysis for Questions representing Usage Spaces with Cronbach Alpha

Usage Space	2013	2015
Safety and Security	0.56	0.67
Relationships	0.75	0.78
Organisation	0.80	0.80
Personal information	0.83	0.76
Non-personal information	0.81	0.70
Self-image	0.82	0.83
Entertainment	-	0.67
Personal History	0.67	0.76
Expansion	-	0.70

Correlation analysis was carried out for all questions representing usage spaces. All questions showed a weak, medium or large correlation with other questions representing the construct. This ranged from a small strength of r = 0.2 to a large strength of r = 0.6.

3.7 Results

3.7.1 Questionnaires

The results from the questionnaires are reported. These include demographic data and results based on the constructs of MOPTUM.

3.7.1.1 Demographics: Ownership, Gender and Technology Ownership

8-11s

Demographic results show that 53% of respondents were girls and 47% were boys in 2013 and in 2015, 63% of respondents were girls and 38% were boys. Findings show that 66% reported owning a mobile phone in 2013 with 95% of 8-11s reporting they had access to using one. In 2015, 62% reported owning a mobile with 88% reporting they had access to using a phone. Laptop ownership is similar in 2013 (61%) and 2015 (67%), but tablet ownership increases considerably between 2013 (38%) and 2015 (67%).

11-14s

Nearly all participants reported owning a mobile, both in 2013 and in 2015. Demographic results show that 56% of the respondents were girls and 44% were boys in 2013. In 2015, 51% of respondents were girls and 49% were boys. In 2013, 98% of participants reported owning a mobile phone and in 2015, 94% did. Laptop ownership was very similar in 2013 and 2015, but tablet ownership increased considerably between 2013 and 2015. By 2015, over two thirds of users had access to using a tablet.

14-18s

Demographic results show that 44% of respondents were girls and 56% were boys in 2013. In 2015, 55% of respondents were girls and 45% were boys. Findings show that 96% reported owning a mobile phone in 2013. In 2015, 97% reported owning a mobile. Laptop ownership was similar in 2013 (85%) and 2015 (90%), but tablet ownership increased considerably between 2013 (26%) and 2015 (81%).

18-25s

Demographic results show that 21% of respondents were females and 79% were males in 2013. In 2015, 78% were females and 22% were males (79%) did. It was found that 100% reported owning a mobile phone in 2013 and 99.7% in 2015. Reported laptop ownership was a 100% in 2013 and 99.7% in 2015. Tablet ownership was more in 2013 (41%) than 2015 (49%).

Personal factors: Perceived Technological Expertise

Personal factors provide a technological profile of participants related to self-rated competence of the mobile phone, the laptop, the internet and the tablet. The first technological profile assessed the level of technological advancement based on Roger's innovation diffusion categories. Rogers' innovation diffusion categories are shown in Figure 2.2 on Page13. This is referred to as 'technological advancement' and relates to perceived mobile, laptop, internet and tablet technological advancement level. For perceived 'mobile advancement level, a further category was created. This is referred to as perceived 'mobile orientation' and is only applied to mobile phones. Perceieved 'mobile orientation' was based on Roger's innovation levels but the questions were asked in a slightly different way to the questions for perceived 'mobile advancement' levels. The results for the perceived variability between the different technologies is also reported to find out which device users showed greater perceived competence with.

8-11s

Figure 3.1. shows the levels of perceived technological advancement in 8-11s (based on Roger's Innovation Diffusion Theory, 1995). More users identified themselves as 'techies', comfortable with exploring and using technology in 2015 (37%) than in 2013 (25%). In the second category, many more users identified as 'liking to find out about new developments in technology although they did not consider themselves technologists' in 2013 (34%) than in 2015 (21%). The same number of users identified themselves as 'fairly comfortable with technology' in 2013 (31%) and 2015 (31%). Those not comfortable or not interested in technology were very few and there was a very similar number of participants in 2013 (7.5, 3.7%) and 2015 (6.2, 3.9%) respectively.

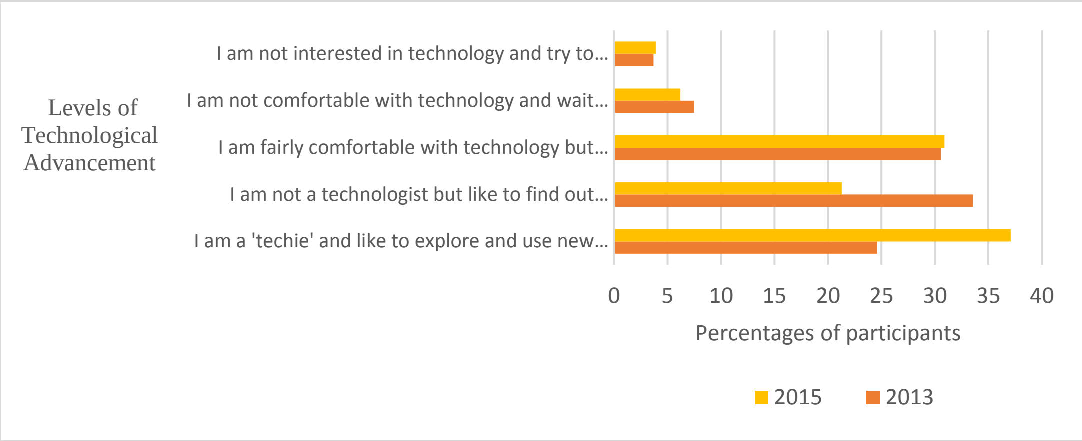


Figure 3.1
Levels of Technological Advancement in 8-11s (based on Roger's Innovation Diffusion Theory, 1995)

11-14s

Figure 3.2 shows the levels of perceived technological advancement in 11-14s. More users identified themselves as 'techies', comfortable with exploring and using technology in 2013 (34%) than in 2015 (39%).

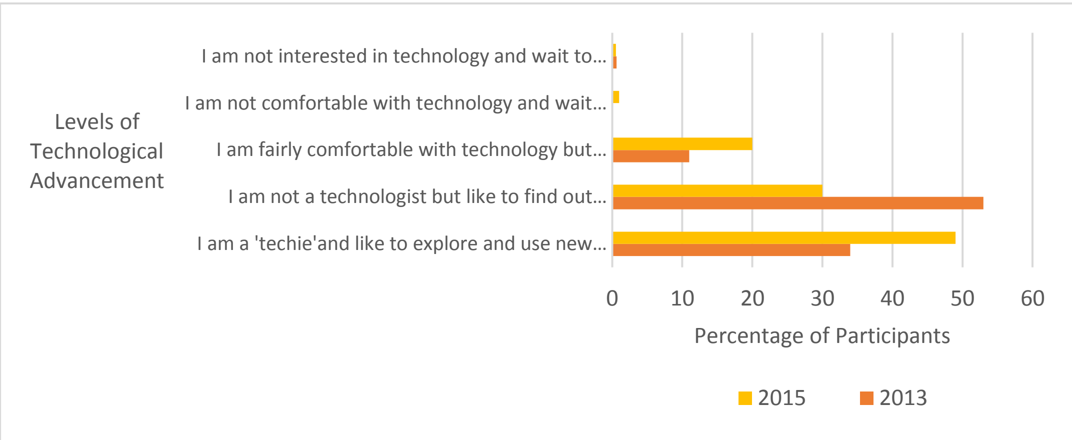


Figure 3.2
Level of Technological Advancement in 11-14s (based on Roger's Innovation Diffusion Theory, 1995)

In the second category, many more users identified themselves as ‘liking to find out about new developments in technology although they did not perceive themselves as technologists’ in 2013 (53%) than in 2015 (30%). Many users identified themselves as ‘fairly comfortable with technology’, the middle category, more in 2015 than 2013. This would suggest less perceived competency in 2015 than 2013. Those not interested in technology were very similar in 2013 and 2015.

14-18s

Table 3.3 shows the levels of perceived technological advancement in 14-18s. Very slightly more users identified themselves as ‘techies’, comfortable with exploring and using technology in 2013 (15%) than in 2015 (14%). In the second category, there were many more

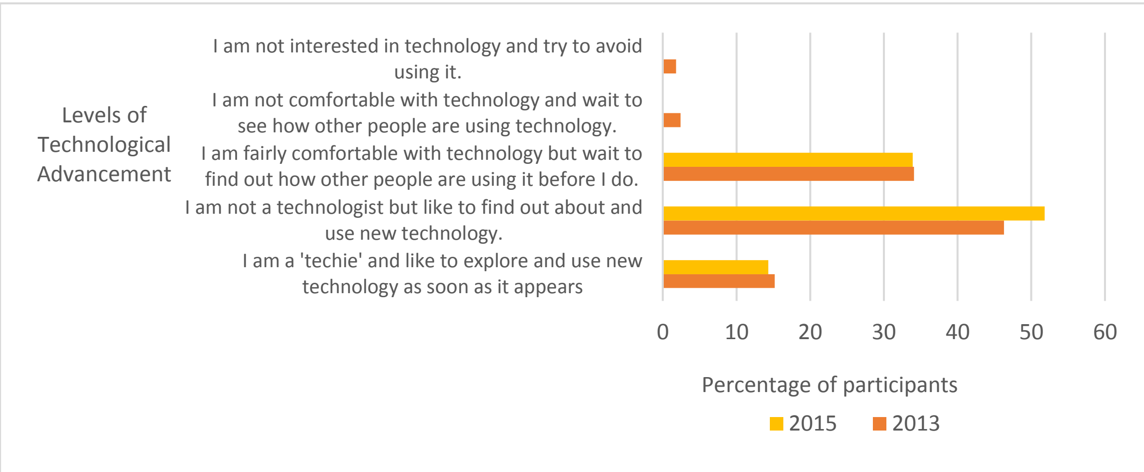


Figure 3.3
Level of Technological Advancement in 14-18s (based on Roger’s Innovation Diffusion Theory, 1995

users that identified themselves as ‘liking to find out about new developments in technology although they do not consider themselves technologists’ in 2015 (52%) than in 2013 (46%). The same number of users identified as ‘fairly comfortable with technology’ in 2013 (34%)

and 2015 (34%). Few participants report themselves as not being comfortable or not interested in technology in 2015 and only a few in in 2013 (2.4, 1.8%) respectively.

18-25s

Figure 3.4. shows that more users identified themselves as ‘techies’, comfortable with exploring and using technology in 2015 (16%) than in 2013 (11%).

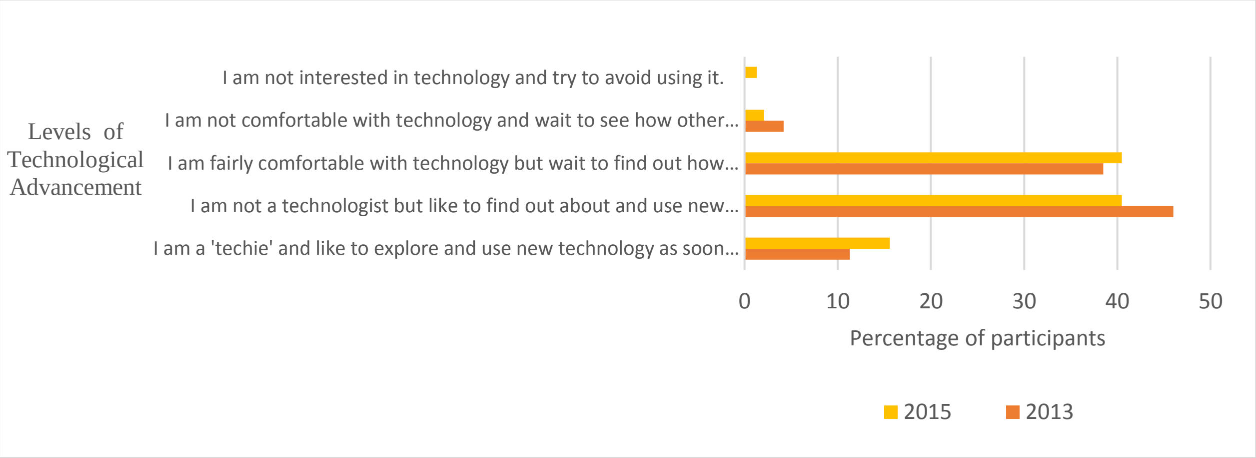


Figure 3.4.
Level of Technological Advancement in 18-25s (based on Roger’s Innovation Diffusion Theory, 1995)

In the second category, there were more users that identified as ‘liking to find out about new developments in technology although they do not consider themselves technologists’ in 2013 (46%) than in 2015 (41%). A similar number of users identified themselves as being ‘fairly comfortable with technology’ in 2013 (39%) and 2015 (41%). Those not comfortable or not interested in technology were very few. There was a very similar number of participants in 2013 (4, 0%) and 2015 (2, 1%) respectively. To get an overall picture of the pattern of technological advancement levels, the percentages are summarised in Table 3.6 2013 (4, 0%) and 2015 (2, 1%) respectively.

Table 3.6
Comparison of the Percentages of Participants showing Perceived Technological Advancement Levels of all Ages

	8-11		11-14		14-18		18-25	
Level	2013	2015	2013	2015	2013	2015	2013	2015
1	25	37	34	49	15	14	11	16
2	34	21	53	30	46	52	46	41
3	31	31	11	20	34	34	39	41
4	8	6	0	1	2	0	4	2
5	4	4	0.6	0.5	2	0	0	1

To gain a more detailed demographic picture of participants, information was also collected about participants' perceived skills. perceived expertise and perceived anxiety of use with different technology (Questions in Booklet 1a1 and Booklet 3). Questions referred to mobile phone, internet, laptop, and tablet expertise and anxiety. Independent 't' tests were carried out to explore the differences between the variables. Pearson's product moment correlations were then carried out between each of the dependent variables for 2013 and 2015. Only significant relationships were reported in Appendix D for 2013, 2015 and then for 2013 and 2015. The hypotheses tested were that:

1.There will be a significant increase between perceived levels of technological skill for technology, the mobile phone, the laptop, the internet and the tablet between 2013 and 2015 due to increased ownerships and use of technology in this period of time. More extensive use has led to participants perceiving themselves as more skilled with technology.

2.There will be a significant increase between perceived expertise in these technologies in 2013 and 2015, due to increased ownerships and use of technology. More extensive use has led to participants perceiving greater expertise.

3.There will be a significant decrease between perceived anxiety between these technologies in 2013 and 2015, due to increased ownership and use of technology. This has led to participants perceiving less anxiety when they use technology.

4.There will be a significant relationship between all variables of perceived levels of technological skill for technology, the mobile phone, the laptop, the internet and the tablet in 2013 and 2015, due to more extensive use of these technologies. This has led to participants perceiving themselves as more technologically skilled in all areas of technology

5.There will be a significant relationship between all variables of perceived expertise for these technologies in 2015 than in 2013, due to more extensive use. This has led to greater perceptions of technological expertise.

6.There will be a significant relationship between all variables of perceived anxiety for these technologies in 2013 and 2015, due to more extensive use. This because has led to participants perceiving less anxiety when use all technology.

8-11s

Comparison of Perceived Technological Skill Level between 2013 and 2015

As a test for the hypotheses that there will be an increase in perceived technology advancement, perceived mobile advancement, perceived mobile orientation, perceived laptop advancement, perceived internet advancement and perceived tablet advancement from 2013 to 2015, independent 't' tests were conducted for each variable for 8-11s. Results that were significant did not support the hypothesis. Results showed that there was a significant decrease for perceived mobile advancement between 2013 (M = 3.21, SD = 0.09), and 2015 (M = 2.73, SD = 0.09; $t(313) = -3.66, p<.01$, d = 5.33. The magnitude of the difference in the means was large (Cohen's d = 5.33). For perceived mobile orientation, there was a significant decrease between 2013 (M = 3.21, SD = 1.10), and 2015 (M = 2.72, SD=1.18); $t(313) = -3.37, p.<0.01$, d = 0.41. The magnitude of the difference in the means was medium (Cohen's d = 0.41). There was also a significant decrease for perceived internet advancement between

2013 (M = 3.13, SD = 1.1), and 2015 (M = 3.54, SD = 0.89; $t(313) = 3.71$, $p<.01$, d = 0.42. The magnitude of the difference in the means was medium (Cohen's d = 0.42). The difference between the measures were compared between 2013 and 2015. There was no significant difference between 2013 and 2015 for perceived technology advancement (overall perceived technology competence based on Roger's innovation diffusion categories), laptop or tablet measures.

Comparison of Perceived Expertise Levels between Technologies

As a test for the hypotheses that there will be an increase between all expertise levels for the mobile, laptop, internet and tablet between 2013 and 2015, independent 't' tests were conducted for each variable for 8-11s. Significant differences were found for the two-year period for perceived expertise for the internet and the tablet but not for the mobile phone or the laptop. Perceived internet expertise increased from 2013 to 2015, supporting the hypothesis. The difference for perceived internet expertise between 2013 (M = 2.98, SD = 0.95), and 2015 was (M = 3.42, SD = 0.82); $t(312) = 0.45$,$p<.01$, d = 0.35. The magnitude of the difference in the means was medium (Cohen's d=0.35). Perceived tablet expertise was higher in 2013 than 2015. The hypothesis was not supported. There was a difference for perceived tablet expertise between 2013 (M = 3.26, SD = 0.27), and 2015 (M = 3.15, SD = 0.53; $t(312) = 2.39$, $p<0.03$, d=0.71. The magnitude of the difference in the means was large (Cohen's d=0.71).

Comparison of Perceived Anxiety levels between Technologies

As a test for the hypotheses that there will be a difference between all perceived anxiety levels for the mobile, laptop, internet and tablet in 2013 and 2015, independent 't' tests were conducted for each variable for 8-11s. Significant differences were found for the two-year period for perceived internet anxiety but not for the mobile, the laptop or the tablet. For the internet, there was a significant increase between 2013 (M = 2.07, SD = 0.42), and 2015 (M = 3.04, SD = 0.52); $t(312) = 2.86, p<.01$, d = 0.06. The magnitude of the difference in the means was small (Cohen's d=.06).

Examination of the Relationships between Technologies

Significant relationships for the interactions between perceived skills were conducted separately for 2013, 2015 and both 2013 and 2015. These are reported in Appendix C. There were many significant correlations.

Examination of the relationships between Perceived Advancement, Perceived Expertise and Perceived Anxiety

The hypothesis tested was that there was a relationship between perceived advancement. perceived expertise, perceived anxiety and all variables. Perceived mobile expertise was found to positively correlate with perceived mobile advancement and perceived laptop expertise in 2013, 2015 and both 2013 and 2015 at $p<0.01$ (2 tailed). Perceived laptop expertise and perceived tablet expertise were highly correlated at $p<0.01$ (2 tailed) as were perceived internet and perceived tablet expertise and perceived internet expertise and perceived internet anxiety. Significant correlations for perceived anxiety were seen for perceived internet anxiety and perceived tablet advancement, and perceived internet anxiety with perceived tablet anxiety at $p<0.01$ (2 tailed). For perceived tablet expertise, there were three significant correlations at $p<0.01$. These were found for perceived tablet anxiety, perceived internet anxiety and perceived laptop advancement.

11-14s

Comparison of Perceived Technological Skill Level between 2013 and 2015

As a test for the hypotheses that there will be an increase in perceived technology advancement, mobile advancement, mobile orientation, laptop advancement, internet advancement and tablet advancement from 2013 to 2015 for 11-14s, independent 't' tests were conducted for each variable. The hypothesis was not supported as there was a significant decrease for perceived mobile advancement in 2013 (M = 3.18, SD = 0.94) and 2015 (M = 2.72, SD = 0.88); $t(376) = 4.87, p<0.01$, d =0.5. This means that there was a higher level of perceived advancement amongst participants in 2013 than in 2015. The magnitude of the difference in the means was medium (Cohen's d = 0.5). This shows that 5 per cent of the variance was explained by the difference over time. There was no significant difference in results for perceived advancement, perceived mobile orientation or perceived laptop advancement.

Comparison of Perceived Expertise Levels between Technologies

As a test for the hypotheses that there will be a difference between all expertise levels for the mobile, laptop, internet and tablet in 2013 and 2015, independent 't' tests were conducted for each variable for 11-14s. There was a significant increase between perceived laptop expertise in 2013 (M = 2.79, SD = 0.77), and 2015 (M = 2.96, SD = 0.56; $t(376) = 3.14, p<0.01$, d = 0.25. The magnitude of the difference in the means was small (Cohen's d=0.25). This means that the hypothesis is supported as perceived laptop expertise was greater in 2015 and explained 2.5 per cent of the variance. No significant differences were reported for the mobile phone, the internet or the tablet.

Examination of the Relationships between Perceived Advancement, Perceived Expertise and Perceived Anxiety

Pearsons Product moment correlation analysis showed significant relationships between perceived mobile expertise and perceived mobile anxiety, perceived mobile anxiety and perceived internet anxiety; and perceived laptop anxiety and perceived tablet anxiety. These are reported in Table 2 in Appendix C.

14-18s

Comparison of Perceived Technological Skill Level between 2013 and 2015

As a test for the hypotheses that there will be a difference between perceived technology advancement, perceived mobile advancement, perceived mobile orientation, perceived laptop advancement, perceived internet advancement and perceived tablet advancement in 2013 and 2015, independent ‘t’ tests were conducted for each variable. The independent ‘t’ test showed a significant increase for perceived mobile orientation, between 2013 (M = 2.45, SD = 0.86), and 2015 (M = 3.0, SD = 0.84); $t(322) = 6.25$, $p>0.01$, d = 0.65, supporting the hypothesis. The magnitude of the difference in the means was large. There was a significant decease for perceived laptop advancement between 2013 (M = 3.16, SD=1.05), and 2015 (M = 2.87, SD = 0.87); $t(322)=6.25, p<0.01$, Cohen’s d = 0.3. The hypothesis was not supported. The magnitude of the difference in the means *wa*s medium. There was a significant increase for perceived internet advancement between 2013 (M = 2.98, SD = 0.95), and 2015 ((M = 3.42, SD = 0.82); $t(322)=45$, $p<0.01$, Cohen’s d = 0.5, supporting the hypothesis. The magnitude of the difference in the means was large (Cohen’s d=0.5). There was a significant increase for perceived tablet advancement between 2013 (M = 3.4, SD = 1.5), and 2015 (M = 3.5, SD = 0.85); $t(322)=45$, $p<1$, d = 0.5, supporting the hypothesis.. The magnitude of the difference in the means was large (Cohen’s d=0.5). There was no significant difference between 2013 and 2015 for overall perceived technology advancement or perceived mobile advancement.

Comparison of Perceived Expertise between 2013 and 2015

As a test for the hypotheses that there will be a difference between all expertise levels for the mobile, laptop, internet and tablet in 2013 and 2015, independent ‘t’ tests were conducted for each variable for 14-18s. Significant differences were found for the two-year period for perceived expertise for the mobile phone, the internet the tablet but not for the laptop. For mobile phones. there was a significant decrease between 2013 (M = 2.89, SD = 0.54), and 2015 (M = 2.76, SD = 0.56); $t(322) = 0.21$, $p<.03$, d = 0.24. The magnitude of the difference in the means was small (Cohen’s d = 0.24). For the internet, there was a significant increase between 2013 (M = 2.86, SD = 0.63), and 2015 (M = 3.13 SD = 0.47); $t(322)=.21$, $p<0.03$, d = 0.49. The magnitude of the difference in the means was medium (Cohen’s d = 0.49). For the tablet, there was a significant decrease between 2013 (M = 3.49, SD = 8.47), and 2015 (M = 3.1, SD = 0.57); $t(322) = 4.98$, $p<0.01$, d =.0.5. The magnitude of the difference in the means was small (Cohen’s d = 0.05).

Comparison of Perceived Anxiety levels between Technologies

As a test for the hypotheses that there will be a difference between all anxiety levels for the mobile, laptop, internet and tablet in 2013 and 2015, independent ‘t’ tests were conducted for each variable for 14-18s**.** Significant differences were found for the two-year period for perceived internet anxiety and perceived tablet anxiety that support the hypothesis. For the internet, there was a significant increase between 2013 (M = 2.35, SD = 0.53), and 2015 (M = 2.5, SD = 5.6); $t(322) = 2.86$, $p<0.01$, d=0.28. The magnitude of the difference in the means was small (Cohen’s d=0.28). For the tablet, there was a significant increase between 2013 (M = 2.18, SD = 0.71), and 2015 (M = 3.1, SD = 0.57); t(322) = 4.87, $p<0.01$, d = 0.53. The magnitude of the difference in the means was large (Cohen’s d = 0.53). Results were not significant for the mobile phone or the laptop.

Relationships between Perceived Technology Skills, Perceived Expertise and Perceived Anxiety for 14-18s

The hypothesis tested was that there is a relationship between perceived technology skills (technology advancement, mobile advancement, mobile orientation, laptop advancement, internet advancement and tablet advancement) and all variables, Perceived mobile expertise and all variables; and perceived anxiety and all variables.

All variables of perceived mobile expertise showd a significant relationship with all perceived technology advancement levels in either 2013, 2015, both 2013 and 2015 or all years, except the laptop. The calculated results are shown in Table 3 of Appendix C. A very strong positive relationship was found between mobile variables ($r = 1$, $n = 332$, $p<0.01$) in 2013 with high levels of mobile expertise associated with high levels of laptop expertise. A similar association was found in 2015 ($r = 0.99$, $n = 332$, $p<0.01$) and for both 2013 and 2015 ($r = 0.98$, $n = 332$, $p<0.01$).

All perceived expertise and perceived anxiety variables showed an association with each other. There was a small significant negative association between perceived mobile expertise and mobile anxiety in 2013, ($r = -0.17$, $n = 332$, $p<0.01$) in 2013, and ($r =0.32$, $n = 332$, $p<0.01$) in both 2013 and 2015. There was a small significant negative association between perceived laptop expertise and laptop anxiety in 2013, ($r = -0.06$, $n = 332$, $p<0.01$) in 2013, but associations were positive in 2015 ($r = 0.14$, $n = 332$, $p<0.05$) and ($r = 0.4$, $n = 332$, $p<0.01$) in both 2013 and 2015. There was a small significant positive association between perceived internet expertise and internet anxiety in 2013, ($r = 0.20$, $n = 332$, $p<0.01$) and a medium association in 2015 ($r = 0.37$, $n = 332$, $p<0.01$) and in both 2013 and 2015 ($r = 0.37$, $n = 332$, $p<0.01$). There was a small significant positive association between perceived internet expertise and internet anxiety in 2013, ($r = 0.20$, $n=332$, $p<0.01$) and a medium association in 2015 ($r = 0.37$, $n = 332$, $p<0.01$) and in both 2013 and 2015 ($r = 0.37$, $n = 332$, $p<0.01$). For the tablet, there was a large association between tablet expertise and tablet anxiety, but this was only significant in both 2013 and 2015 ($r = 0.66$, $n = 332$, $p<0.01$), not in 2013 or 2015.

18-25s

Comparison of Perceived Technological Skill Level between 2013 and 2015

As a test for the hypotheses that there will be a difference between technology advancement, mobile advancement, mobile orientation, laptop advancement, internet advancement and tablet advancement in 2013 and 2015 for 18-25s, independent 't' tests were conducted for each variable**.** Results show that there was a significant increase for perceived mobile advancement, ($M = 2.63$, $SD = 0.95$) in 2013 and ($M = 2.96$, $SD = 0.94$) in 2015, $t(416) = -3.75$, $p<0.01$, $d = 0.35$. The magnitude of the difference in the means for this effect size was medium (Cohen's $d = 0.35$). There was a significant increase for perceived laptop advancement, ($M = 2.89$, $SD = 0.94$) in 2013 and ($M = 3.08$, $SD = 0.96$) in 2015, $t(458) = -2.14$, $p<0.01$, $d = 0.20$, supporting the hypothesis. The magnitude of the difference in the means for this effect size was small (Cohen's $d = 0.20$). There was a significant increase in perceived tablet advancement ($M = 2.33$, $SD = 1.52$) in 2013 and ($M = 2.64$, $SD = 1.36$) in 2015, $t(461) = -2.33$, $p<0.01$, $d = 0.28$, supporting the hypothesis. The magnitude of the difference in the means for this effect size was small (Cohen's $d = 0.28$). There was no significant difference between 2013 and 2015 for overall perceived technology advancement or for mobile orientation.

Comparison of Perceived Expertise between 2013 and 2015

As a test for the hypotheses that there will be a difference between all levels for perceived mobile expertise, perceived laptop expertise, perceived internet expertise and perceived tablet expertise in 2013 and 2015, independent ‘t’ tests were conducted for each variable for 18-25s. A significant increase in perceived mobile expertise was found in 2013, (M = 2.89, SD = 0.41) and in 2015 (M = 3.04, SD = 0.64), $t(378) = 2.99$, $p<0.01$, d = 0.28. The magnitude of the difference in the means for this effect size was small (Cohen’s d = 0.28). An independent ‘t’ test for perceived internet expertise found a significant decrease, (M = 3.52, SD = 0.55) in 2013 and (M = 2.95, SD = 0.37) in 2015, $t(416) = -13.33$,$p<0.01$, d = 1.22. The magnitude of the difference in the means was large (Cohen’s d = 1.22).

Comparison of Perceived Anxiety levels between Technologies

As a test for the hypotheses that there will be a difference between all anxiety levels for the mobile, laptop, internet and tablet in 2013 and 2015, independent ‘t’ tests were conducted for each variable for 18s-25s. Results showed that perceived mobile anxiety increased significantly, (M = 1.81, SD = 0.34) in 2013 and (M = 2.27, SD = 0.36) in 2015, t(461) = 14, $p<0.01$, d = 1.31. The magnitude of the difference in the means for this effect size was large (Cohen’s d=1.31)). Perceived laptop anxiety also inceased significantly, (M = 2.26, SD = 0.29) in 2013 and (M = 2.93, SD = 0.82) in 2015, t(277) = 11.77, $p<.01$, d = 1.09. The magnitude of the difference in the means for this effect size was large (Cohen’s d = 1.09). Results showed that perceived internet anxiety decreased significantly, (M = 2.31, SD = 0.30) in 2013 and (M = 1.57, SD = 0.54) in 2015, t(461) = 3.43, $p<0.01$, d = 1.69. The magnitude of the difference in the means for this effect size was large (Cohen’s d = 1.69).

Relationships between Perceived Technology Skills, Perceived Expertise and Perceived Anxiety for 18-25s

The hypothesis tested was a relationship between perceived technology skills (technology advancement, perceived mobile advancement, perceived mobile orientation, perceived laptop advancement, perceived internet advancement and t perceived tablet advancement and all variables, perceived mobile expertise and all variables; and perceived anxiety and all variables. Many significant relationships were found with perceived technology, mobile, laptop, internet, and tablet advancement levels in either one or all of 2013, 2015, both 2013 and 2015 either at $p<0.01$ or $p<0.05$. The calculated results are shown in Appendix C.

Mobile expertise showed a relationship with many variables and this is shown in Appendix C. Perceived mobile expertise showed a positive relationship with perceived mobile anxiety particularly in 2015, with a medium strength correlation ($r = 0.44$, $n = 454$, $p<0.01$). There was also a significant positive association between perceived mobile anxiety and mobile orientation in 2015 ($r = 0.35$, $n = 454$, $p<0.01$). The strength of the relationship was moderate.

To see if any patterns were emerging from the independent 't' test results, Table 3.7 was created to summarise the direction of the differences. A significant increase in the perceived variable is indicated by ↑ and a significant decrease in the perceived variable is indicated by ↓. The effect sizes are indicated by a letter that indicates the effect size as L = Large, M = Medium and S = Small. Table 3.37 shows only two results with a significant difference for 11-14s, whereas 8-11s show seven significant differences and for 14-18s and 18-25s, there are eight results showed significant differences. This means that the 11-14s are the age group showing the fewest changes in perceived values of technological skill, expertise and anxiety.

For 11-14s, these changes are for perceived general technology advancement and perceived mobile expertise whereas for 14-18s, these are for perceived mobile orientation, perceived laptop, perceived internet and perceived tablet advancement, perceived mobile expertise and perceived internet and perceived tablet anxiety.

Table 3.7
Summary of the Results of Independent 't' test analysis for significant differences

	Age Group Category			
Perceived Results	8-11	11-14	14-18	18-25
Technology Advancement				
Mobile Advancement	↓L	↓M		↑M
Mobile Orientation	↓M		↑L	
Laptop Advancement			↓M	↑S
Internet Advancement	↓M		↑L	
Tablet Advancement				↑S
Mobile Expertise			↓S	↓S
Laptop Expertise		↑S		
Internet Expertise	↑M		↑M	↓L
Tablet Expertise	↓L		↓S	
Mobile Anxiety				↓L
Laptop Anxiety				↓L
Internet Anxiety	↑S		↑S	↑L
Tablet Anxiety	↑L		↑L	

3.7.1.2. Constructs of MOPTUM

Social Influence

Social influence was represented in Questions 1-32 in Booklet 2, Section B. The results of the Social Influence questions were discussed in the sections on Perceived Ease of Use, Perceived Usefulness, Attitude, Perceived Enjoyment, Self Image and Usage Spaces.

Behavioural Intention

Behavioural Intention was represented by the importance of each Usage Space. For this, the Usage Spaces were ordered from 1 to 10 to show user motivation. Many users owned a mobile phone, the results of the analysis of this were presented at the beginning of the results section in this Chapter. The fact that so many users own mobile phones was an indication of behavioural intention to use the phone.

The results for the mean scores for the constructs of PEU and PU are reported. Comparisons were possible for the 11-14s, 14-18s and 18-25s because a 5-point likert scale was used for each age group. No direct comparisons were made for the 8-11s, as the likert scale for the 8-11 was 3-point.

Perceived Ease of Use (PEU)

Hypothesis 7 predicted that Perceived Ease of Use would be an important belief for mobile phone use. The 8-11 and 11-14 age group results for perceived ease of use are shown in Table 3.8. The 8-11s identifed PEU as an important construct. In 2015, Question 2b1, 'I find mobile phones easy to use' was identified as having a mean score (M = 3.77, SD = 0.45) and in 2013, (M = 3.70, SD = 0.45), for Question 2b1. For all age groups, this question gained the highest mean scores.

Table 3.8

Mean and standard deviations for Perceived Ease of Use for 8-11s and 11-14s

	8-11		11-14	
	2013	2015	2013	2015
2b1. I find mobile phones easy to use.	3.70(1.0)	3.77(0.45)	3.50(0.67)	3.40(1.33)
2b7. I find it easy to get a mobile phone to do what I want.	3.50(0.65)	3.46(1.0)	3.01(0.95)	2.92(0.95)
2b13. A mobile phone helps me get things done quickly.	3.27(1.12)	3.50(0.70)	2.44(2.6)	2.87(1.0)
2b26... Learning to operate a mobile was easy for me.	2.76(0.79)	3.01(0.88)	3.11(1.83)	3.01(1.02)

Table 3.9 shows the results for Perceived Ease of use for the 14-18 amd 18-25 age groups. Most values for Perceived Ease of Use were over the mid point value of 2.5 suggesting that

PEU is an important belief for these ages. It is worth noting that the results show the 18-25s response to the question 'I find mobile phones easy to use' in 2015 was high with a mean value of 3.83. The standard deviation was high at 1.28 suggesting a wide variation in opinion to this question. The response to the other questions referring to PEU are below the 2.5 mid point value. The results for standard deviation showed there was less variation in these results.

Table 3.9

Mean and standard deviations for Perceived Ease of Use for 14-18s and 18-25s

Perceived Ease of use	14-18		18-25	
	2013	2015	2013	2015
2b1. I find mobile phones easy to use.	3.59(0.63)	3.47(0.70)	3.51(0.55)	3.83(1.28)
2b7. I find it easy to get a mobile phone to do what I want.	3.23(0.78)	3.17(0.73)	3.14(0.61)	2.49(0.51)
2b13. A mobile phone helps me get things done quickly.	2.43(1.06)	3.06(0.88)	2.77(0.94)	2.14(0.59)
2b26... Learning to operate a mobile was easy for me.	3.21(0.85)	3.32(0.88)	3.21(1.83)	2.12(1.02)

Buying importance

Results for factors users consider important when buying a mobile are presented in Figure 3.5. Eight factors were considered but the five most important factors aspects are included in the table**.** These were cost, quality, network coverage, ease of use and 'look and feel' of the phone. The intention was to find out how much users value the concept of ease of use when buying a mobile in relation to other factors, so accessories, brand and model of the mobile phone that were not considered highly by users, are not included in the table. Cost was considered the most important factor when buying a phone for 8-11s in 2013 (M = 2.60) and 2015 (M = 2.69). There was not a big difference between how cost, quality and ease of use are perceived. Quality was considered important in 2013 (M = 2.59) and 2015 (M = 2.59). This was similar to perceptions of ease of use in 2013 (M = 2.56) and 2015 (M = 2.59).

Many ages, however, perceived quality as the most important factor when buying a mobile. This was the case for 11-14s, in 2013 (*M* = 2.71) and 2015 (*M* = 2.56), 14-18s (*M* = 2.58) in 2013 and 2015 (*M* = 2.71), and for 18-25s in 2013 (*M* = 2.47) and 2015 (*M* = 2.48).

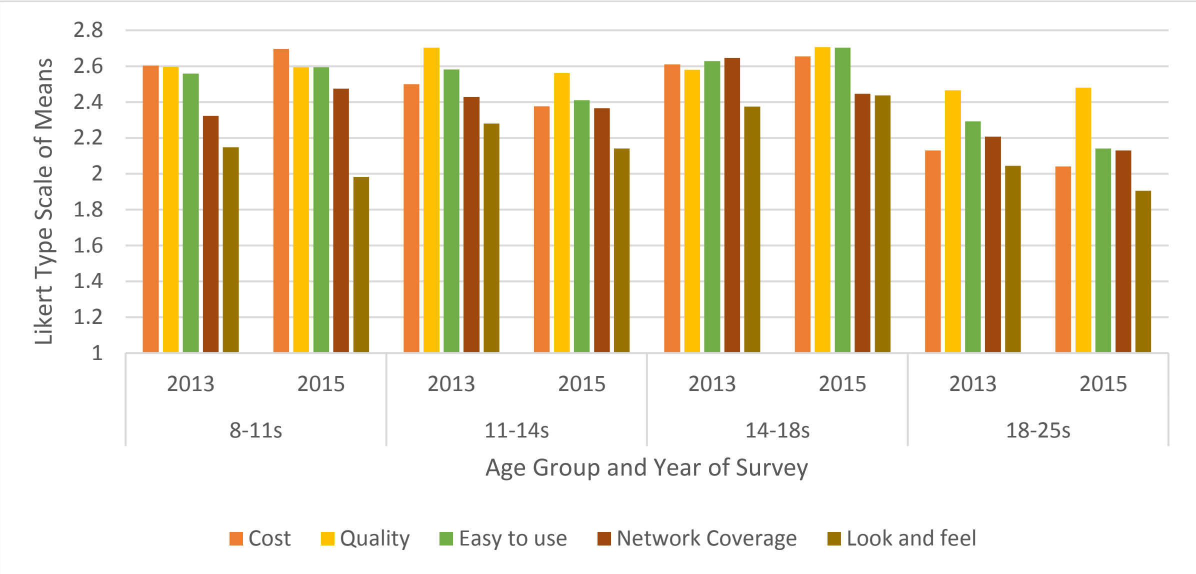


Figure 3.5.
Factors users perceive as important when buying a mobile phone

Perceived ease of use was considered the second most important factor by 11-14s in 2013 (*M* = 2.58) and 2015 (*M* = 2.41), the 14-18s in 2013 (*M* = 2.63) and the 18-25s in 2013 (*M* = 2.29) and 2015 (*M* = 2.14). For 14-18s in 2015, the most important factor was network coverage (*M* = 2.65). These results provide support for Hypothesis 7.

Perceived Usefulness (PU)

Hypothesis 8 predicts that Perceived Usefulness will be an important belief for mobile phone use. The mean results for Perceived Usefulness are shown in Table 3.10 and Table 3.11 and provide support for Hypothesis 8. All mean scores for PU have a higher self-reported rating for all groups in 2015 than in 2013, suggesting that users value PU more in 2015 than in 2013.

Table 3.10
Mean and standard deviations for Perceived Usefulness for 8-11s and 11-14s

	8-11		11-14	
	2013	2015	2013	2015
2b10. Using a mobile phone helps me learn well.	3.16(0.73)	3.39(0.72)	2.66(1.26)	2.62(1.03)
2b13. A mobile phone helps me get things done quickly.	2.52(1.12)	3.51(0.69)	2.12(1.13)	2.47(1.18)
2b15. I use my mobile phone to manage my school work/ studies.	2.53(0.73)	2.78(0.89)	1.95(1.25)	2.83(0.98)
2b16. I use my mobile to find out information.	3.04(0.85)	3.66(0.62)	2.78(1.84)	3.01(1.02)
2b28. I use my mobile phone to help me with my homework	2.56(3.69)	3.18(0.87)	2.11(1.36)	2.63(1.16)

Table 3.10 and 3.11 showed that Perceived Usefulness was valued by all age groups with a wide range of mean responses from (*M* = 3.66, *SD* = 0.62) to (*M* = 1.73, *SD* = 1.21). The 8-11 age group identified PU as an important construct. In 2015, Question 2b16. 'I use my mobile phone to find out information' was identified as having the highest mean score in 2015(*M* = 3.66, *SD* = 0.62) and in 2013 (*M* = 3.04, *SD* = 0.85). For all age groups, this question gained the highest mean scores. The 11-14s also had the highest mean score for this question compared to the other questions, in 2013 (*M* = 2.78, *SD* = SD1.84) and in 2015 (*M* = 3.01, *SD* = 1.02).

PU was rated most highly by the 18-25s (*M* = 3.52, *SD* = 1.51) in 2015 for Question 2b15. 'I use my mobile phone to manage my studies'. This means that the 18-25s identifies the belief of PU as important for mobile phone use. The importance of this belief for 18-25s increased from 2013 to 2015. In 2013, the mean value for this question reached the mid point value (*M*

= 2.50, *SD* = 1.06) but this had increased by 2015 (*M* = 3.25, *SD* = 0.83). The results for the standard deviation showed that there was more variability in 2013 than 2015.

Table 3.11
Mean and standard deviations for Perceived Usefulness for 14-18s and 18-25s

	14-18		18-25	
	2013	2015	2013	2015
2b10. Using a mobile phone helps me learn well.	2.26(0.87)	2.26(0.72)	2.09(0.95)	2.56(0.73)
2b13. A mobile phone helps me get things done quickly	2.47(1.06)	3.06(0.88)	2.77(0.93)	3.14(0.58)
2b15. I use my mobile phone to manage my school work/studies	2.05(1.18)	2.11(0.96)	2.50(1.06)	3.25(0.83)
2b16. I use my mobile to find out information.	2.75(1.09)	2.93(0.77)	3.24(0.76)	3.52(1.51)
2b28. I use my mobile phone to help me with my homework	1.73(1.21)	2.40(1.19)	1.90(1.17)	2.23(1.10)

Attitude

Hypothesis 9 predicts that users will find attitude an important consideration when using a mobile phone. There was partial support for this result with values that were over the mid-point of 2.5. Table 3.12 and Table 3.13 showed the mean and standard deviation for the questions based on Attitude. The means were higher for 8-11s for the question ‘I think using a mobile phone is a good idea’ in both years than for the question ‘I think using a mobile phone is a bad idea’. For the question ‘I think using a mobile phone is a bad idea’ the means were all higher in 2015 than in 2013 for all ages.

Table 3.12
Mean and standard deviations for Attitude for 8-11s and 11-14s

	8-11		11-14	
	2013	2015	2013	2015
2b2. I think using a mobile phone is a bad idea.	2.30(0.56)	2.44(0.64)	3.15(1.07)	3.35(0.77)
2b8. I think using a mobile phone is a good idea	3.70(0.58)	3.61(0.65)	2.70(1.35)	3.23(0.81)

For the question ‘I think using a mobile phone is a good idea’, the mean was higher for 8-11s in 2013 (3.70, *SD* = 0.58) and was slightly less in 2015 (3.61, *SD* = 0.65*)*. For 11-14s (*M* = 2.70, *SD* =1.35 in 2013, *M* = 3.23*, SD* = 0.81) and 18-25s (*M* = 3.09, *SD* = 0.70 in 2013, *M* = 3.23, *SD* = 0.69 in 2015) the means were higher and for the 14-18s the means were the same (*M* = 1.01, *SD* = 0.83). The standard deviation was smaller for 8-11s (*SD* = 0.58 in 2013, *SD* = 0.65 in 2015) than for 11-14s (*SD* =1.35 in 2013, *SD = 0.81)* suggesting there was less variability in judgements for 8-11s than for 11-14s.

Table 3.13
Mean and standard deviations for Attitude for 14-18s and 18-25s

	14-18		18-25	
	2013	2015	2013	2015
2b2 I think using a mobile phone is a bad idea.	2.03(0.97)	3.20(0.74)	3.24(0.87)	3.38(0.73)
2b8. I think using a mobile phone is a good idea	1.01(0.83)	1.01(0.83)	3.09(0.70)	3.23(0.69)

Perceived Enjoyment

Hypothesis 10 predicts that users will find Perceived Enjoyment important to mobile phone users. This is supported by the results in Table 3.14 for ‘positive’ statements. Overall, the younger users showed higher mean values of perceived enjoyment particularly for the ‘positive’ statements. Results were above the mid-point of 2.5 except for the ‘negative’ comments for the 14-18 age group. However, the ‘positve’ comments for 14-18s were above the mid-point suggesting users had a positive attitude to using their mobile phone.

The results in Table 3.14 showed a higher mean score when participants were asked for a response to a ‘positively’ conctructed statement (2b3 and 2b11) for the construct of Perceived

Enjoyment than when they were asked for a response to a negatively constructed statement (2b5 and 2b11).

Table 3.14
Mean and standard deviations for Perceived Enjoyment for 8-11s and 11-14s

	8-11		11-14	
	2013	2015	2013	2015
2b3. I feel happy when I get a text.	3.56(0.64)	3.59(0.65)	2.72(1.00)	2.90(0.91)
2b5. I feel bad when no-one rings me.	3.03(0.82)	2.61(1.21)	2.66(1.40)	2.37(0.77)
2b11. I feel happy when my mobile phone rings.	2.67(0.74)	3.42(0.65)	2.70(3.30)	2.52(1.07)
2b11. I feel bad when o-one texts me..	2.87(0.74)	2.87(0.79)	1.95(1.24)	2.47(1.18)

Table 3.15 shows the results for Perceived Enjoyment for 14-18s and 18-25s.

Table 3.15
Mean and standard deviations for Perceived Enjoyment for 14-18s and 18-25s

	14-18		18-25	
	2013	2015	2013	2015
2b3. I feel happy when I get a text.	2.88(0.75)	2.57(1.00)	2.93(0.59)	2.95(0.71)
2b5. I feel bad when no-one rings me.	1.16(1.04)	1.36(0.87)	2.38(0.98)	2.77(0.87)
2b11. I feel happy when my mobile phone rings.	2.55(0.91)	2.55(0.93)	2.38(0.62)	2.74(0.71)
2b. I feel bad when o-one texts me.	1.79(1.08)	1.72(1.44)	3.11(1.00)	2.28(1.04)

Self image

Hypothesis 11 predicts that users will believe the association of owning a mobile phone will present a positive self image. The means and standard deviations for the questions based on Self Image are shown in Table 3.16 and Table 3.17. The results suggest that the hypothesis cannot be supportded for 11-25s but can be supported amongst the 8-11s. All mean values for the 8-11s were over the 2.5 mid-point judgement. The younger users believed that the mobile phone improved their self image.

Table 3.16
Mean and standard deviations for Self Image for 8-11s and 11-14s

	8-11s		11-14	
	2013	2015	2013	2015
2b4. The mobile phone I choose is a way of showing who I am..	3.03(0.82)	3.25(0.72)	1.86(1.20)	2.56(0.73)
2b22. I choose a particular mobile phone to be cool.	2.60(2.69)	2.97(0.82)	1.60(1.24)	2.27(1.19)
2b24. My mobile phone is useful in improving my self image.	2.89(0.83)	3.04(0.85)	1.61(1.15)	2.24(1.22)
2b16. My mobile says something about my image.	2.60(0.78)	2.99(0.88)	1.76(1.15)	2.26(1.51)
2b29. Having a funky or cool phone makes me feel good.	3.51(0.73)	3.54(1.19)	2.04(1.24)	2.47(1.16)

The mean judgements were higher in all age groups for the question ‘Having a funky or cool makes me feel good’ compared to the other questions representing the construct of self image. The mean values were higher in the 8-11 age group for this question compared to the other age groups.

Table 3.17
Mean and standard deviations for Self Image for 14-18s and 18-25s

	14-18		18-25	
	2013	2015	2013	2015
2b4. The mobile phone I choose is a way of showing who I am..	1.80(1.11)	1.80(0.64)	1.62(1.05)	1.75(1.10)
2b22. I choose a particular mobile phone to be cool.	1.5(1.13)	1.47(0.88)	2.77(1.31)	1.61(1.11)
2b24. My mobile phone is useful in improving my self image.	1.31(0.90)	2.11(0.90)	0.76(0.87)	1.86(1.12)
2b16. My mobile says something about my image.	1.13(1.12)	2.53(0.77)	2.38(1.24)	2.53(2.00)
2b29. Having a funky or cool phone makes me feel good.	1.90(1.10)	2.03(1.08)	1.90(1.17)	2.53(0.56)

3.7.1.3 Actual System Usage: Usage breadth, Usage Variety and Usage intensity

Usage breadth

Usage breadth was captured by the number of saved phone numbers participants have on their phone and can be viewed in Table 3.18. Hypothesis 12 predicts that saved phone numbers will increase from 2013 to 2015. Hypothesis 12 was not supported by the results. The number of saved phone numbers decreased from 2013 to 2015 for all ages. The mean and standard deviation results for 11-14s was higher in 2013 (*M* = 55.51, *SD* = 57.41) than in 2015 (*M* = 30.93, *SD* = 34.26). The minimum value was 0 in both years and the maximum number of saved numbers was 251 in 2013 and 202 in 2015. Results for other age groups are shown in Table 3.18. Table 3.18 also shows that the number of saved phone numbers increased with age from the 8-11 age group (*M* = 11.54, *SD* =1.32) in 2013 and in 2015 (*M* =10.71, *SD* = 13.28) to the 18-25 age group (*M* = 128.80, *SD* = 108.97) in 2013 and 2015 (*M* = 123.01, *SD* = 98.68).

Table 3.18
Mean Values of Saved Phone Numbers

Age group	Mean		Minimum		Maximum	
	2013	2015	2013	2015	2013	2015
8-11	11.54(1.32)	10.71(13.28)	0	0	101	69
11-14	55.51(57.41)	30.93(34.26)	0	0	251	202
14-18	71.97(92.47)	40.79(25.71)	0	0	601	108
18-25	128.80(108.97)	123.01(98.68)	0	10	88	666

Usage variety

Hypothesis 13 predicts that usage variety will increase between 2013 and 2015. Usage variety is captured by what participants reported they use their phone for. The results showed that there was some support for Hypothesis 13. This is shown in Figure 3.6 for 8-11s. Users reported an increase in some uses of the mobile phone but a decrease in other uses. This was also found for 11-14s, 14-18s, and 18-25s and is shown in Figures 3.7, 3.8 and 3.9 respectively. The values represent the means of the Likert type scale of strongly agree (5), agree (4), neither agree nor disagree (3), disagree (2) and strongly disagree (1) from Question 6, 'What do you use a mobile for?' So, the higher the score, the greater the participant strongly agrees about using this function.

8-11s

In both 2013 and 2015, 8-11 years old users reported that the functions that they used most on a mobile phone were texting and email. In both these areas of use, participants reported that this function increased in use from 2013 to 2015. To see if there was a significant difference between 2013 and 2015, independent 't' tests were carried out for all functions that participants reported using. Significant differences between 2013 and 2015 were found for the camera functions of exchanging a photo and recording a video, internet and music. These are shown in Table 3.9. There was no significant difference for emails between 2013 (M = 3.48, SD = 0.82), and 2015 (M = 3.48, SD = 0.76; $t(313) = 0.14$, $p<0.89$) or texts (M = 3.47, SD = 0.80), and 2015 (M = 3.52, SD = 0.75; $t(313) = 0.69$, $p<0.48$). Texting showed an effect size of 0.07 and emails of 0.01.

Table 3.19
Significant Results for Mobile Phone Usage Variety for 8-11s in 2013 and 2015

Use	Mean and SD		Independent 't' test	Effect Size
	2013	2015	t(313)	
Exchange a photo	3.02(0.77)	3.21(0.77)	2.14, p<.03*	.25
Record a video	2.89(0.74)	2.92(0.78)	2.83, p<.001*	.38
Internet	2.67(3.6)	2.89(0.84)	4.06, p<.046*	.42
Music	2.90(0.85)	1.82(0.85)	2.88, p<.004*	.50

*p<0.05 level (2 tailed)
Note: Effect sizes are provided by Cohen's d as equal variances can be assumed

In both 2013 and 2015, 8-11 years old users reported that calling was the next most used function but this decreased in use from 2013 to 2015 (*M* = 3.47, *SD* = 0.80), and 2015 (*M* = 3.52, *SD* = 0.75; t(313) = 0.69, p<0.48). However, the effect size was tiny at 0.01.

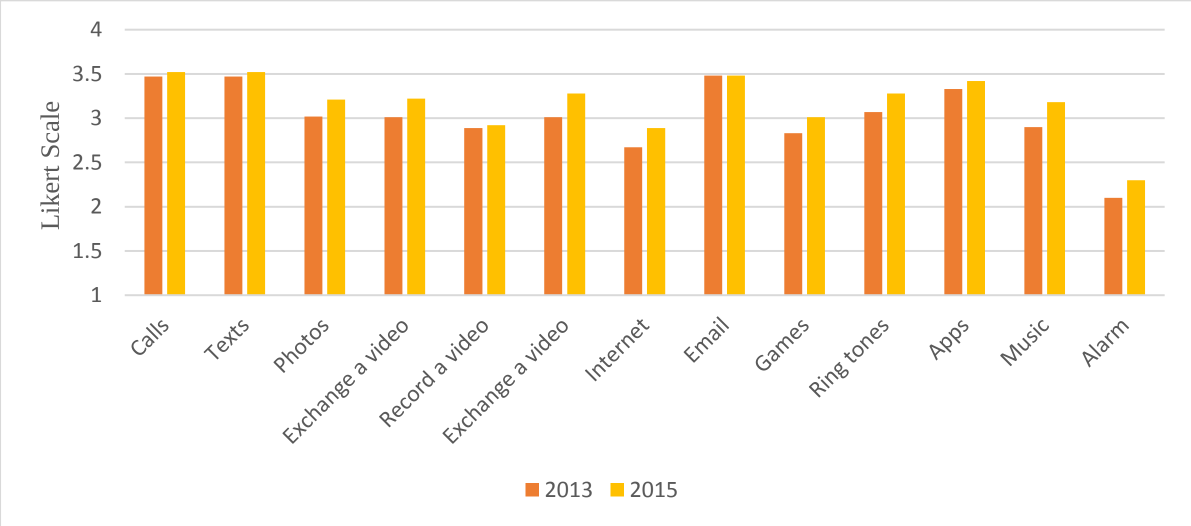


Figure 3.6
Mobile Phone Use Variety for individual components of Mobile Phone Use for 8-11s in 2013 and 2015

Use of all these functions was more in 2015 and this was evident in Figure 3.9 and Table 3.19.

11- 14s

Table 3.20 shows the significant results for mobile phone usage variety for 11-14s in 2013 and 2015**.** Independent 't' tests indicated that only a few functions on the mobile were reported as being used less in 2015 than in 2013, with many functions being used more frequently. These are shown in Figure 3.7. Although reported mean values for making texts and calls were rated highly, reported use decreased from 2013 to 2015. There was no significant difference for calls between 2013 (*M* = 3.52, *SD*=0.62), and 2015 (*M* = 3.40, *SD* = 0.66; t(376) = -1.72, p<0.09). The magnitude of the difference in the means showed a small effect (Cohen's d = 0.18). Results revealed a significant difference for texting (*M* = 3.74, *SD* = 0.56) in 2013 and (*M* = 3.56, *SD* = 0.66; t(376) = -2.83, p<.004) in 2015.

Table 3.20

Significant Results for Mobile Phone Usage Variety for 11-14s in 2013 and 2015

Use	Mean and SD		Independent 't' test	Effect
	2013	2015	t(376)	Size
Texts	3.74(0.56)	3.56(0.66)	2.83, p<.004*	.30
Exchange photos	2.81(0.73)	3.12(0.75)	4.06, p<.000*	1.02
Record a video	2.89(0.74)	3.25(0.77)	2.83, p<.000*	.50
Exchange a video	2.60(0.68)	2.92(0.79)	4.06, p<.000*	.42
Games	3.11(0.76)	3.38(0.72)	3.63, p<.001*	.38
Ringtones	2.47(0.73)	2.85(0.80)	4.64, p<.000*	.50
Apps	3.02(0.82)	3.26(0.98)	2.60, p<.010*	.27
Social networks	2.41(0.78)	2.66(0.15)	2.48, p<.014*	.26
Other	2.41(0.06)	2.63(0.08)	2.48, p<.017*	3.08

*p<0.05 level (2 tailed)

Note: Effect sizes are provided by Cohen's d when equal variances are assumed and Welsch's correction when equal variances are not assumed

The magnitude of the difference in the means for texts was small to moderate (Cohen's d = 0.30). Twitter and Facebook were used more in 2013 than 2015; (t(376) = 0.35, p<0.970) and (t(376) = -1.047,p<0.28) respectively although use of other social networks and other phone functions showed an increase; (t(376) = 2.48,p<.0.01) and (t(376) = 2.48,p<0.01) respectively. All other functions showed an increase in use from 2013 to 2015. The camera functions on the mobile include exchanging a photo, recording a video, (t(376) = 2.83,p<0.01) and exchanging a video, (t(376) = 0.41,p<.01), and all these functions showed a significant increase in reported use from 2013 to 2015.

The increase in use found from 2013 to 2015 for exchanging a photo was highly significant, (t(376) = 4.06,p<0.01) and the effect size was very large (Cohen's d=1.02). The other significant increases were for playing games, (t(376) = 3.63,p<0.01), downloading ringtones (t(376) = 4.64,p<0.01) and apps (t(376) = 2.60,p<0.01). Young people reported listening to music on their phones more in 2015 than in 2013, (t(376) = 1.42,p<0.14), but this result was not significant. Use of the alarm had a very minimal increase (t(376) = 0.07,p<0.940).

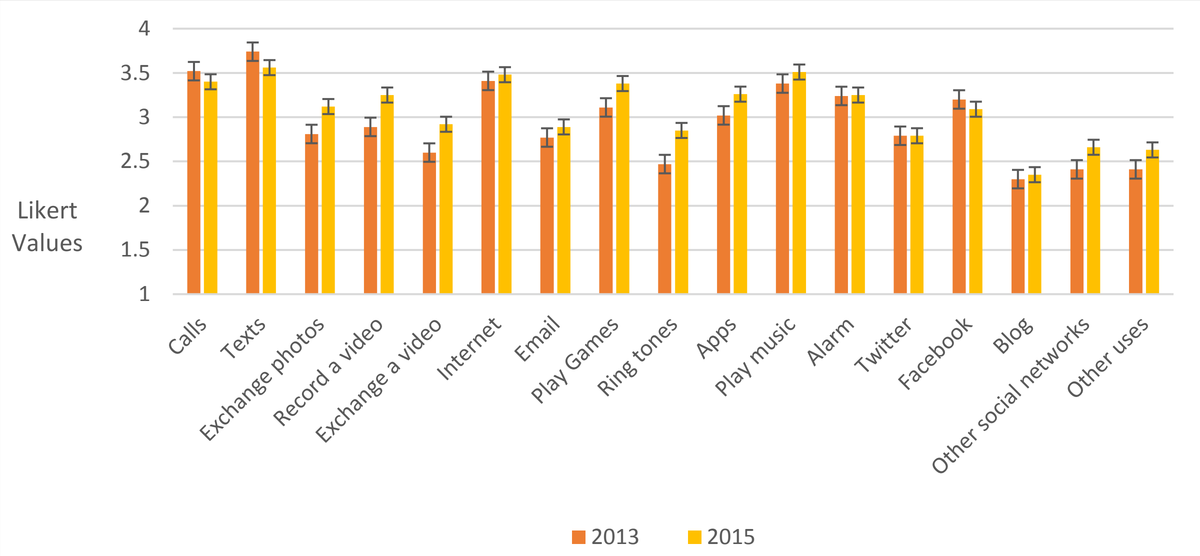


Figure 3.7
Mobile Phone Usage Variety for individual components of Mobile Phone Use for 11-14s in 2013 and 2015

14-18s

Table 3.21 showed significant results for mobile phone usage variety for 14-18s and Figure 3.8 showed all results for functions of mobile phone use for this age group. Significant differences in the Likert type scale means were found for texting, exchanging a photo, exchanging a video, apps, music, Facebook, Blogging and other uses between 2013 and 2015.

Increases were found for exchanging a photo, exchanging a video, internet, apps, Facebook and other uses whereas a decrease in use was found for texting, blogging were found. Participants reported using the function of texting most in 2013 but this decreased significantly between 2013 and 2015, (M = 3.85, SD = 0.40) in 2013 and (M = 3.62, SD = 0.62; t(332) = -2.83, p<0.01). The effect size was large at 0.64. There was also a decrease in calls, but this was not significant. Surprisingly, there was a significant decrease in participants playing music, (*M* = 3.58, *SD* = 0.66) in 2013 and (*M* = 3.36, *SD* = 0.83; t(332) = -2.83, p<.01) in 2015. The effect size was small.

Table 3.21
Significant Results for Mobile Phone Usage Variety for 14-18s in 2013 and 2015

Use	Mean (M)		Independent 't' test	Effect
	2013	2015	t	Size
Texts	3.85(0.40)	3.62(0.62)	-5.55, p<.000*	0.64
Exchange Photos	2.73(0.68)	3.20(0.63)	4.99, p<.000*	0.56
Exchange a video	3.40(0.81)	3.77(0.56)	4.43, p<.000*	0.53
Apps	3.21(0.82)	2.20(0.42)	8.02, p<.000*	0.92
Music	3.58(0.66)	3.36(0.83)	-2.51, p<.013*	0.29
Facebook	3.24(0.87)	3.49(0.76)	2.7, p<.007*	0.46
Blog	2.24(0.64)	2.03(0.05)	-3.98, p<.000*	0.29
Other	2.31(0.06)	2.70(0.80)	3.19, p<.002*	0.34

*p<0.05 level (2 tailed)
Note: Effect sizes are provided by Cohen's d when equal variances are assumed and Welsch's correction when equal variances are not assumed

Participants reported using the function of texting most in 2013 but this decreased

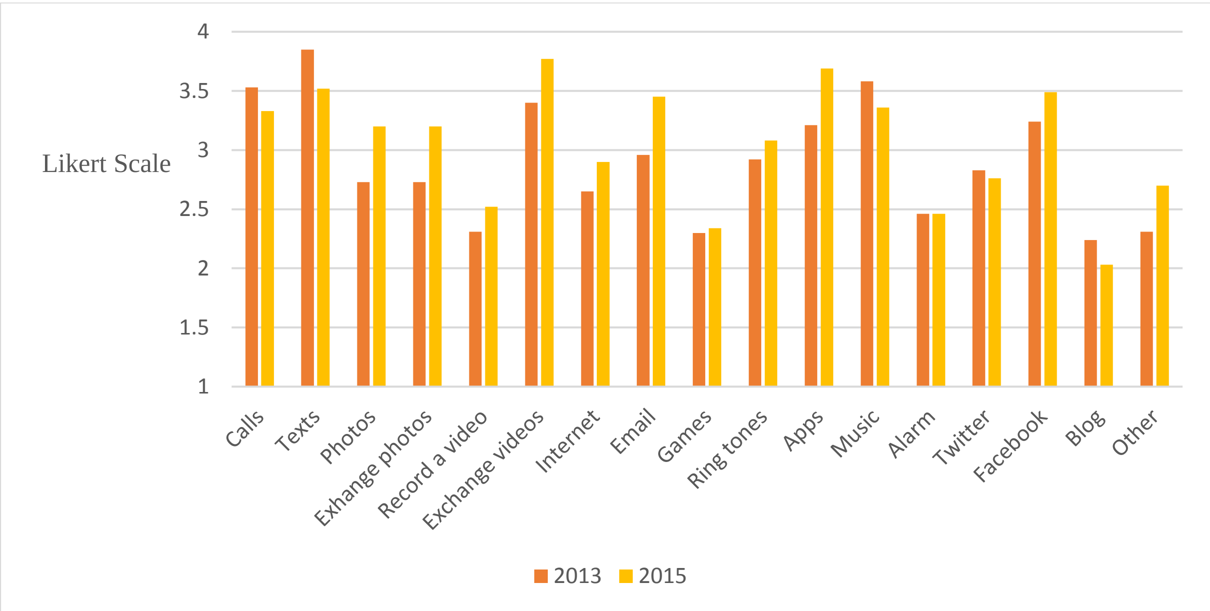


Figure 3.8
Mobile Phone Usage Variety for Individual Components of Mobile Phone Use for 14-18s in 2013 and 2015

significantly between 2013 and 2015, (*M* = 3.85, *SD* = 0.40) in 2013 and (*M* = 3.62, *SD* = 0.62; t(332) = -2.83, p<0.01). The effect size was large at 0.64. There was also a decrease in calls, but this was not significant. Surprisingly, there was a significant decrease in participants playing music, (*M* = 3.58, *SD* = 0.66) in 2013 and (*M* = 3.36, *SD* = 0.83; t(332) = -2.83, p<.01) in 2015. The effect size was small. The mean differences, standard deviation, 't' values and effect sizes of all other increases can be seen in Table 3.21.

18-25s

Figure 3.9 shows the results for mobile phone usage variety for 18-25s in 2013 and 2015.

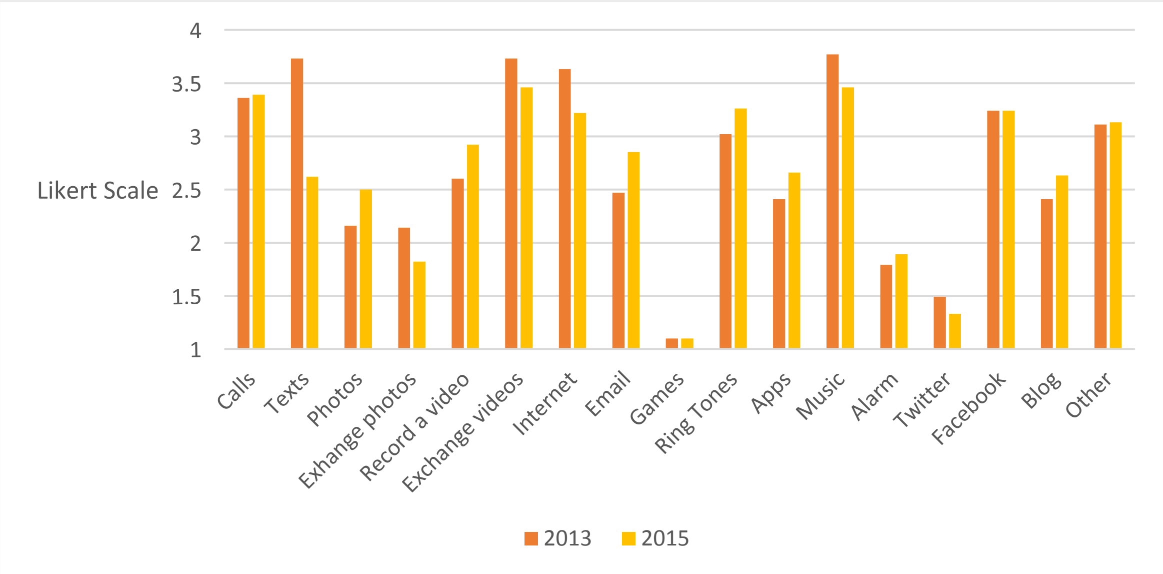


Figure 3.9
Mobile Phone Usage Variety for Individual Components of Mobile Phone Use for 18-25s in 2013 and 2015

Functions participants reported using most are listening to music (*M* = 3.77, *SD* = 0.63) in 2013 and (*M* = 3.46, *SD* = 0.95; t(567) = 1.61, p<0.1) in 2015 followed by exchanging a video, (*M* = 3.73, *SD* = 0.58) in 2013 and (*M* = 3.46, *SD* = 0.95; t(576)= -2.38, p<0.01) in 2015. The next most reported function is use of the internet (*M* = 3.63, *SD* = 0.77) in 2013 and (M = 3.22, *SD* = 1.14; t(576) = 0.21, p<0.83) in 2015. This was followed by calling, (*M* = 3.36, *SD* = 0.76) in 2013 and (*M* = 3.39, *SD* = 0.76; t(576) = 0.49, p<0.62) in 2015.

There are many significant differences in use between 2013 and 2015 for 18-25s. The only significant function participants report an increase in use is ringtones. The other functions show a significant decrease in use. These are texts, taking photos and exchanging photos, recording and exchanging a video, email, games, apps and blogging. The mean values for these significant values are shown in Table 3.22.

Table 3.22
Significant Results for Mobile Phone Usage Variety for 18-25s in 2013 and 2015

Use	Mean and SD		Independent 't' test	Effect
	2013	2015	t(376)	Size
Texts	3.73(0.56)	2.62(0.66)	-11.74, p<.000*	0.27
Taking photos	2.19(0.73)	1.88(0.75)	-3.41, p<.001*	0.42
Exchanging photos	2.11(0.74)	1.75(0.77)	-3.5, p<.001*	0.27
Record a video	2.40(0.68)	2.08(0.79)	-2.91, p<.004*	0.43
Exchange a video	1.89(0.76)	1.62(0.72)	-2.39, p<.017*	0.36
Email	2.53(0.73)	2.15(0.80)	-2.24, p<.026*	0.49
Ringtones	1.98(0.82)	1.74(0.98)	2.43, p<.016*	0.27
Apps	2.59(0.78)	2.34(0.15)	-2.59, p<.010*	0.45
Blog	2.59(0.06)	2.37(0.08)	-3.02, p<.003*	3.11

*p<0.05 level (2 tailed)
Note: Effect sizes are provided by Cohen's d when equal variances are assumed and Welsch's correction when equal variances are not assumed

Usage Spaces

Two to four questions in the questionnaire booklets are associated with a particular usage space and are shown in Table 3.2 at the start of Chapter 3. Particpants were asked to respond to the question by either 'Stongly agree, agree. neither agree nor disagree, disagree or strongly disagree'. A further question asked participants to order the importance of each usage space. Investigation of Usage Spaces was only carried out in 2015, as it was a method of enquiry that was added to the questionnaires in 2015. It was carried out with 11-14s, 14-

18s and 18-25s but not 8-11s. It was expected that the communication function would be the most important usage space, but no formal hypothesis was made as this was an exploratory enquiry.

11-14s

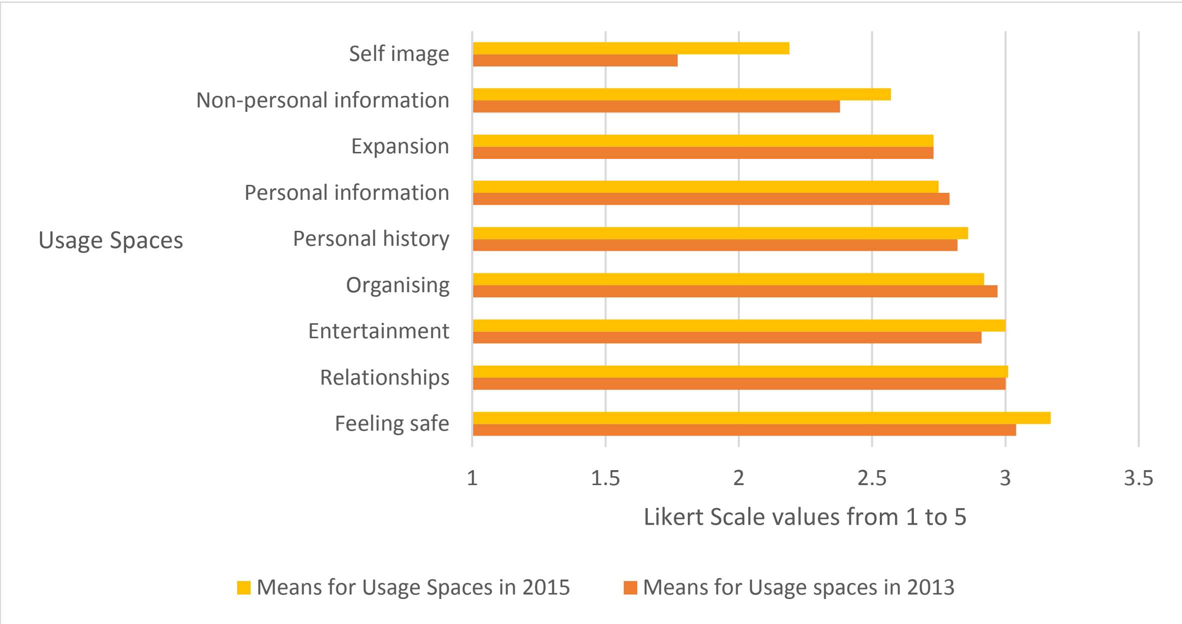


Figure 3.10
Means of usage spaces for 2013 and 2015 for 11-14s

Figure 3.10 shows the results for the questions associated with usage spaces. The most important usage space was safety and security both in 2013 (*M* 3.05) and 2015 (*M* 3.27) followed closely by the use of the mobile for relationships (*M* 3.17) and then entertainment (*M* 2.96).

14-18s

Figure 3.11 shows the results for the questions associated with usage spaces for 14-18s. The most important usage space was safety and security both in 2013 (*M* 3.36) and 2015 (*M* 3.32) followed closely by the use of the mobile for relationships (*M* 2.92) in 2013 and 2015 (*M*

2.82). Organising (M 2.78) in 2013 and (M 2.77) in 2015 was the next most reported usage space.

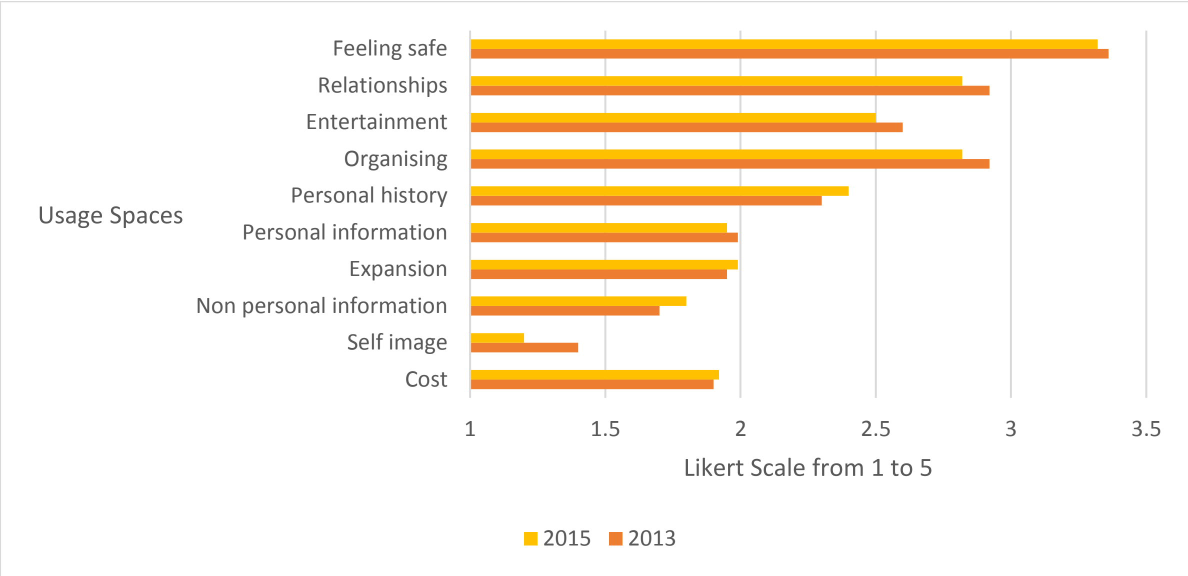


Figure 3.11
Means of usage spaces for 2013 and 2015 for 14-18s

18-25s

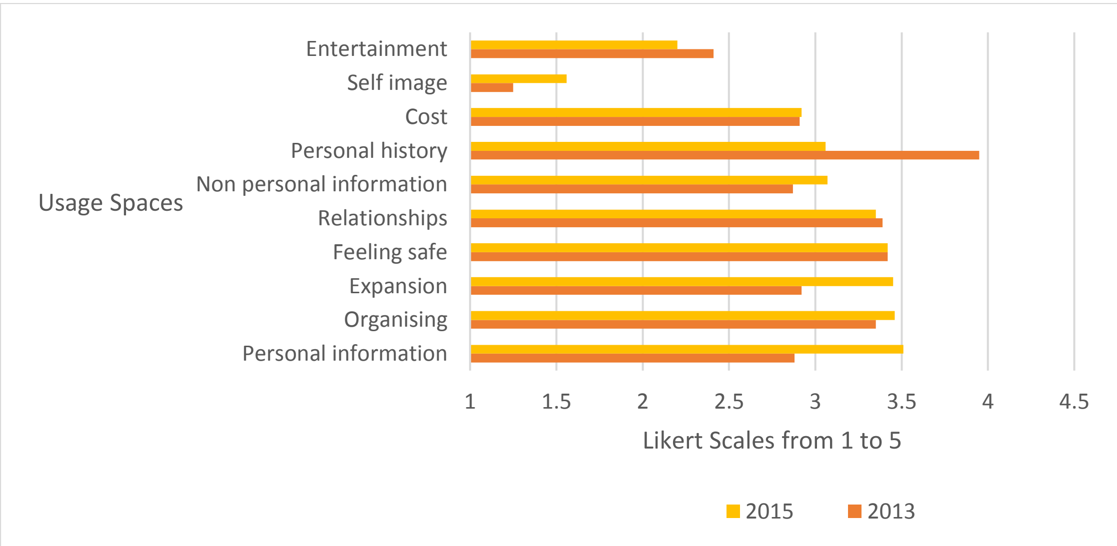


Figure 3.12
Means of usage spaces for 2013 and 2015 for 18-25s

Figure 3.12 shows the results for the questions associated with usage spaces for 18-25s. The most important usage space in 2013 was feeling safe (*M* 3.42), followed by relationships (*M* 3.39) and then using the mobile for organising arrangements (*M* 6.35). Personal information was rated as the fourth most important usage space but in 2015 personal information was the most important motivation for using the mobile (*M* 3.51). This was followed closely by the use of organising (*M* 3.46), then expansion (*M* 3.45) and then relationships (*M* 3.35).

Usage Space Order

The mean scores of participants for the order of usage spaces are shown in Figure 3.13 for 11-14s, 14-18s and 18-25s. This was only carried out in 2015 as it was a method of enquiry that was added to the second questionnaire.

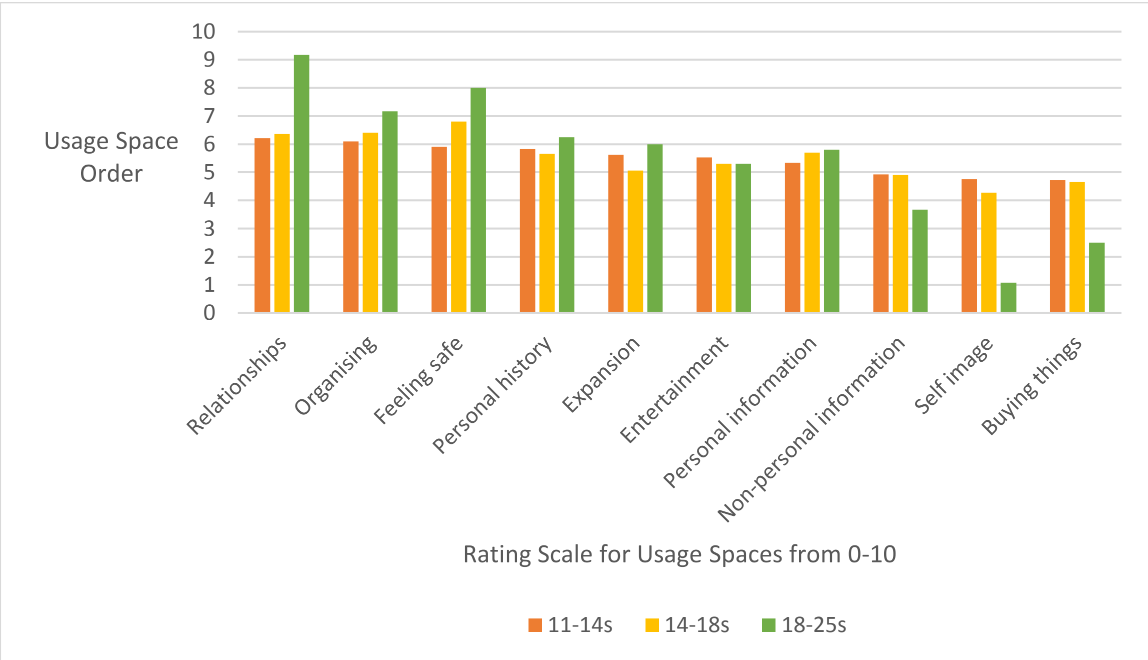


Figure 3.13
Mean scores for user ratings for Mobile Phone Usage Spaces

As a representative sample, the results for the 11-14s for the order of importance for usage spaces and the mean scores for usage space order were compared. Differences between the age groups showed that different usage spaces were considered more highly in different age groups. The usage spaces given most importance were relationships, feeling safe and using the mobile for organising arrangements. This was to see if there was any difference in results gained by using the different methods of enquiry. Table 3.23 shows that the order of importance of the usage spaces varied with the different methods of enquiry.

Table 3.23
Comparison of Usage Space Importance from the Likert Scale and the Usage Space Order for 11-14s

Order	Likert result	Rating result
1	Feeling safe	Relationships
2	Relationships	Organising
3	Entertainment	Feeling safe
4	Organising	Personal history
5	Personal history	Expansion
6	Expansion	Entertainment
7	Personal information	Personal information
8	Buying things	Non-personal information
9	Non-personal information	Self-image
10	Self-image	Buying things

Usage intensity

Usage intensity was captured by the questions that asked about the volume of apps, calls, and texts made by participants. It showed the way in which users communicated with each other and it found out about the number of calls and texts made by young people. Hypothesis 14 predicts that these will increase over time. Data was taken from the questionnaire Booklet 2 and the interviews. Direct questions refered to the number of calls and texts made in a day and the volume of apps used.

Apps

As a representative sample, data on Apps for 11-14s were considered. The type of Apps participants' use is shown in Figure 3.14. Participants used a wide range of Apps.

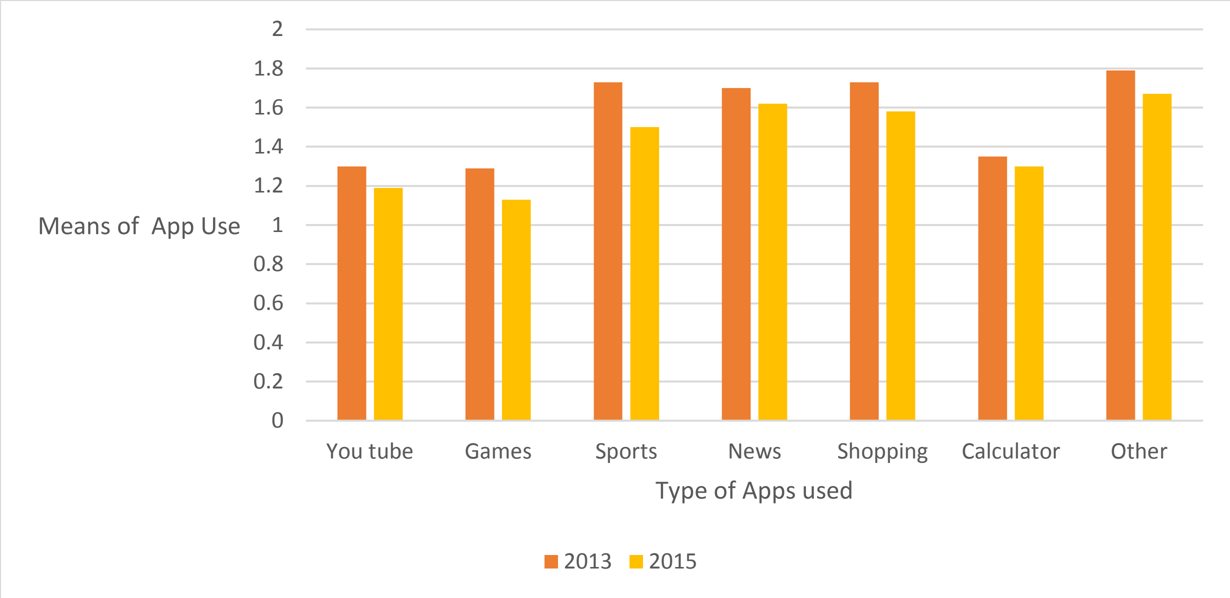


Figure 3.14
Apps Used by 11-14s in 2013 and 2015

Results showed that 79% of 11-14s used Apps in 2013 and 92% used Apps in 2015. Apps used most were Sports, news and shopping, then calculator, games and You tube Apps. All showed higher usage in 2015. Table 3.24 shows the percentage of users who use apps in both 2013 and 2015. The results suggest that Hypothesis 14 can be supported for the use of Apps.

Table 3.24
Apps Use in 2013 and 2015 (in percentages)

Age	2013	2015
8-11s	75.5	84.3
11-14s	79.0	92.0
14-18s	84.3	81.8
18-25s	89.0	90.4

Calls

The mean values of calls that users made are shown in Table 3.25. Usage increased with age in 2013. It also increased over time for the 8-14s but decreased over time for the 14-25s, giving support to Hypothesis 14 for the younger age groups of 8-14. Use varied from a minimum number of calls of 0 for nearly all ages and a maximum number of calls by 18-25s in 2013. Calls decreased for 14-25s. In 2013, 14-18s made nearly 5 calls a day in 2013. This dropped to nearly 2 in 2015. For 18-25s this changed from over 120 calls in a day 2013 to nearly 4 calls a day in 2015.

Table 3.25

Mean values of calls

Age group	Mean		Minimum		Maximum	
	2013	2015	2013	2015	2013	2015
8-11	3.52(5.77)	4.93(10.75)	0	0	50	100
11-14	3.38(36.54)	5.59(15.60)	0	0	53	101
14-18	4.65(17.17)	1.32(1.32)	0	0	213	5
18-25	122.49(98.96)	3.59(3.87)	1	1	500	20

For 8-11s and 11-14s calls made increased from 2013 to 2015. For 8-11s, this was from 50 to 100 calls a day and for 11-14s, this was from 53 to 101. Figure 3.15, 3.16, 3.17 and 3.18 show the distribution of calls made by each age group.

8-11s

2013 **2015**

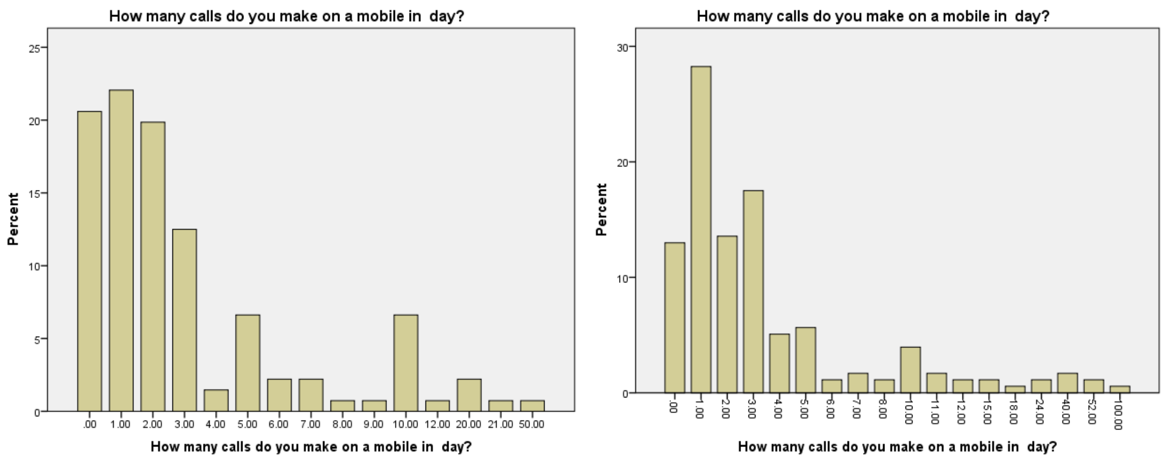


Figure 3.15

Distribution of Means for Calls for 8-11s

Figure 3.15 shows that many 8-11s made a few calls in a day and that 20.1% made 1 call a day, 21.6% made 2 calls a day and 19.4% made 3 calls a day in 2013. The pattern was similar in 2015 with many 8-11s making only a few calls but there was a difference between 2013 and 2015. More users made only one call a day (28.2%) in 2015 whilst 13.6% made 2 calls a day and 17.5% made 3 calls a day

11-14s

The 11-14 age group made more calls than the 8-11 age group. Nearly a third of 11-14s made 1 call a day in 2013 (29%) and 2015 (23%). In 2015, more users made 2 calls a day (21%) than in 2013 (20%) and 3 calls a day (23%) than in 2013 (12%). This can be seen in Figure 3.16.

2013 **2015**

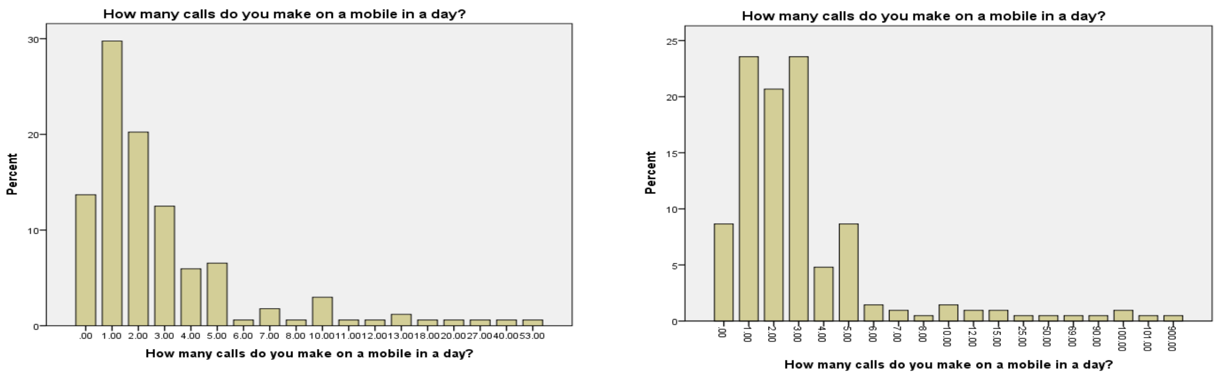


Figure 3.16
Distribution of Means for Calls for 11-14s

14-18s

The 4-18s made more calls in 2013 than 2015, although the pattern was similar to the 8-11s. These can be seen in Figure 3.20. Nearly 30% of users made 1call a day whereas just over 20% made 1 call a day in 2013. Nearly 20% made 3 calls a day in 2015 whereas in 2013, just over 10% made three calls a day.

2013 **2015**

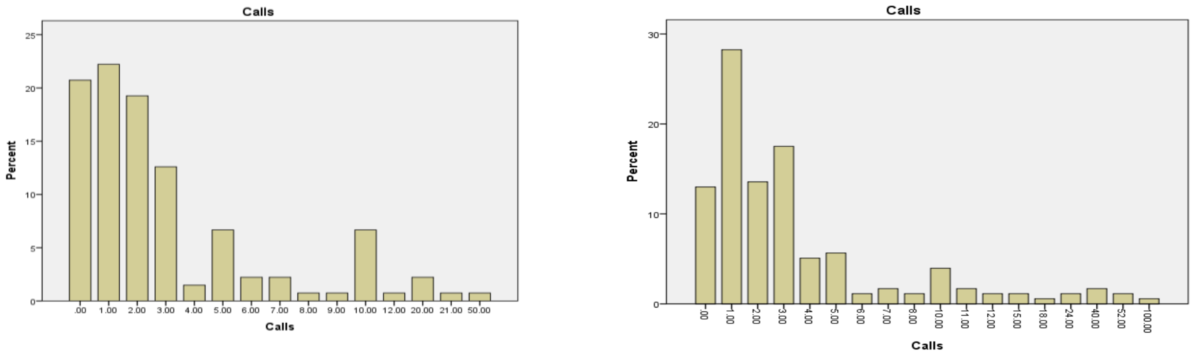


Figure 3.17
Distribution of Call for 14-18s

18-25s

A few users made 1 call a day in 2013 (7%) and many made 100 calls a day (9.5%). Few users made 200 calls a day (5.7%) in 2013 This can be seen in Figure 3.18. As mentioned earlier, a very different pattern was apparent in 2015. The maximum number of calls was 20 and the minimum was 1. The mean was 3.59(52.4). Many users made 1 call a day in 2015 (25.5%). Less users made 2 calls a day (21.5%) than 1 call a day. A few users made 3 calls a day (11.4%). No users made more than 20 calls a day, showing a big change between 2013 and 2015.

2013 **2015**

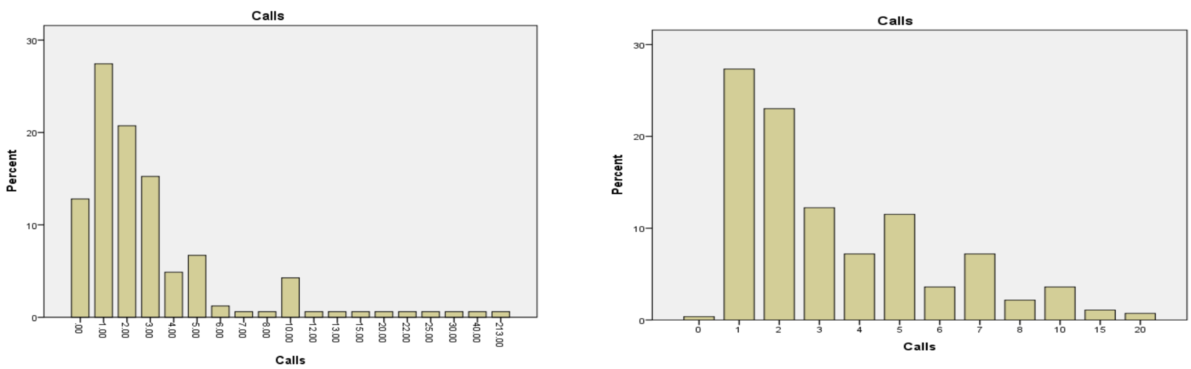


Figure 3.18
Distribution of Call for 18-25s

Texts

The mean and standard deviations for texts for all ages is shown in Table 3.26 along with the maximum and minimum number of texts users made. This suggests that Hypothesis 14 can be confirmed for 11-14s and 18-25s, but not for 8-11s or 14-18s. There was much variability in text use, for example, the standard deviation for text use was 86.97 in 2013 for 11-14s but for 8-11s, the standard deviation was 0.36.in 2015. Variability was also evident in the mean values and the minimum and maximum values. The mean value of texts for 8-11s in 2015 was 7.21 and the maximum value was 60.12 for 11-14s in 2015. The minimum number of texts was 0 for many age groups and the maximum number is 1000 for 11-14s in 2015.

Table 3.26

Mean values of texts

Age group	Mean		Minimum		Maximum	
	2013	2015	2013	2015	2013	2015
8-11	M12.10SD29.01	M7.21SD0.36	0	0	201	100
11-14	M49.55M86.97	M60.12SD49.12	0	0	502	1000
14-18	M53.91SD0.69	M14.33SD25.71	0	0	250	150
18-25	M28.99SD49.71	M34.75SD52.40	10	0	666	500

8-11s

2013 **2015**

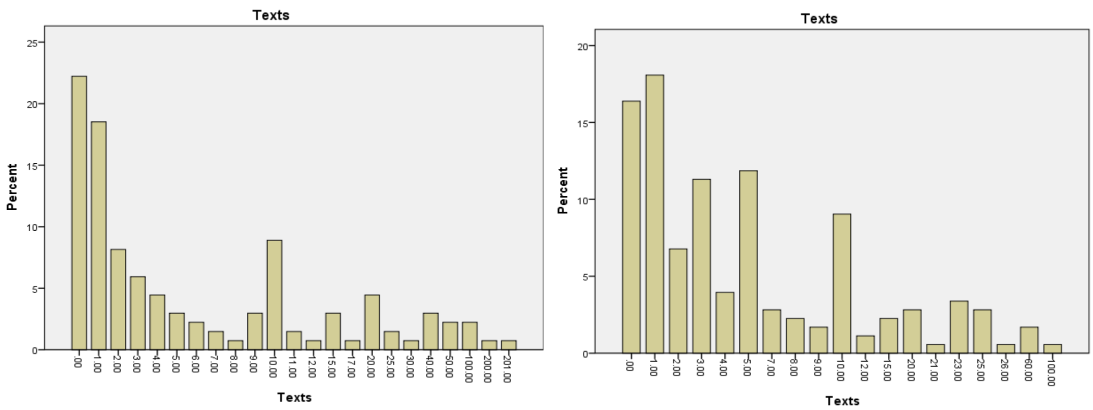


Figure 3.19

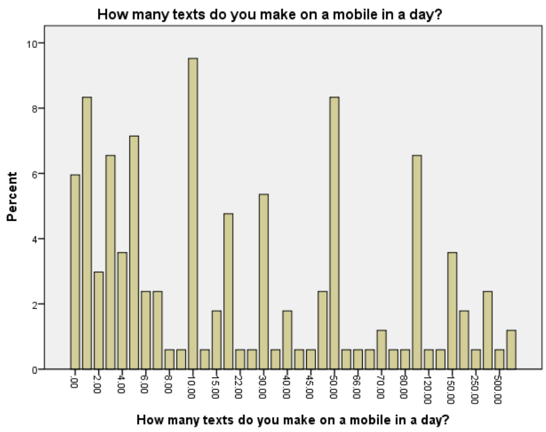
Distribution of Texts for 8-11s

Figure 3.19 shows that many 8-11s (18.5%) made 1 text a day and 8.9% made about 10 texts a day in 2013. In 2015, 18.2% made 1 text a day and 9% make 10 texts a day. A similar pattern appears to be showing in 2015 to 2013. However, more users made about 3 texts a day in 2015 (11.3%) compared to 5.9% in 2013 and more users made 5 texts a day in 2015 (11.9%) than 2013 (11.9%).

11-14s

Figure 3.20 shows that 11-14s made many more texts than 8-11s. Figure 3.23 shows that 18.5% of users made 1 text a day and 8.9% made10 texts a day in 2013. In 2015, 6.7% users made 1 text a day whilst in 2015, 7.7% made 10 texts a day. In 2013, 8.3% made 50 texts day and in 2015, 4.3% made 50 texts a day. Many 11-14s made a 100 or more texts a day in 2013 (17.7%) and 2015 (18.5%).

2013 **2015**



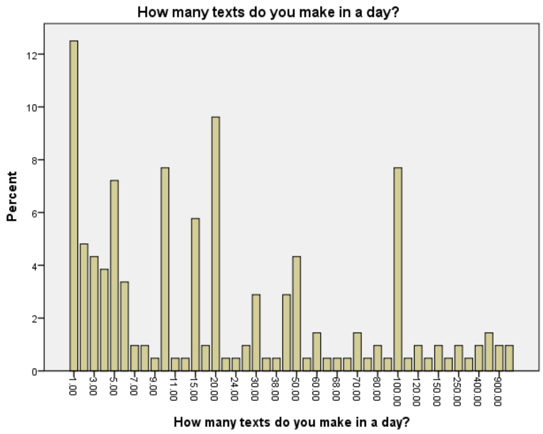


Figure 3.20
Distribution of Texts for 11-14s

14-18s

Figure 3.21 shows just over 5.5% of users made 1 text a day in 2013 whilst in 2015, 24.8% made 1 text a day. In 2013, 10.4% made 10 texts day and in 2015, 10.9% made 10 texts a day. In 2013, 1.4% of 14-18s made 20 texts a day and in 2015 (6.7%). In 2013, 22% of 14-18s made 100 or more texts in a day and in 2015, only 5.4% of users made this amount.

2013 **2015**

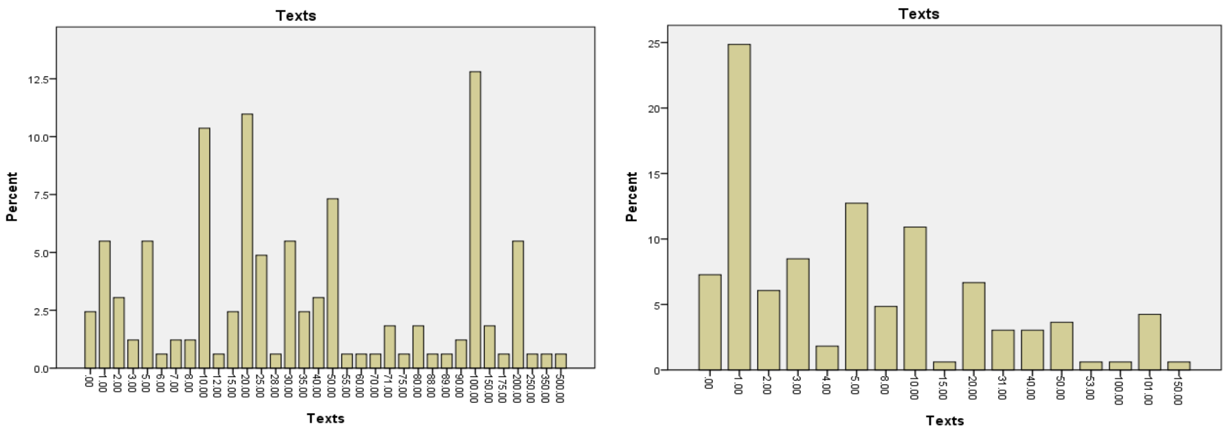


Figure 3.21
Distribution of Texts for 14-18s

18-25s

2013 **2015**

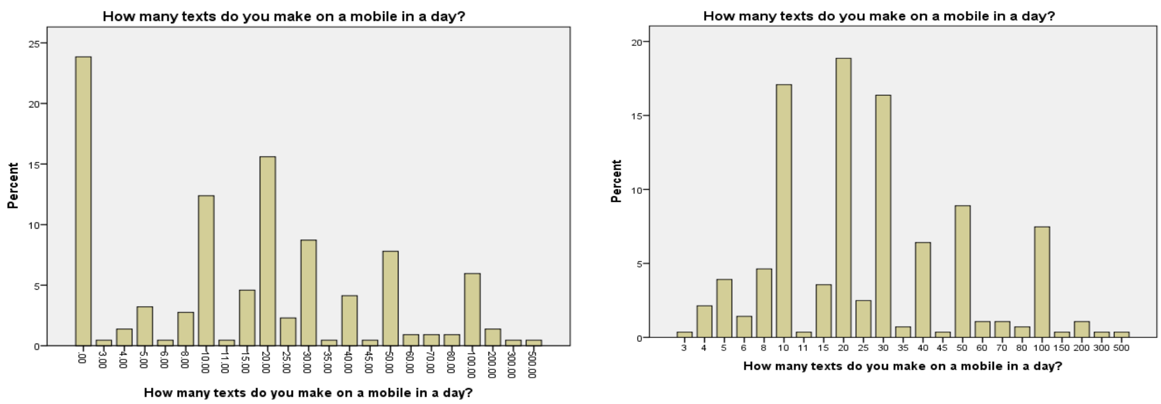


Figure 3.22
Distribution of Texts for 18-25s

Figure 3.22 shows the distribution of texts for 18-25s. In 2013 and 2015, no users made 1 text a day. In 2013, 14.7% made 10 texts day and in 2015, 16.1% made 10 texts a day. In 2013, 15.6% of 18-25s made 20 texts a day and in 2015 17.8% do. More 18-25s made 20 texts a day than 14-18s. In 2013, 7.8% of users made 50 texts and in 2015, 8.4% do. In 2013, 8.4% of 18-25s made 100 or more texts in a day and in 2015, 9% of users do.

3.7.1.4 The Open-Ended questions: The first word responses

The open-ended questions were those asking participants what the first word that comes to mind when they think about mobile phones and what they 'like most' and what they 'like least' about mobile phones. This was an exploratory investigation, so no formal hypothesis was made. Only the first word was analsysed although 3 words were asked in the questionnaire.

The First Word Responses

Analysis of first word responses are reported. A full list of words elicited by respondents are shown in Appendix G. The first ten words elicited from each age group are shown in Table 3.27. Texting was mentioned by users age 8-18 as the first word that comes to mind when they think about mobile phones, and communication was the first word that comes to mind for 18-25s. All first words were then classified into five main categories into a coding scheme for both 2013 and 2015 and are shown in Table 3.28. The categories were: Communication, Evaluative characteristics, Physical Attributes, Entertainment and Cost. Few participants selected words associated with safety as their 'first word', so a category for Safety was not created. The few words that did refer to safety were included in the 'evaluative comments' category. Sample subcategories were further broken down from the main categories to convey different facets of communication. An example of whether the word was positive/neutral, or negative/neutral is shown in the last column of Table 3.28. The intention of the ‘first word’ question was to isolate one concept. Phrases were accepted if a phrase captured the users’ train of thought, for example, ‘Stuck to me’ or ‘Hard to turn on’. The words Communication, Games, Fun, Call, Technology, Social were common in both 2013 and 2015. The most common theme observed was communication, and words related to communication, for example, contact, connect, social and call.

Table 3.27
Analysis showing the percentage of the first ten words

	8-11		11-14		14-18		18-25	
	2013	2015	2013	2015	2013	2015	2013	2015
1	Text (37.5)	Text (20.2)	Text (50.3)	Text (39.4)	Text (44.5)	Text (54.8)	Communication (13)	Communication (14.3)
2	Games (11.8)	Games (15.2)	Communication (9.5)	Fun (4.8)	Communication (6.7)	Call (8.3)	Text (12.1)	Useful (12.3)
3	Fun (7.4)	Fun (6.2)	Games (7.1)	Call (3.8)	Easy (5)	Easy (7.7)	Technology (9.9)	Text (11.9)
4	Talk (5.1)	Talk (5.1)	Friends (4.7)	Social (2.9)	Contact (4.3)	Lovely (7.7)	Useful (9.4)	Iphone (9.8)
5	Phone (2.9)	Electric (3.4)	Contact (3.6)	Games (2.9)	Friends (3.7)	Games (6.7)	Iphone (6.7)	Quick (4.9)
6	Quick (2.2)	Ring (3.4)	Technology (3.6)	Mobile (2.4)	Convenient (3)	Awesome (5.4)	Friends (5.8)	Convenient (8.2)
7	Buttons (2.2)	Dangerous (2.8)	Call (3.0)	Facebook (2.4)	Connect (3)	Distracting (5.4)	Social (5.8)	Social (4.1)
8	Communication (1.5)	Helpful (2.2)	Connect (3.0)	Communication (1.9)	Conversation (1.8)	Friends (5.4)	Call (4.5)	Call (4.5)
9	Cool (1.5)	Amazing (2.2)	Fun (1.8)	Technology (1.9)	Technology (1.8)	Messages (1.2)	Convenient (3.6	Social (4.1)
10	Helpful (1.5)	Friends (2.2)	Social (1.2)	Awesome (1.9)	Awesome	Internet (1.2)	Connect (3.6)	Contact (4.1)

Table 3.28 shows the main categories of the coding scheme for both 2013 and 2015.

Table 3.28

Main categories of the coding scheme for First Words

Main Category	Sample subcategories	Positive or neutral example	Negative or neutral example
Communication	Contact Spoken Language Social Community Bridge distance Micro-coordination Internet communication functions	Connect. Communication. Chatter. Talking. Conversation. Friends. Family. Social. Mum. Girlfriend. Sister. Teenagers. Nanna. Long distance. Anywhere. Arrange. Organise. Snapchat. Facebook. Skype. Facetime. Emails. Instagram. WhatsApp. Apps. Email. Twitter. Selfies. Social Networking.	 Noisy. Anti-social. Privacy. Private.
Evaluative	Ease of Use Usefulness Speed Safety Health Independence Image Mobility Transmission	Easy. Simple. Convenient. Handy. Necessary. Practical. Essential Quick. Fast. Instantly. Emergency. 999. Security. Safe. Safety. Trust. Responsibility. Brain. Freedom. Reliance. Style. Fashionable. Personal. Portable. Mobile. Hand-held. Stuck to me. Wi-fi. Wireless. Network	Hard to turn on. Useless. Stressful. Police. Dangerous. Violence. Hacking. Bullying. Strangers. Radiation Headaches. Dependency. Obsessive. Addictive.
Physical Attributes	Size and shape Phone components	Small. Brick. Light. Compact. Battery. Charger.	

	Ancillary functions Phone makes	Wi-fi. Buttons. Touch screen. Alarm. Camera. Calendar. Blackberry. Iphone. Apple. Nokia. Samsung. Android.	
Entertainment	Enjoyment	Camera. Music. Selfies. Video. Games. You tube.	Distracting.
Cost		Credit. Money. Sim.	Expensive. Cost. Overpriced.

A bar chart was then created to show the distribution of these categories. The aim of this was to capture any major differences between 2013 and 2015.

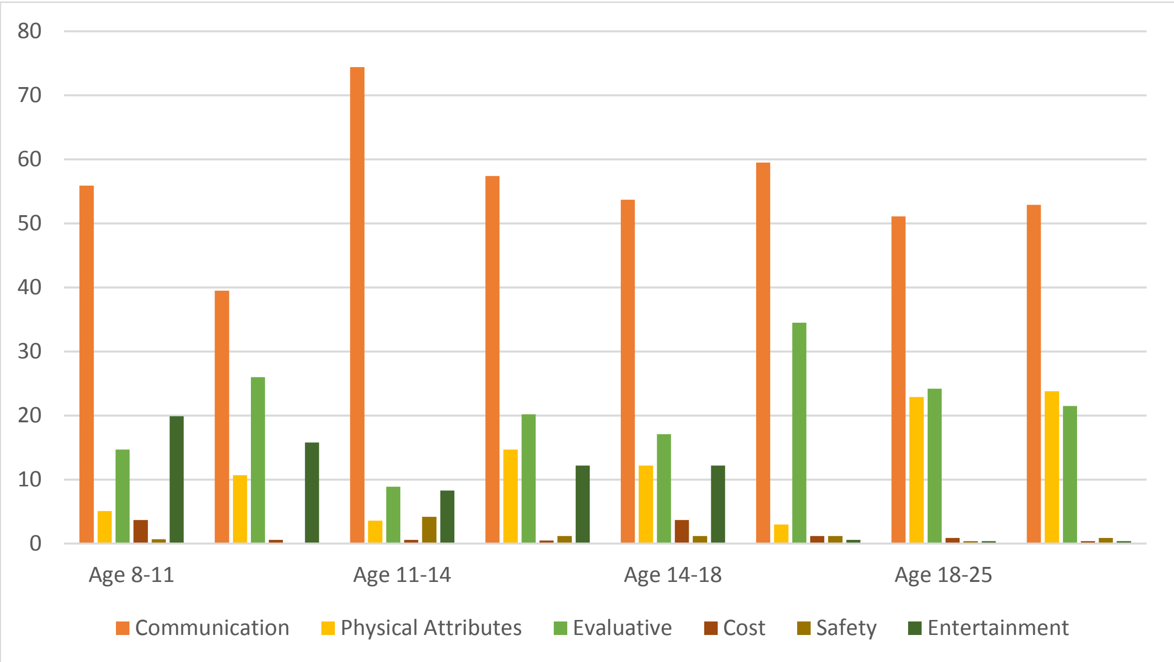


Figure 3.23
Major Categories created for Coding the First Word

Table 3.28 shows that communication is the most important category for all ages. The users who put forward most words associated with communication are the adolescents. More 11-14s chose a word associated with the communicative function of the mobile (74%) in 2013. This decreased in 2015 (57%). The 8-11 age group evidenced a similar drop in the use of words associated with communication from 2013 to 2015, from 56% in 2013 to 40% in 2015. For the 14-18 age group, words associated with communication increased from 2013 (54%) to 2015 (60%). This was also the case for 18-25s. A small increase from 51% in 2013 to 53% in 2015 was seen. Words that make a judgement are referred to as ‘evaluative’ comments. These increased in 8-11s, 11-14s, and the 14-18s from 2013 to 2015 but for the 18-25 age group, there was a small decrease in the number of ‘evaluative words’ from 2013 (24.2%) to 2015 (21.5%). The most ‘evaluative’ words were found amongst the 14-18s in 2015 where 35% of users chose this type of word. The 18-25s chose words that were associated with physical attributes of the mobile most in both 2013 (22.9%) and 2015 (23.8%). These included words such as slim, portable, smart, small. Words associated with safety and security were not mentioned often as can be seen in Table 3.27. The number of words put forward associated with entertainment were highest amongst the younger age group; 20% in 2013 and 16% in 2015. Reference to words associated with entertainment tended to decrease with age, although there was a high percentage of 14-18s (12%). For the 18-25s, this was negligible at 0.4%.

Overall, there were more positive words associated with mobile phones than negative. A sample of descriptive words are outlined in Table 3.29.

Table 3.29

Descriptive First Words

Positive	Negative
Cool. Swanky. Awesome. Lovely. Fun. Clever. Entertaining. Delicate. Valuable. Important. Amazing. Intelligent. Happy. Creative. Exciting. Fantastic. Enjoyable. Amusement. Good. Trust. Fancy. Nice.	Boredom. Annoying. Frustrating. Pain. Harmful. Weird. Addicting. Annoying. Irritating. Noisy. Awkward. Hurtful. Rubbish. Wrong. Lazy. Obsessive. Distracting.

3.7.2.2 The Open-Ended Questions: Like Most/Like Least Responses

Participants identifed the one thing they 'liked most' and the one thing they 'liked least' about using a mobile. It was thought that the majority of 'like most' responses will be related to the communicative capacity of the mobile phone**.**'To get an idea of how many positive and negative 'like most' and 'like least' comments were made about mobiles, comments were analysed for the 11-14 age group. This is shown in Table 3.31. There were many positive comments about the communicative aspects of mobiles (65%) and a few negative comments (17%).in 2013. These were less in 2015 with 58% of positive comments and 13% of negative comments. For physical aspects of the phone, there were few positive comments (4%) in 2013 but many negative comments (32%). This increased in 2015 to 5% of positive comments and 47% of negative comments. These mainly referred to the problems of the lack of signal and the battery, but also to issues around the safety on the mobile phone. These were higher in 2013 (27%) than in 2015 (10%). There were many positive comments about Safety. These refer to 'feeling safe' if there is an emergency. Table 3.31 represents the major components of the coding scheme and sample subcategories, with examples from participants' responses. For example, in the main category of 'evaluative' comments, the positive subcategory was 'freedom' and the negative subcategory was 'dependency'.

Table 3.30.
Percentage Responses for what Users 'Like most' and 'Like least' about Mobile Phones

	2013		2015	
	Like most	Like least	Like most	Like least
Communication	65	17	58	13
Physical	4	32	5	47
Evaluative issues	10	27	14	15
Cost	0	8	10	10
Safety	19	27	2	10
Entertainment	5	1	10	1

Table 3.31
Coding of the 'Like Most' and 'Like Least' Responses

Major Category	Sample Subcategories Like most	and Examples Like least
Communication	Contact (e.g. 'Talking to my mates') Contact others (e.g. 'Speak to friends') Others contact me (e.g. 'being hassled to go anywhere, as long as I have my phone') Written language (e.g. 'that you can text people') social community (e.g. 'Stay in touch with friends and family easily') Bridge distance (e.g. 'That you can phone all over the world')	Contact (e.g. 'Banter') Contact others (e.g. 'Facebook') Others contact me (e.g. 'Parents can consult me whenever') Un-welcome contact (e.g. 'You might get sales calls') Bullying ('It could be used as a way of cyberbullying')
Physical	Multipurpose device (e.g. 'You can get apps on them and text your friends and take selfies')	Size (e.g. They're slowly getting bigger) Ergonomic (e.g. 'They have small buttons')
Evaluation Issues	Freedom (e.g.' the feeling of being kind of free for five minutes while you're on it') Mobility ('portable, hand-held') Convenience (e.g. 'Fast contact with others') General evaluative terms (e.g. They're cool and I like the look of them') Personalisation (e.g. You can have your own mini photo album) Identity (e.g. It's yours and on-one else's and you can connect with people')	Dependency (e.g. 'That texting can take over your life') Equipment issues (e.g. 'When they run out of battery' Transmission issues (e.g. 'The internet is not very fast, no wi-fi') General evaluative terms (e.g. 'slow sometimes, don't work and they break easily'') Identity (Competition between friends about whose 'got the best')
Cost	No comments	Affordability (e.g. 'It cost a lot of money')
Safety	General issues (e.g. 'They can save you if you're lost, or for phoning home')	Safety of handset (e.g. 'They are bad for driving') Safety ('People can get your details and stuff')
Entertainment	Action (e.g. 'to be able to access different media, apps, social networking sites, music, games and reading from the internet')	Action (e.g. Games)
No comment		
Nothing		

3.7.2 The Interviews

A full list of the interviews is presented in Appendix G. An Interpretative Phenomenological Analysis (IP|A) was created from these interviews for all ages. The themes of the Interpretative Phenomenological Analysis (IPA) are shown in Table 3.32.

Table 3.32
Main themes of the Interpretative Phenomenological Analysis (IPA)

Super-ordinate themes	Emergent themes	Sub themes (used for)	Phone function
Communication	Positive: being able to keep in touch with friends and family Negative: Dependence Addiction being woken up in the night	Micro-coordination Hyper-coordination Perpetual contact Being woken up in the night; constant checking	Texting Calling Internet Social media: for example, Snapchat Facebook for 11s and over
Evaluative issues	Usefulness for homework, school, college or university work and organising schedules	For studying Functionality Microcoordination Hyper-coordination	Texting Reminders Calculations Storing
Safety and Security	Emergency situations Cyberbullying	Positive: safety afforded, for example, Good if there is a fire Walking home at night Negative	Calling
Physical Attributes	Positive: Aesthetics, e.g. slim Negative: Frustration	Dissatisfaction	Fragility of phone, Battery, Signal
Immediacy	Instant action and results		Calling, internet, maps, reminders
Keeping up to date	Trends/News	Sense of ‘being out there’/’on it’	Internet, Social media
Safety and Security	Emergency situations	Good if there is a fire	Calling
Cost	Negative aspects: go over text limit		Calling, internet, maps, reminders
Entertainment	Leisure	Enjoyment	Internet, listening to music, playing games

Eight main themes were identified. These were Communication, Physical Attributes and Functions, Evaluative Issues, Cost, Safety and Security, Immediacy, Keeping Up to Date and Entertainment. It is evident that communication was the prime function of the mobile phone, but other areas were also important. The themes of immediacy and keeping up to date were more important for the older users, but some younger users show evidence of the importance of these areas. The interest and importance of these areas increased with age.

3.7.3 Everyday Concerns

This section presents the results from the questionnaires and the interviews representing physical, cognitive and social concerns of everyday use of mobile phones and associated behaviour. Physical concerns were musculoskeletal effects, hearing, vision, headaches, and damage to fertility. Cognitive concerns were to do with attention and multi-tasking. Social concerns were to do with screen use, sleep, dependence, addiction and reasons for talking or texting.

3.7.3.1 Physical concerns: Musculoskeletal, Fertility, Vision, Hearing and Headaches

Where do you Carry your Mobile when on the Move?

The most reported place to keep a mobile for all ages was in a pocket. This can be seen in Table 3.33. For 8-11s, nearly a half carried their phone in a pocket in 2013 (46%) and this increased slightly in 2015 (49%). In 2013, three quarters of 11-14 years old users kept their phone in a pocket (75%) but this decreased by 2015 (64%). In this age group, fewer users carried their phone in a bag. This increased from 2013 (14%) to 2015 (29%). For 14-18s, nearly two thirds kept their phone in a pocket (63%) and this decreased by 2015 (54%). For

18-25s, under half of users carry their phone in a pocket in 2013 (42%) but this increased by 2015 (48%).

Many users carried their phone in a bag, In 2013 there were 34% of 18-25sdoing this and in there were 29%. They were also the age group who carried their mobile phone in their hand more than other age users. This is similar for both 2013 (24%) and 2015 (23%). Carrying a phone in a bag increased for 11-14s and 14-18s in 2013 (14%, 23%) and 2015 (23%, 39%) respectively but decreased for 8 to 11s from 2013 (32%) to 14%). Very few users carried their phone slung on a belt. Those users who say they carried their phone in a place other than a bag, a pocket, slung on a belt or in their hand, reported carrying their phone on the dashboard when driving or in the car compartment near the gear stick. Two users said they carry their phone in their bra.

Table 3.33
Where do you Keep your Mobile Phone when on the Move (shown in percentage)?

	8-11		11-14		14-18		18-25	
	2013	2015	2013	2015	2013	2015	2013	2015
In a bag	32	14	14	29	23	39	34	29
In a pocket	46	49	75	64	63	54	42	48
Slung on a belt	2	2	2	6	4	1	0	0
In my hand	8	9	9	2	10	6	24	23
Other	12*	8	0	1	0	0	3	3

*Other refers to additional areas that users keep their mobiles in

Do you use your fingers, thumbs or both your fingers and thumbs when using a mobile?

The results are shown in Table 3.34. Participants who used their fingers and thumbs the most were the 8-11s in both 2013 (57%) and 2015 (57%) whereas the 14-18 years old users used their fingers and thumbs the least in both 2013 (33%) and 2015 (33%). The 11-14 years old users revealed that just under a third used their fingers and thumbs (30%) in 2013 and just over a half do in 2015 (53%) whereas the 18-25s used fingers and thumbs more in 2013

(47%) than 2013 (42%). In 2015, using fingers and thumbs increased to over half of 11-14s (53.9%).

The 14-18 years old users used thumbs only the most in 2013 (64%) and 2015 (63%) followed by university users, where over half of users used thumbs only in both 2013 (52%) and (53%). Both these age groups showed little change over the two-year period. The biggest increase for thumbs only uses of the mobile was in the 11-14 age group, where thumbs only use increased from 2013 (24%) to 2015 (40%). Very few 11-14 years old participants used only their fingers (8%) in 2013 and in 2015 (7.2%).

Table 3.34
Fingers, Thumbs or Both?

	8-11		11-14		14-18		18-25	
	2013	2015	2013	2015	2013	2015	2013	2015
Fingers	16	23	8	7	3	4	18	5
Thumbs	24	20	24	40	64	63	52	53
Both fingers and thumbs	57	57	30	53	33	33	47	42

The age group using fingers only the most were the 8-11 years old users in both 2013 (16%) and 2015 (23%). This increased from 2013 to 2015, whereas for 18-25s using fingers only to operate the mobile decreased from 2013 (18%) to 2015 (5%). Very few participants used fingers only for 11-14s and 14-18s in both 2013 (8%, 3%) and 2015 (7%, 4%) respectively.

3.7.1.2. Cognitive Concerns: Multitasking

Hypothesis 17 predicts that the number of users multitasking will increase over the two-year period.

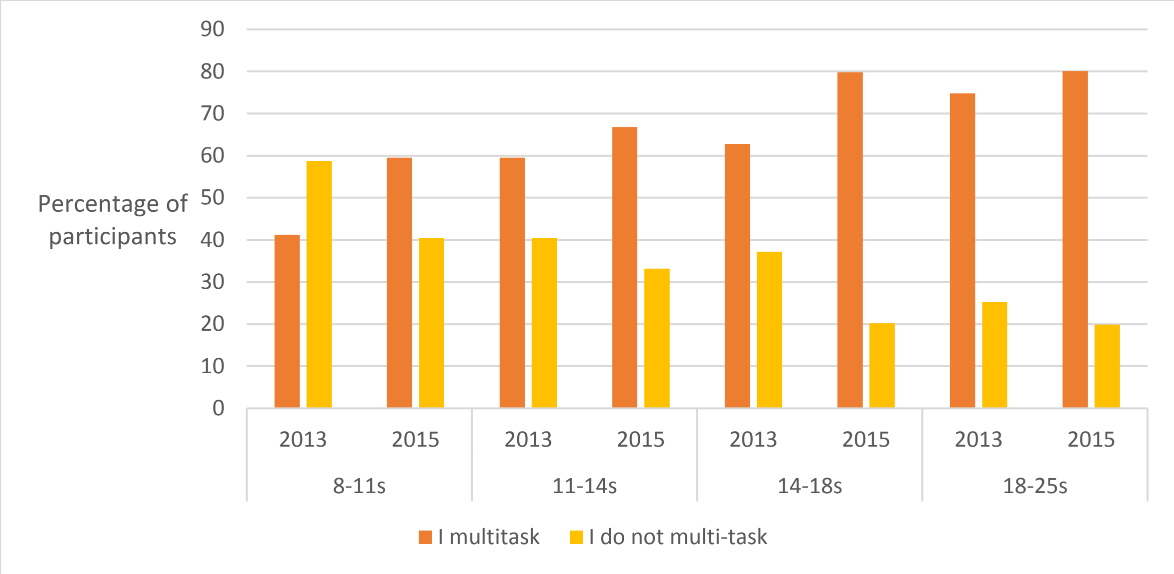


Figure 3.24
Multitasking with a Mobile

Figure 3.27 shows multitasking did not increase from 2013 to 2015 and refutes Hypothesis 17. More 8-11s reported multitasking in 2015 (59%) than in 2013 (41%). Multitasking increased with age. From 59% to 67% for 11-14s, 63% to 80% for 14-18s and from 75% to 80% for 18-25s. The biggest change was for the 8-11s.

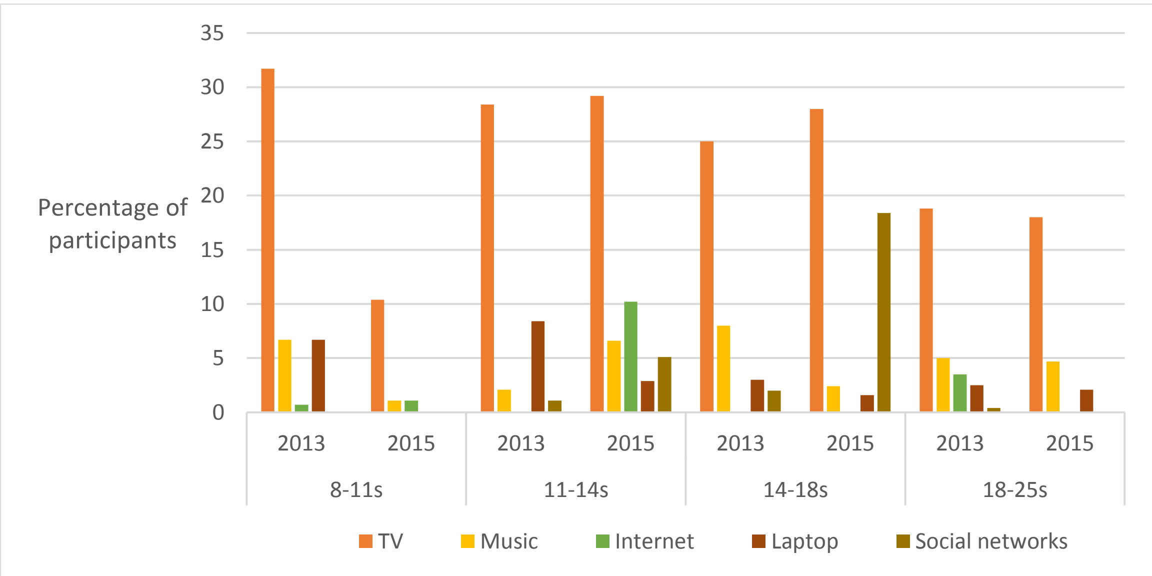


Figure 3.25
Reported Media Multitasking Activities by Users

Data was collected on the type of activities users liked to multitask with. Figure 3.28 shows the five most reported multitasking activities. Watching TV was by far the most reported activity. This was highest for the 8 to 11s in 2013 but dropped over 20% for this age group in 2015. The 18-25s multitasked less than the other age groups. Results that stand out are those for 14-18s in 2015 where 18% reported multitasking with social networks. The next highest group who reported multitasking with social networks were the 11-14s in 2015. Figure 3.25 shows that 5% multitask in 2015. Multitasking with social networks was low for 18-25s in 2013 and was not a use in 2015. Other frequently reported activities to multitask with were listening to music, using a laptop and the internet. Other reported multitasking activities included using an iPod or computer, walking, talking, eating, playing games, horse riding, using Facebook or other social network sites. A surprising finding was that 11-14s reported playing with games (play station, game console or Xbox) less in 2015. This decreased to 4% from 12% in 2013. The third most reported multitasking activities were homework (5%) and talking (5%) in 2015.

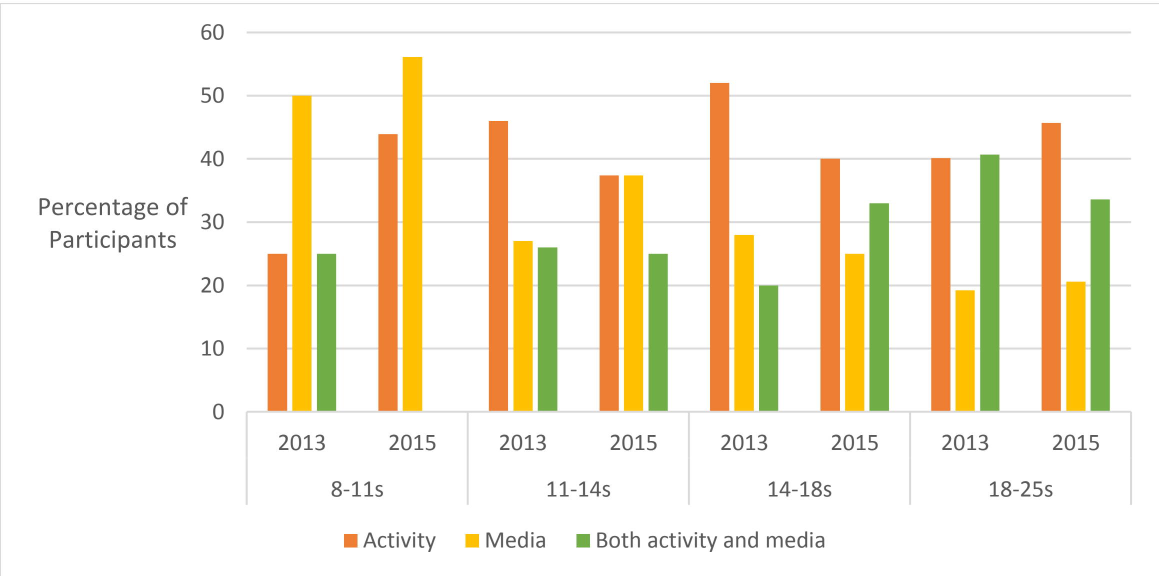


Figure 3.26
Comparison of Reported Media and Activity-Based Multitasking

Tasks were either activity based or used technology. The latter, as mentioned in Chapter 2, is described as media multitasking.

To further explore the results of this data, behaviour was categorised into activity or technology based multitasking behaviour (media multitasking). This is shown in Figure 3.26. Hypothesis 16 predicts that more users will report media mulittasking than multitasking with activity- based tasks. This was not supported except for the 8-11 age group. More 8-11s reported media multitasking than multitasking with an activity in both 2013 and 2015. Media multitasking increased for the 8-11s and 11-14s but decreased for the 14-18s and the 18-25s. For 11-14s, the same number of user's media multitasked as multitasked with an activity-based task in 2015.

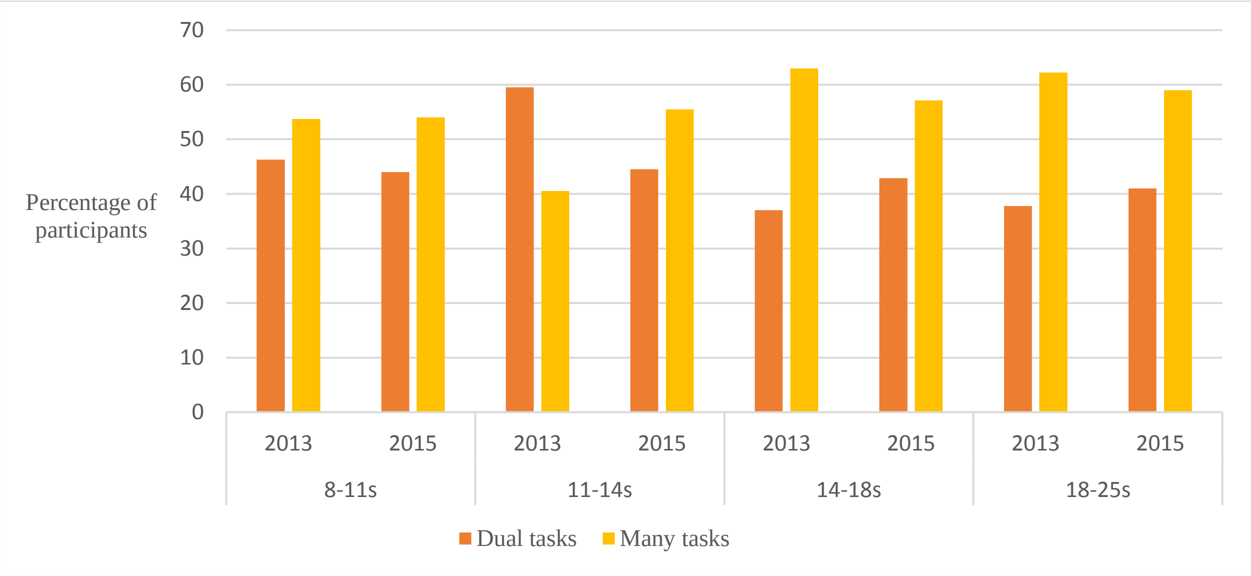


Figure 3.27
Dual or ManyTtasks?

The data was also split into those participants who used their mobile along with one other task, dual tasking, or with many other tasks. All age groups, except for the 11-14s in 2013, reported dual tasking more than they 'many task' in each year.

3.7.1.3 Social concerns: Communication, Dependence, Sleep, Addiction and Screen use

The results of questions related to communication, screen use, dependence, sleep and addiction from the questionnaires and interviews are presented.

Communication

This section reported the results of reasons given for communicating on a mobile phone. Data was collected on the types of mobiles participants owned and the method of payment they used for their phone. The latter data is presented in Appendix H and I respectively. Results in this section include answers to questions on who participants liked to contact on a mobile and which communication media they preferred to use.

Who do you Contact on a Mobile?

Figure 3.28 shows whether users preferred to contact friends, parents or siblings most.

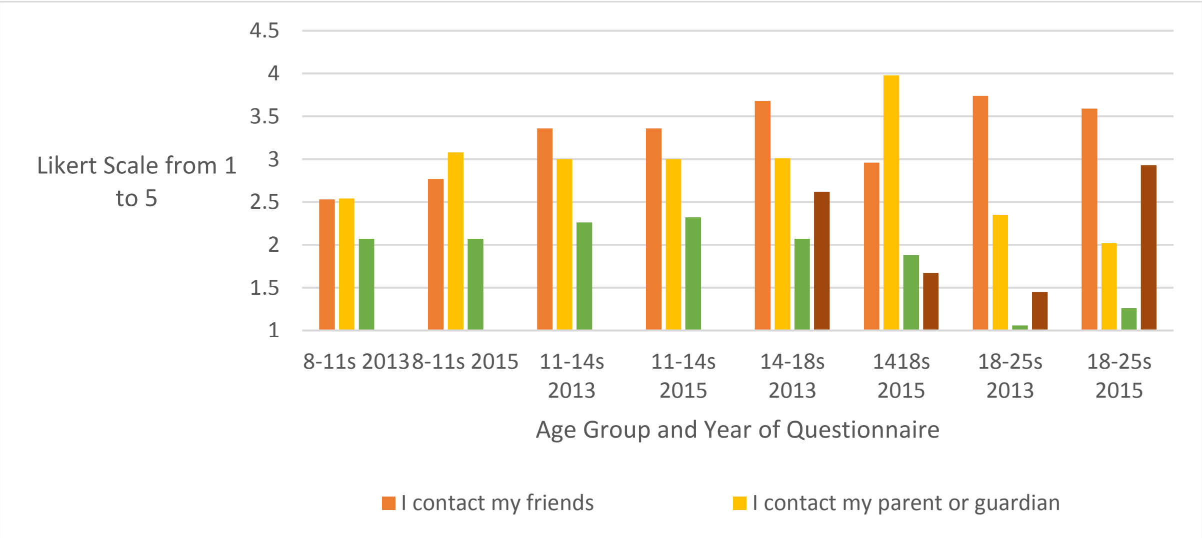


Figure 3.28
Who do Users Report Contacting on a Mobile?

Nearly all ages reported contacting their friends most, except for 8-11s and 14-18s in 2015 who reported contacting their parents most. Siblings are the next group that users reported contacting except for the 18-25s where users reported contacting partners as much as parents in 2013 and more than parents in 2015.

How do Users Like to Contact Others?

8-11s

For 8-11s, face to face contact (*M* 3.71) is the preferred way of contacting in 2013, followed closely by texting (*M* 3.49) and calling (*M* 3.16*)* on the mobile. In 2015, talking on the phone (*M* 3.07) is preferred to face to face contact (*M* 3.71), followed by texting (*M* 3.60). Other results can be seen in Figure 3.29.

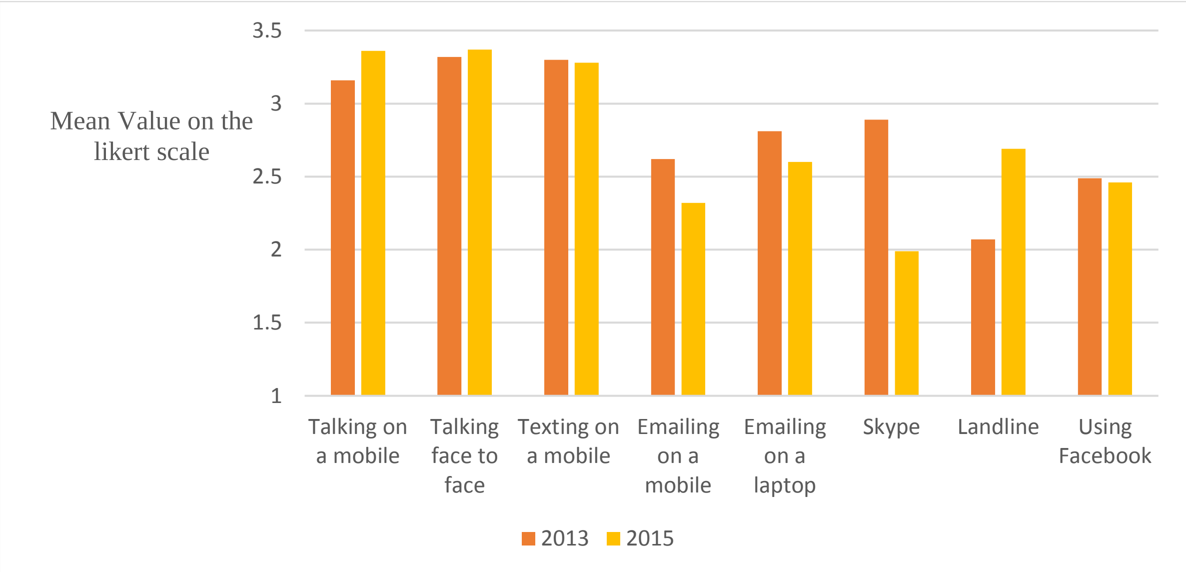


Figure 3.29
How do 8-11s Like to Contact People?

11-14s

More 11-14s reported face to face contact (*M* 3.61) as their preferred way of contacting in 2013, followed by texting (*M* 3.42), then Facebook (*M* 3.36) and then talking on a mobile (*M*

1.84). This can be seen in Figure 3.30. In 2015, texting (*M* 3.49) was the preferred way of contact to face to face (*M* 3.32). This was followed by talking on the phone (*M* 3.32) and then Facebook (*M* 3.19).

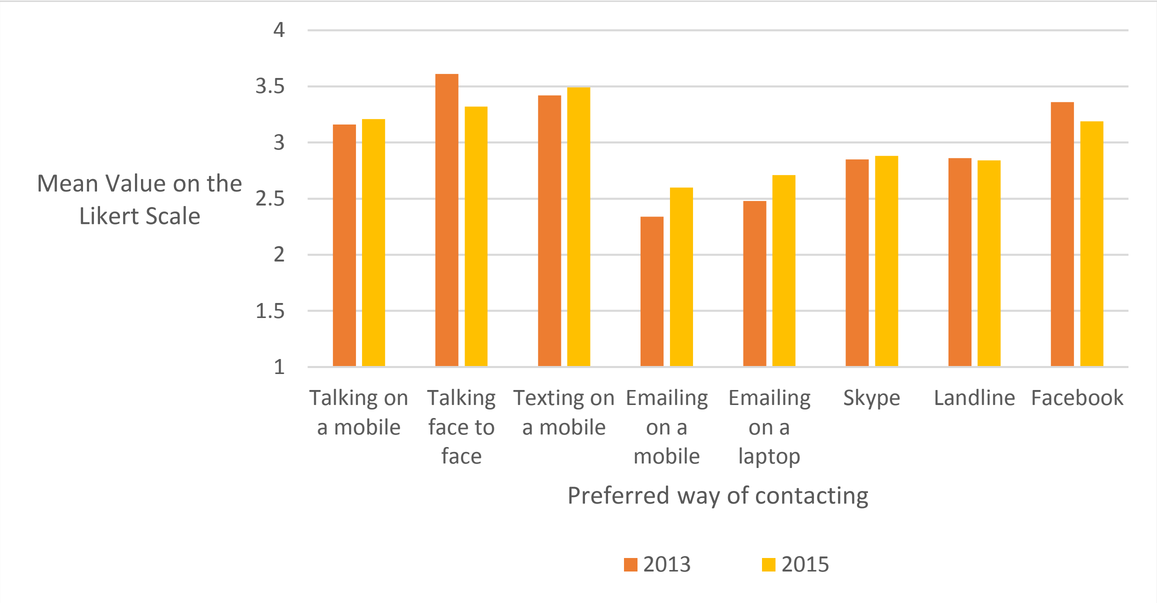


Figure 3.30
How do 11-14s Like to Contact People?

For 11-14s, independent 't' tests were carried out to see if the differences were significant between 2013 and 2015. An independent 't' test showed that the difference in scores for face to face contact were significant. This was shown by the results for 2013 (M = 3.61, SD = 0.78), and 2015 (M = 3.32, SD = 0.86, t (376) = -2.08, $p<0.04$). The difference in scores were also significant for texting; (M = 1.39, SD =0.56), and 2015 (M=1.63; SD = 0.67, t (376) = -3.89, $p<0.01$). Making contact through Facebook was also more common for 11-14s in 2013. The mean value for 11-14s liking to contact people through email on a laptop or on a mobile was greater in 2015 than 2013. An independent 't' test showed that the difference in scores for participants liking to contact people through email on their mobile was significant for 2013 (M = 2.34, SD =0.60), and 2015 (M = 2.60; SD = 0.74, t (376) = 4.30, $p<0.01$). The mean value for 11-14s liking to contact people through email on a laptop was also significant. An independent ‘t’ test showed that the difference in scores was significant in 2013 (*M* = 2.48, *SD* = 0.66), and 2015 (*M* = 2.71; *SD* = 0.71, t (376) = 4.30, p<.01). The results for whether participants preferred to contact people by texting, calling, skype or landline did not show any significant difference.

14-18s

The results for which method of contact 14-18s preferred is shown in Figure 3.31.

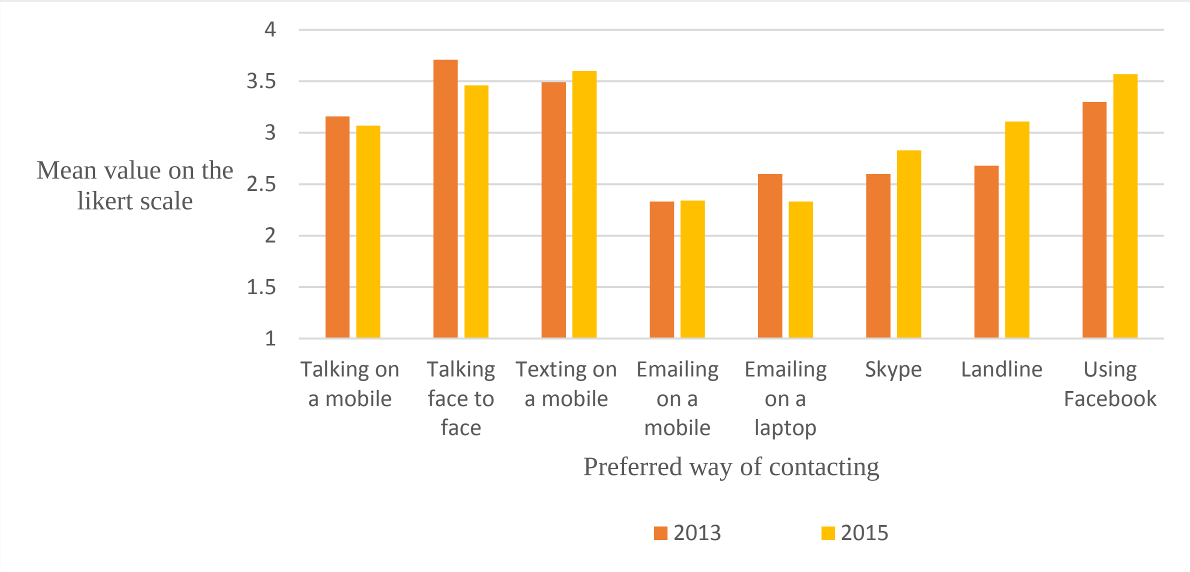


Figure 3.31
How do 14-18s Like to Contact People?

Face to face contact (*M* 3.71.) was reported as the preferred way of contacting in 2013, followed closely by texting (*M* 3.49). This can be seen in Figure 3.3. In 2015, texting (*M* 3.6) was the preferred way of contact, followed by Facebook (*M* 3.57) and then talking face to face (*M* 3.46). The next reported method of contact was on the landline (*M* 3.11) and then talking on the mobile (*M* 3.07). The results for 14-18s showed a similar pattern to the results for 11-14s.

18-25s

The results for which method of contact 18-25s said they preferred is shown in Figure 3.32. Face to face contact was reported as the preferred way of contacting in 2013 (*M* 3.49*)* and 2015 (*M* 3.06), followed closely by texting in 2013 (*M* 3.06) This changed in 2015 (*M* 1.58), where texting dropped considerably as a chosen method of contact. This was replaced by Facebook (*M* 2.9) which was used more than texting or calling (*M* 2.44) for contact purposes. Emailing and skype were reported more as a way of contacting than texting but calling was still preferred to using email on a laptop or skyping. The use of Facebook was similar in 2013 and 2015. It was not reported as much as a way of contact by 18-25s as it was for 11-14s and 14-18s.

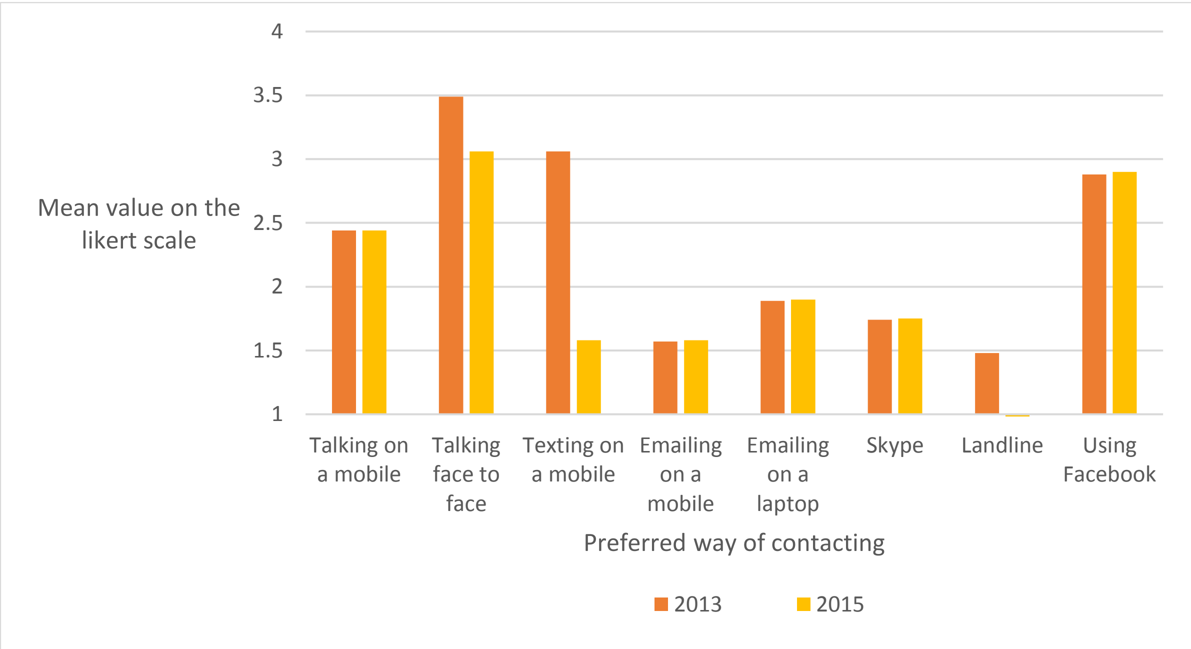


Figure 3.32
How do 18-25s Like to Contact People?

Reasons to contact

8-11s

The reasons participants like to call are shown in Figure 3.33. The reason they reported calling most is to keep in touch with family (*M* 3.32), and then for calling in an emergency (*M* 3.25) and checking 'to say where I am or where someone else is' in 2013. Slight changes occur in 2015 with the reporting of being able to call in an emergency (*M* 3.44) being the most reported function, then checking 'to say where I am or check where someone else is' (*M* 3.44) and for keeping in touch with family (*M* 3.35). As a representative sample, independent 't' tests were carried out for 8-11s to compare differences between 2013 and 2015. The Independent 't' test revealed that there was a significant difference between 2013 and 2015 for friends calling to say Hello and Chat, in 2013 ($M = 2.85$, $SD = 0.75$) and in 2015 ($M = 3.12$, $SD = 0.77$, t(376), $p<.001$), d=0.36.

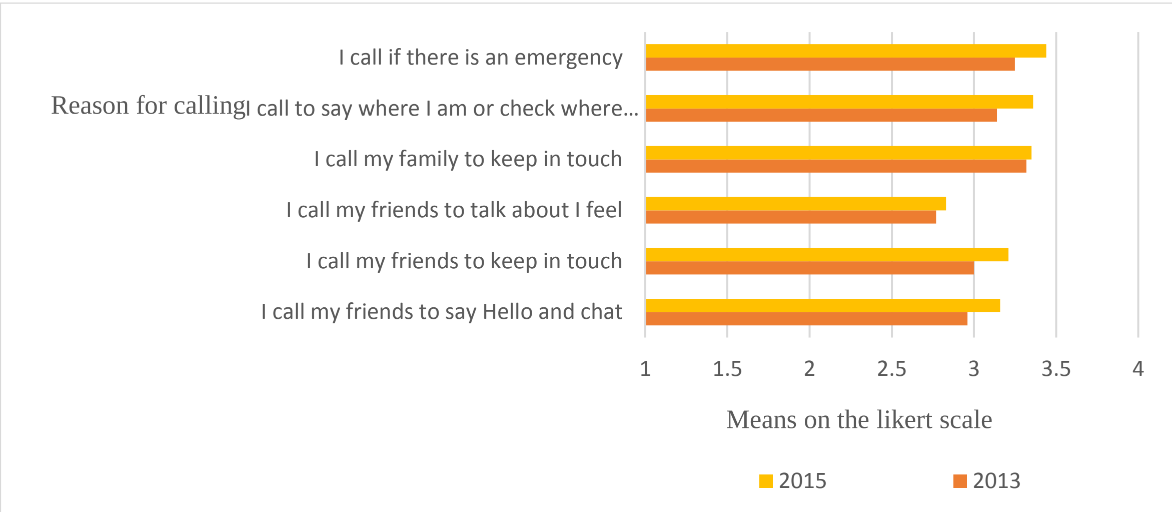


Figure 3.33
Reasons for Calling for 8-11s

There was also a significant difference in 2013 for friends calling to keep in touch ($M = 2.87$, $SD = 0.70$) and in 2015 ($M = 3.14$, $M = 1.03$, t(376) = 3.02, $p<0.03$), d=0.32. Other results for differences between 2013 and 2015 for reasons for calling were not significant

11-14s

The most reported reason for 11-14s was calling to say ‘where I am or check where someone else is’ (*M* 3.4) in 2013 and in 2015 (*M* 3.48). For all other reasons given, the reasons were more important in 2013 than 2015. In 2013, the second most reported reason was calling ‘family to keep in touch’ (*M* 2.85) and then calling ‘friends to keep in touch’ (*M* 2.61). For 2015, the second most important reason was calling ‘family to keep in touch’. (*M* 2.85) and then for calling in an emergency (*M* 3.22) in 2015. Further results are shown in Figure 3.34.

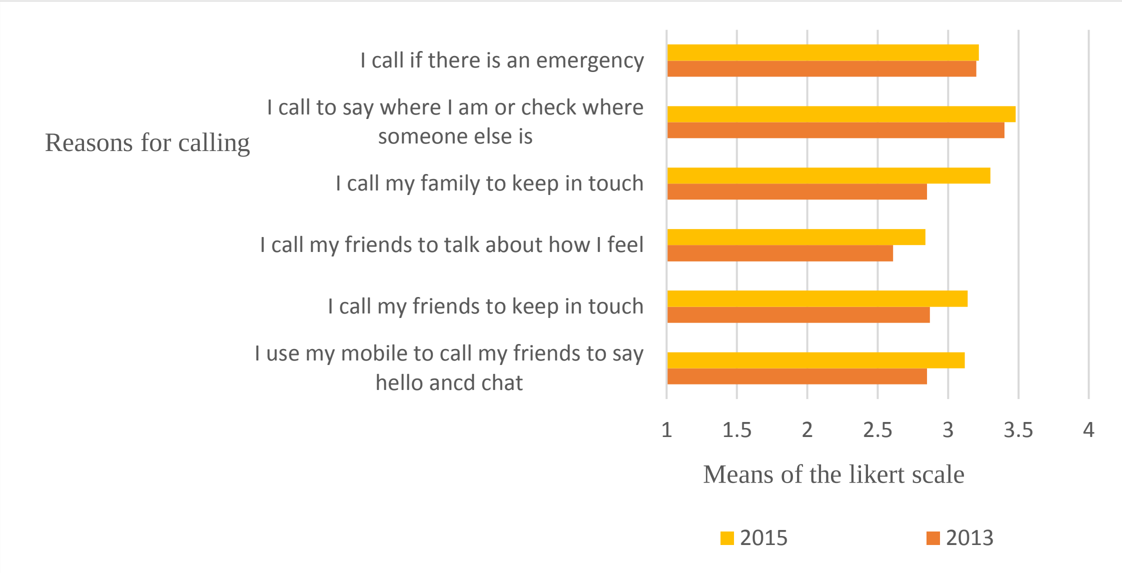


Figure 3.34
Reasons for Calling for 11-14s

14-18s

The most reported reason for 14-18s calling was to say where I am or ‘check where someone else is’. The mean results show that this was more important in 2013 (*M* 3.55) than 2015 (*M*3.39). The second most reported reason for calling 2013 was for being able to use the mobile for an emergency (*M* 3.34). The next most reported reason was calling family to 'keep in touch' but only in 2013 (*M* 2.98). Results are shown in Figure 3.35. In 2015, the second most reported reason for calling was to 'keep in touch' with family (*M* 3.04) and the third was to 'keep in touch' with friends (*M* 2.9)

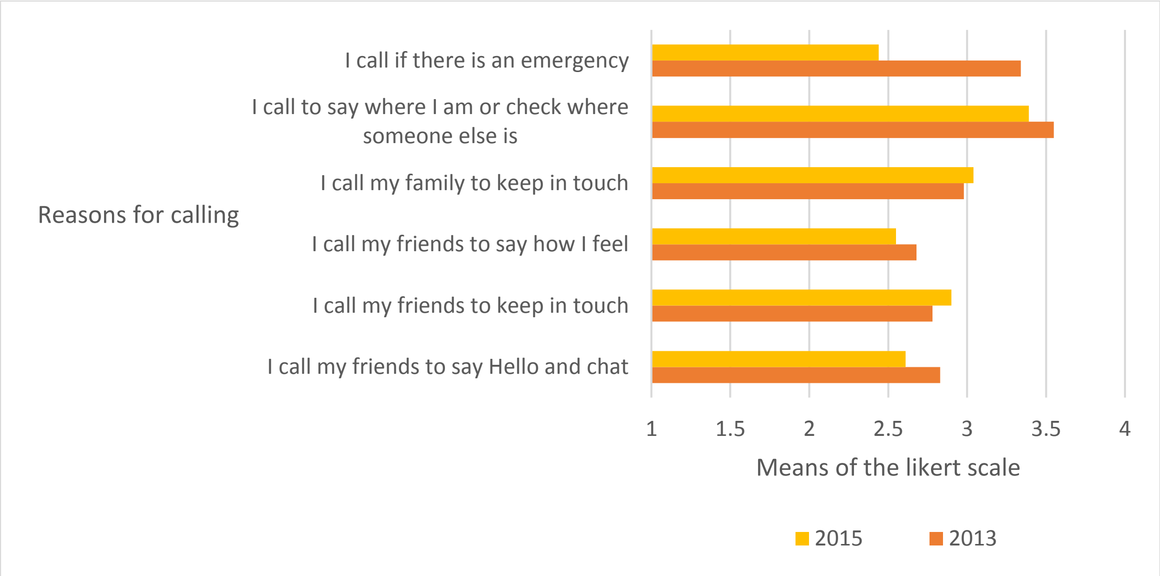


Figure 3.35
Reasons for Calling for 14-18s

18-25s

Results are shown in Figure 3.36. The most reported reason for 18-25s calling was 'to check where I am or check where someone else is'. Mean results show that this was reported more in 2013 (*M* 2.93) than 2015 (*M* 2.83), again this was only by a tiny amount. After calling to check 'where I am or check where someone else is', the next most reported reason for 2013 calling was to 'keep in touch' with family (*M* 2.86) and then calling in an emergency (*M* 2.85). In 2015, the second most reported reason for calling was to 'keep in touch' with family (*M* 2.28) and then calling to 'keep in touch' with friends (*M* 2.21). As with the 11-14s and 14-18s, the mobile was used less for calling friends 'to talk about how I feel'.

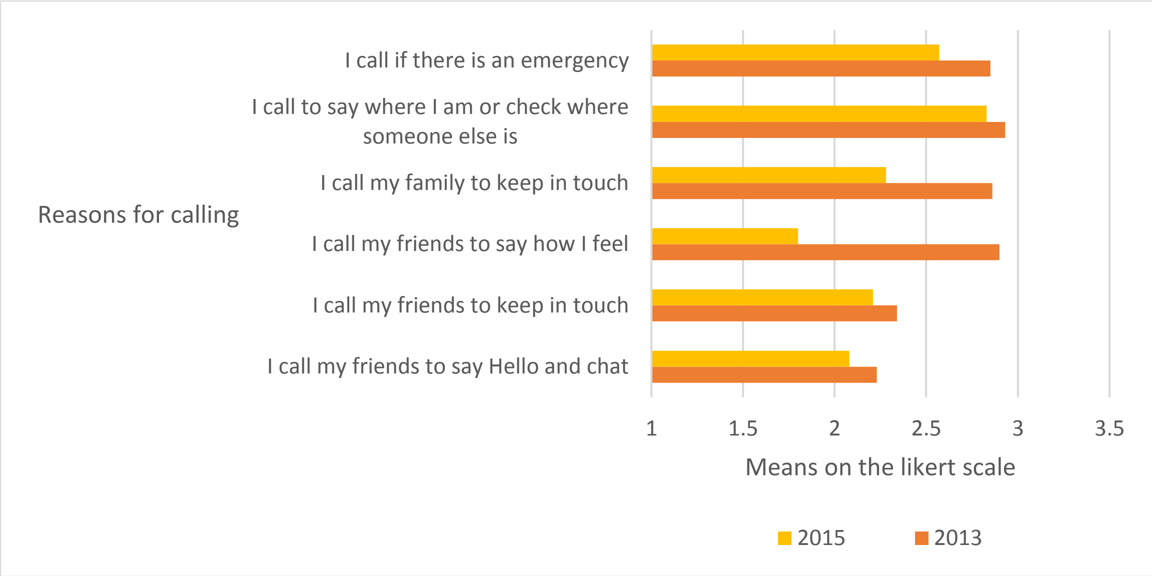


Figure 3.36
Reasons for Calling for 18-25s

Reasons for Texting

8-11s

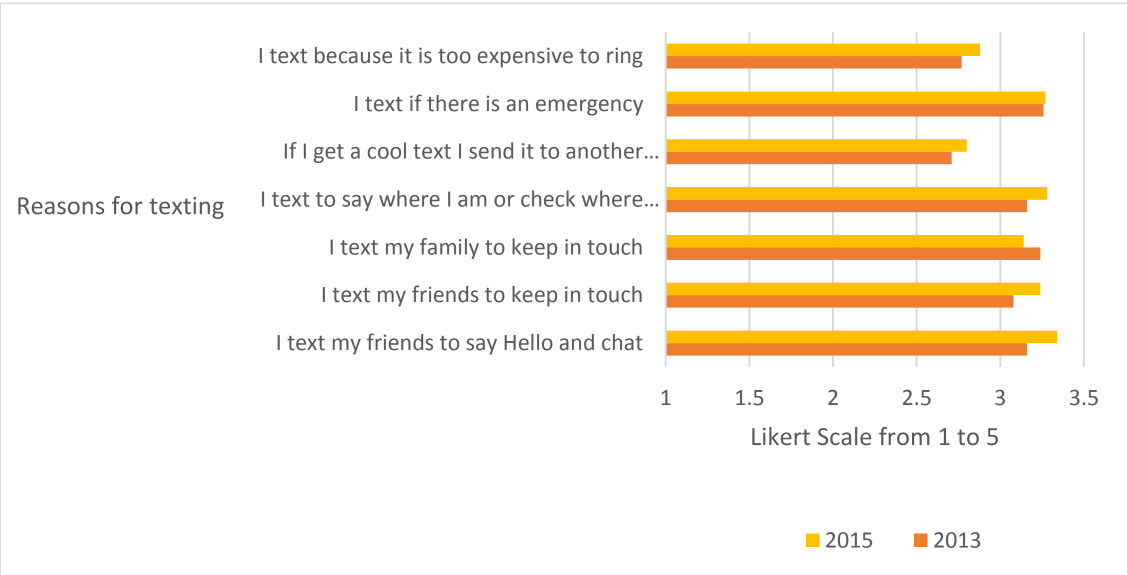


Figure 3.37
Reasons for Texting for 8-11s

Results are shown in Figure 3.37. All reported results for means for reasons why users decided to text was within the mid-point mark of 2.5, so all reported factors can be considered important, some more than others. The most reported reasons for 8-11s texting was to communicate in an emergency in 2013 (*M* 3.26). This was followed closely by texting to keep in touch with family (*M* 3.24) and then to 'say where I am or check where someone else is' (*M* 3.16) and to say Hello and chat (*M* 3.16). In 2015, the most important reason for texting was to say Hello and chat (*M* 3.34). The next most important reason for texting was 'if there is an emergency' (*M* 3.27). and then texting family 'to keep in touch' (*M* 3.24).

11-14s

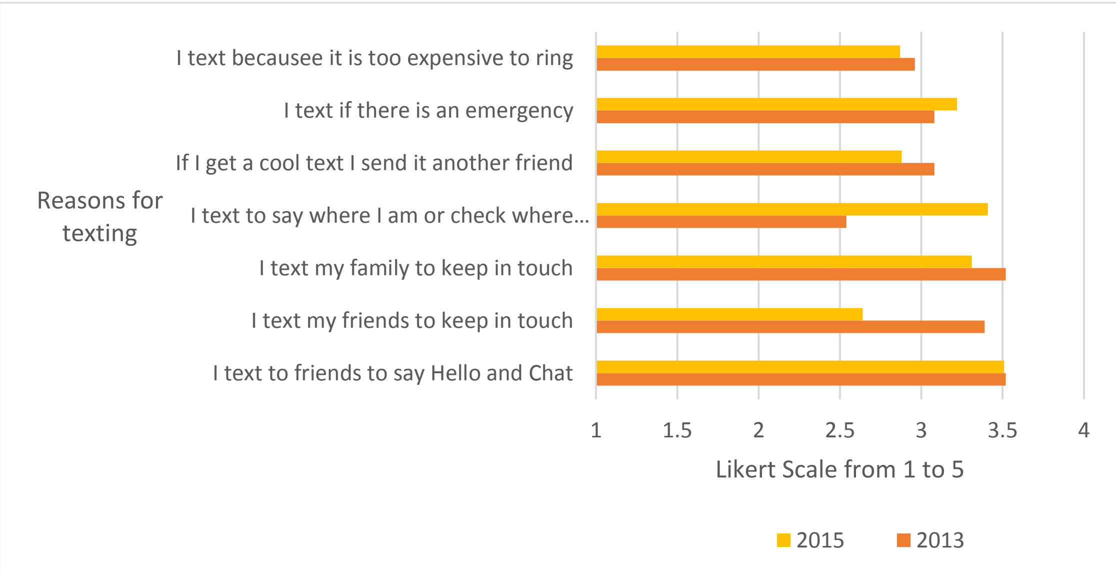


Figure 3.38
Reasons for Texting for 11-14s

Nearly all reported results for means were over the mid-point mark of 2.5, so all factors can be considered important. Figure 3.38 shows the most reported reasons for 11-14s texting in 2013 was to communicate with family to 'keep in touch' (*M* 3.52), followed by texting friends to keep in touch (*M* 3.39) and then texting friends to say, ‘Hello and Chat’ (*M* 3.16). The most reported reason for texting in 2015 was to communicate with friends to say, ‘Hello and Chat’ (*M* 3.51), then to say where they are or ‘check where someone else is’(*M* 3.41), followed by texting family to keep in touch (*M* 3.41).

14-18s

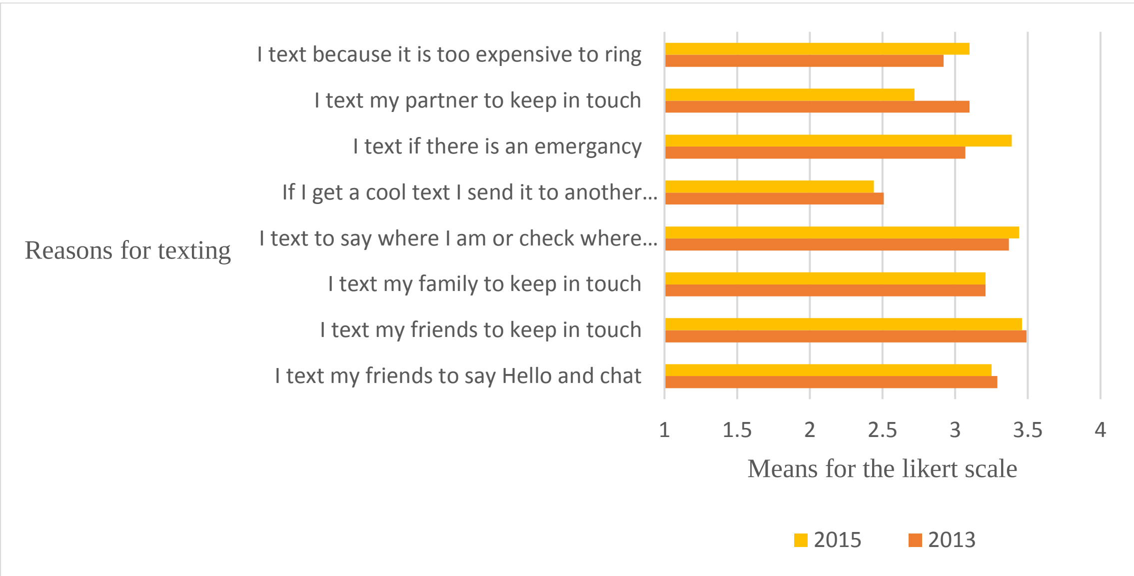


Figure 3.39
Reasons for Texting for 14-18s

Results are shown in Figure 3.39. Nearly all results for means reported were over the mid-point mark of 2.5, so all factors can be considered important. The most important reasons for 14-18s texting in 2013 was to ‘keep in touch’ with friends (*M* 3.49), followed by texting to ‘say where I am or check where someone else is’ in 2013 (*M* 3.37) and then to text to communicate to say, ‘Hello and Chat’ (*M* 3.29). The most reported reason for 14-18s texting in 2015 were also to keep in touch’ with friends (*M* 3.46) followed by texting to ‘say where I am or check where someone else is' in 2013 (*M* 3.44) and then to text in an emergency (*M* 3.39).'

18-25s

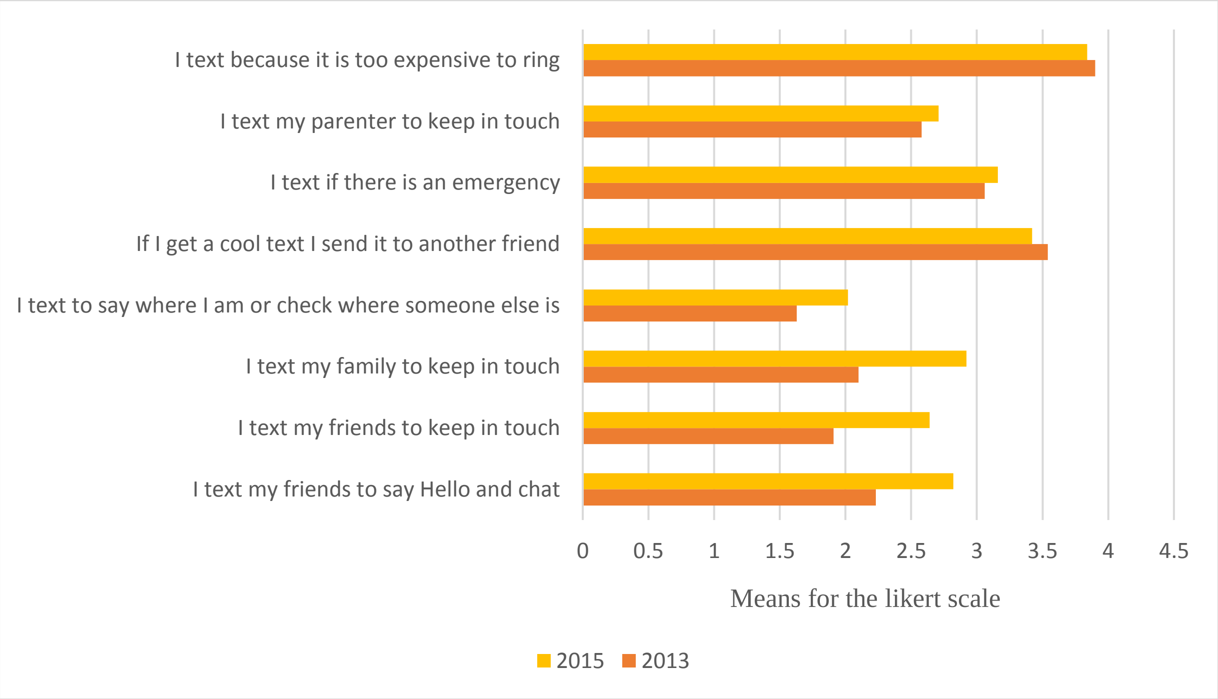


Figure 3.40
Reasons for Texting for 18-25s

Results are shown in Figure 3.40. All reported results for means were over the mid-point mark of 2.5, so all factors can be considered important except for texting 'because it is too expensive to ring'. This was not considered an important reason for texting (*M* 2.8). The most reported reason for 18-25s texting was to 'say where I am or check where someone else is' in 2013 (*M* 3.37). The next most reported reason was to 'say Hello and Chat' in 2013 (*M* 3.32) followed by keeping in touch with friends (*M* 3.49). In 2015, the most reported reason for texting was to 'say Hello and Chat' in 2015 (*M* 3.51) followed by texting in an emergency (*M* 3.16). The next most reported reason was to 'say where I am or check where someone else is' (*M* 2.98).

As a representative sample, independent 't' tests were carried out for the 18-25s. An Independent 't' test revealed that there was a significant increase between 2013 and 2015 for texting friends to 'say Hello and Chat'. In 2013 (M = 3.32, SD = 0.79) and in 2015 (M = 3.51, SD = 0.71, t(376)=2.46, p<0.14), d=0.24. There was also a significant decrease in 2013 for texting friends to keep in touch (M = 3.09, M = 0.69) and in 2015 (M = 2.64, SD = 4.50, t(376)=-2.36, p<.02), d=0.23. There was a significant increase for sending a cool text on to a friend in 2013 (M = 2.54, SD = 0.73) compared to 2015 (M = 2.88, SD = 0.85, t(376) = 4.12, p<.01), d=0.32. Other results for reasons for texting were not significant.

Phone Brand

The results for the type of phone brand users owned are shown in Appendix H. The data for phone brands showed that the most reportyed phone for 8-11s was One Touch in 2013 but this changed to Samsung in 2015. For 11-14s, 14-18s and 18-25s, the most reported brand was Samsung in 2013 and Apple in 2015.

Payment method

The most reported payment method for 8-11s who own a phone was 'pay as you go' and the preferred method of payment for 11-14s and 18-25s was contract. For the 14-18s, contract was the most popular payment in 2013 but this changed to 'pay as you go' in 2015. This was an unexpected result.

Dependence, Sleep and Addiction

Table 3.35 shows the percentage of users who liked to have their phones on all the time. It also shows users who liked to text at all times and liked to keep in touch no matter where they were. It showed how many individuals slept with their phone next to their bed, left the phone on when they went to sleep and how many turned their phone off when they went to bed.

Table 3.35
"Always on" behaviour: on or off?

	8-11		11-14		14-18		18-25	
	2013	2015	2013	2015	2013	2015	2013	2015
I like to have my phone on all the time	67	79	91	92	96	96	99	100*
I like to be able to text or called at all times	76	87	86	89	96	88	96	94
I like to be able to use my phone to keep in touch no matter where I am	74	87	94	91	98	94	97	96
I sleep with my phone next to my bed	53	69	81	82	92	83	91	91
I sleep with my phone on	35	50	72	75	88	85	91	91
I turn my phone off when I go to bed	46	65	46	65	39	45	20	19

* 99.7%

Users between the age of 18 and 25 liked to have their phone on all the time; 99% in 2013 and 100% in 2015. This decreased with age; with 67% of the younger age group always having their phone in 2013. This increased to 79% in 2015. A similar pattern was found for wanting to be available for calls or texts and being able to 'keep in touch no matter where they are'. The older users liked to sleep with their mobile next to their bed in both 2013 (91%) and 2015 (91%). This decreased with age. Sleeping with a phone next to the bed was similar for 11-14s and 18-25s in 2013 and 2015. There was a decrease in the number of participants sleeping with their phone next to their bed in the 14-18 age category but for 8-11s there was a slight increase in the percentage of users sleeping with their phone next to their bed. In 2015, the younger users of 8-14 turned their phone off when they went to sleep more than in 2013. For the 14-18s, there was an increase in users leaving their phone on when they went to sleep. For 18-25s, users turning their phone off when they went to sleep was similar to the results in 2013.

Over three quarters of 11-14s said they like to have their phones on all the time (91%) in 2013 and many say they liked to be able to use a phone to keep in touch ‘no matter wherever they are’ (94%). Over two thirds liked to be available for texts or calls at all times (86%). In 2015, a similar pattern was found with over three quarter of users saying they like to have their phones on all the time (92%). Many said they liked to be able to use a phone to keep in touch no matter where they were (91%). Over two thirds liked to be available for texts or calls ‘at all times’ (89%). With reference to dependency and possible addiction, it was found that 82% of 11-14s slept with a phone next to their bed in 2013, and 72% left their phone on when they went to bed. Nearly half of users (46%) turned their phone off when they went to bed in 2013 but in 2015, 65% of users turned their phone off when they went to bed.

Screen Use

The data presented here comes from the interviews. A full report can be found in the proceedings of the CIEHF conference proceedings in 2017[1]. These were carried out shortly after the first questionnaires in 2013.

The 8-11 Age Group

Figure 3.43 shows the number of hours that 8-11s reported using screens. Interview Group 1 in the table represented the three children in the first interview, Interview Group 2

[1]Fowler, J, Noyes, J., (2017), Using screens: how much time are children and young people spending on technology? In Rebecca Charles and John Wilkinson (Eds.), Contemporary Ergonomics and Human Factors: Proceedings of the Chartered Institute of Ergonomics and Human Factors, Taylor & Francis.

representsed the three children in the next interview and so on.

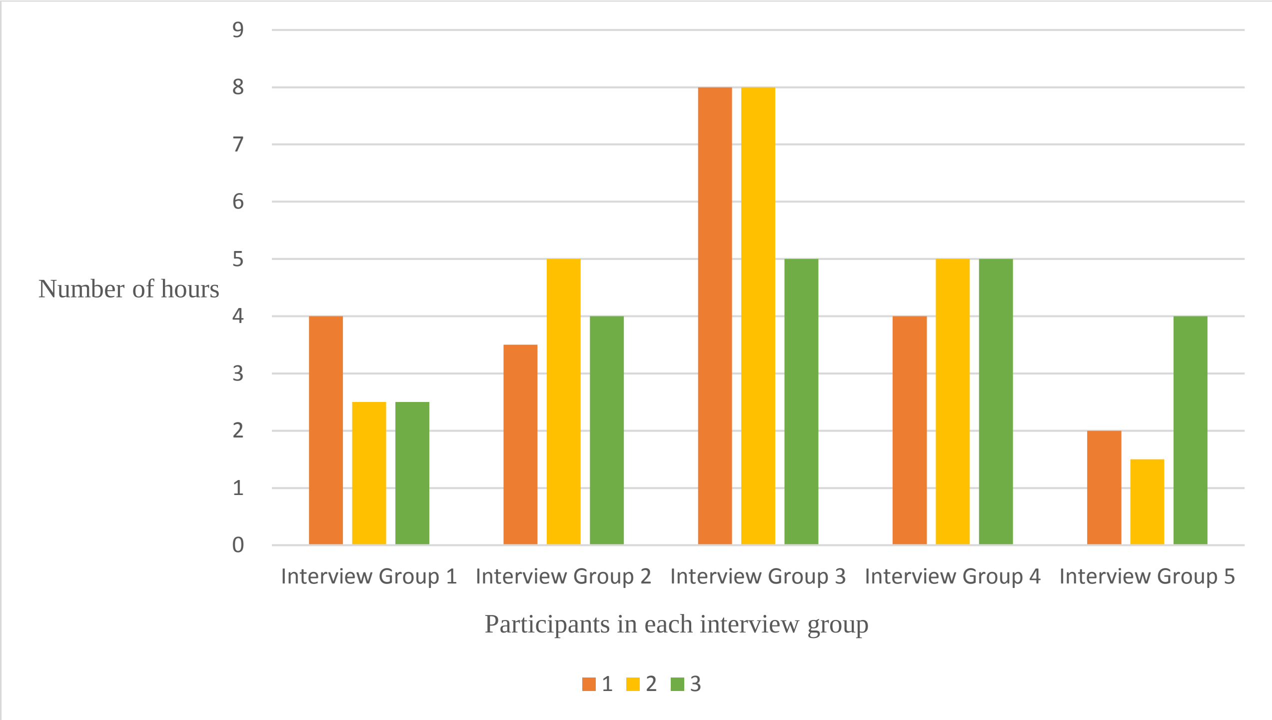


Figure 3.41.
Self-reported number of hours spent on screens by 8-11 years old

The longest time 8-11s spent on screens was 8 hours a day and the lowest was one and a half hours (M=4.3. M=1.9). The range was 6.5 hours.

The 11-14 Age Group

Figure 3.44 shows the number of hours 11-14s reported they use screens. The highest screen use was 10 hours a day and the lowest screen use was one and a half hours (M=3.8, M = 2.1). The range was 8.5 hours.

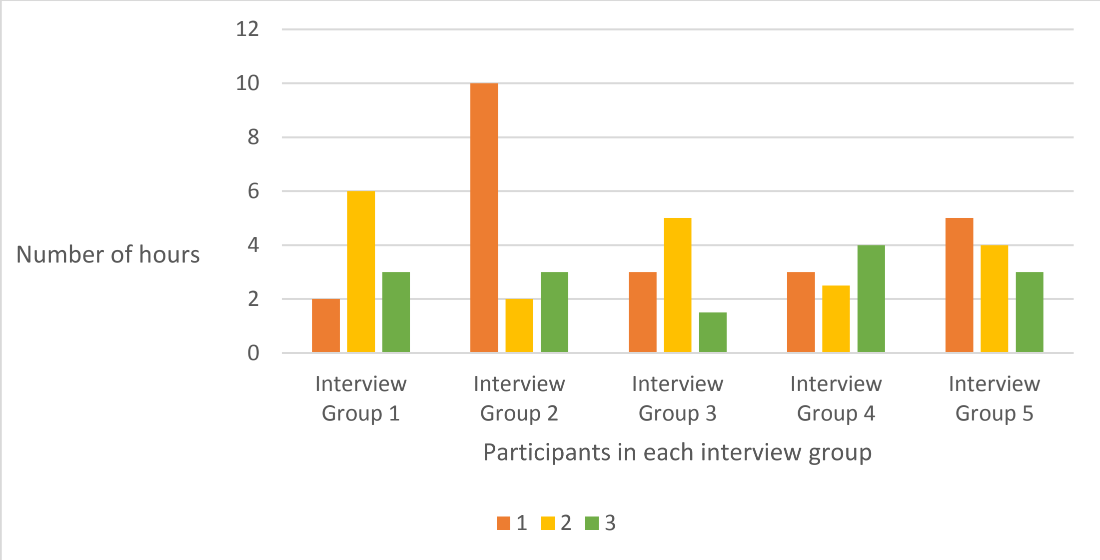


Figure 3.42
Self-reported number of hours spent on screens by 11-14 years old

The 14-18 Age Group

Figure 3.43 shows the number of hours that secondary school and college age young people from 14-18 said they use screens.

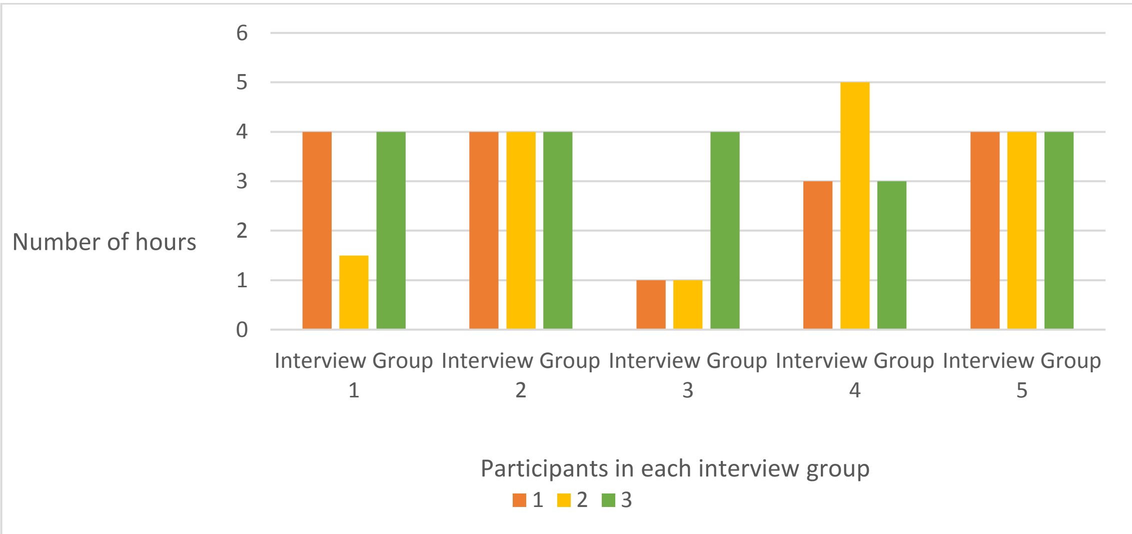


Figure 3.43
Self-reported number of hours spent on screens by 14-18 years old

The highest screen use was 5 hours in a day and the lowest was 1 hour (M=3.7, M=1.2). For this group, the range was small at 4.0.

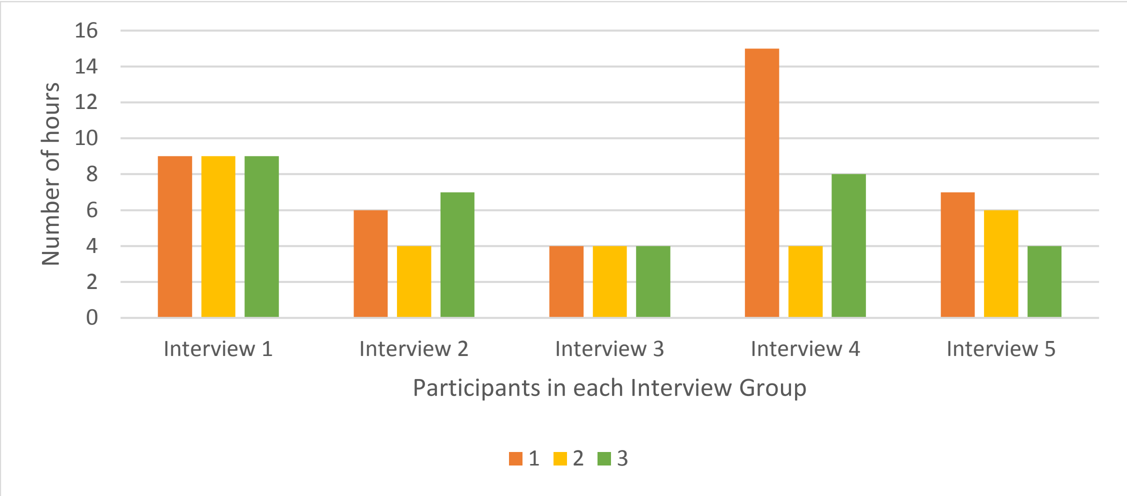


Figure 3.44
Self-reported number of hours spent on screens by 18-25 years old

Figure 3.44 shows that the mobile phone was the most owned device by 11-25 years old users, reaching 100% saturation amongst 18-25s. The games console was the most owned gadget by 8-11 years old in 2013. Many 11-14s also own games consoles but this decreased with age.

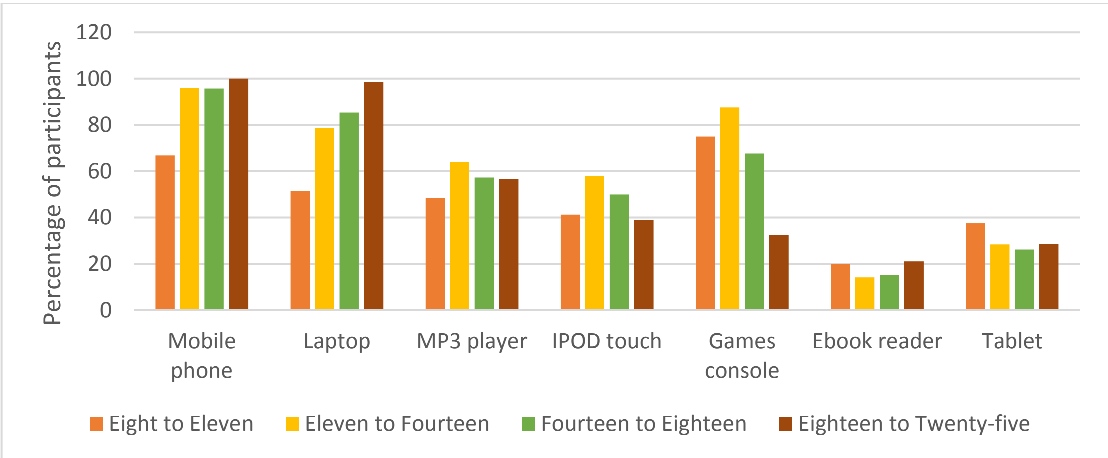


Figure 4.5
Self-reported ownership of screens

3.8 Discussion

This discussion attempts to answer the research question of whether the use of the mobile phone has created a dramatic shift in human behaviour and communication, as part of the 'digital technological revolution'. Before this can be answered, a consideration of the results for ownership of technology and technological expertise is put forward.

The 'digital technological revolution' was evidenced by high technology ownership and use. All 18-25s owned a mobile, both in 2013 and in 2015. Nearly all 11-18s reported owning a mobile phone and two thirds of 8-11s do. This did not change considerably between 2013 and 2015. Reported ownership of laptops was very similar in 2013 and 2015 except for the 18-25s where all users reported owning a laptop in 2013 and just under three quarters of users did in 2015. For 14-18s, over three quarters of users owned a laptop and for 11-14s, two thirds of users did, and this did not change considerably between 2013 and 2015, whilst for 8-11s, laptop ownership increased from a third in 2013 to two thirds in 2015. Tablet ownership showed a different pattern for 18-25s with just under a half saying they owned a tablet in 2013. This dropped a small amount in 2015. For other ages, there was a big increase in tablet ownership. The biggest increase in tablet ownership was amongst the 14-18s, where ownership of tablets increased from a fifth to four fifths of users. It is suggested that 18-25s do not invest in tablet use as much as mobile phone use because of the greater independence enjoyed by using a mobile phone. The mobile phone is a 'user friendly' gadget for everyday, 'on the move' use for the functions of communication, micro-coordination, safety and affords an independent life style. This is backed up by the findings in the interviews and the analysis on the importance assigned to different usage spaces by participants. Usage spaces are discussed in more depth later in this discussion. It is suggested that the tablet is the technological gadget that 11-18s use more because participants spend more time at home and so use the tablet. Many 11-18s used a tablet for different types of social media, Apps and games; which the results in this Chapter show increased in use significantly from 2013 to 2015. One participant expressed his enthusiasm for the games on his phone, “And like the games are so addicting, people can’t put them down”. Although the tablet is portable, it is not such an ‘easy’ device to transport in an everyday ‘on the move’ way as a mobile phone is. Also, the 11-18 age user generally has less independence from parents, so the table is a useful gadget for everyday use ‘in the home’ for 11-18s, more than 18-25s.

The respondents identified as competent users of all technologies as shown by Roger’s innovation diffusion categories (1995). Hypothesis 1 predicted that there would be an increase in perceived technology advancement, mobile advancement, mobile orientation, laptop advancement, internet advancement and tablet advancement between 2013 and 2015. Results for significant differences gave some support for Hypothesis 1. Perceived mobile skills increased significantly in 14-25s. Results show perceived mobile orientation increased significantly for 14-18s and perceived mobile advancement increased significantly for 18-25s. This was not the case for 8-14s. Results show perceived mobile advancement and perveived mobile orientation decreased significantly for 8-11s. For 11-14s, results show perceived mobile advancement decreased significantly. Results show perceived internet advancement decreased significantly from 2013 to 2015 for 8-11s but increased for 11-14s and 14-18s. Perceived tablet advancement increased significantly for 11-25s.

Hypothesis 2 predicted that there would be a significant increase in perceived expertise from 2013 to 2015. For 8-11s, results show perceived internet expertise increased significantly for but decreased significantly for the tablet. For 11-14s, perceived laptop expertise increased significantly. For 14-18s results show perceived expertise increased significantly for the internet but decreased significantly for mobile orientation and the tablet. For 18-25s, perceived expertise increased significantly for the mobile and decreased significantly for the internet.

Hypothesis 3 predicted a significant decrease in perceived anxiety in technology from 2013 to 2015. For 8-11s, results show that perceived anxiety increased significantly for the internet. No significant differences were found for 11-14s. For 14-18s, perceived anxiety increased significantly for the internet and the tablet. For 18-25s, perceived anxiety increased significantly for the internet but decreased significantly for the mobile and the laptop.

Hypothesis 4 predicted a significant relationship between all variables of perceived levels of technological competencies for technology, the mobile phone, the laptop, the internet and the tablet in 2013 and 2015 (as represented by advancement levels and orientation). Partial support was found for Hypothesis 4 as many significant relationships were found. Hypothesis 5 predicted significant relationships between all variables of perceived expertise for technologies in 2013 and 2015. Many significant relationships were found for perceived technology skills between 2013 and 2015, and for specific technologies between 2013 and 2015, giving partial support for Hypothesis 5. Significant correlations were found for all technologies where participants reported a high level of perceived expertise in a specific technology and this was associated with a low level of anxiety**.** Strong relationships were also found for mobile phones, the internet and laptop expertise and anxiety, and extremely large effect sizes for 11-14s were found in 2015. No significant relationships were found for tablets in 2013 and 2015 individually, but overall, there was a highly significant relationship with a large effect. It is suggested that this might be due to the rapid increase in ownership of tablets between 2013 and 2015. Ownership increased from just over a half of users owning a tablet in 2013 to over two thirds owning a tablet in 2015.

Hypothesis 6 predicted significant relationship between all variables of perceived anxiety for technologies in 2013 and 2015. Many significant relationships were found for Perceived Anxiety between technologies. For example, significant relationships were found between mobile anxiety and internet anxiety; laptop anxiety and internet anxiety for 11-14s. This result could be due to increased use of the internet on smart phones, and with this increased use, comes a high level of competence and reduced anxiety. Rees & Noyes (2006) suggested that that the reason for this was because mobile phones and the internet offer young people a unique sense of independence and self-expression that they do not find in other activities (Facer & Furlong, 2001).

The constructs of MOPTUM considered Perceived Ease of Use, Perceived Usefulness, Attitude, Behavioural Intention and Social Influence. The hypotheses of MOPTUM predicted that these beliefs are important for mobile phone use. The results would suggest that Hypothesis 7 and 8 that Perceived Ease of Use and Perceived Usefulness can be supported. The belief of Perceived Ease of Use is highly valued by all age groups as shown by the range of mean responses to the questions representing PEU. All age groups identified PEU as an important belief for mobile phone use. This was rated most highly by the 18-25s and the perceived importance of this belief increased from 2013 to 2015. The 8-11 age group also identified PEU as an important construct. It is interesting that the 8-11s reported a high mean score to the question of ‘I find mobile phones easy to use’. In the reliability analysis, the relationship between the questions for the construct of PEU produced a low Cronbach’s alpha score. It could be that the 8-11s mis-understood the questions or that the way in which users interpretated the question varied. The Likert type scale for the 8-11s was 3 point, which could also be a factor contributing to the poor reliability of the four questions. It was concluded that the constructs of PEU for younger children need to be further tested and validated with a 5 or 7-point scale.

The construct of Perceived Usefulness was valued by all age groups All mean scores for PU hade a higher self-report rating of the mean scores in 2015 than in 2013, suggesting that the value of PU had increased in importance in this time period. The belief of PU was rated most highly by the 18-25s with the highest mean score in 2015 for Question 2b15. There was less variability in the mean in 2013 than 2015. Overall, the mean scores for PU were less than those for PEU. This suggested that participants consider the belief of PEU as more important than that of PU for mobile phone use. However, when the qualitative data to the ‘first word’ analysis, the ‘like most/like least’ questions and the interviews were considered, a different pattern emerged. Qualities to do with PU were mentioned more often than factors associated with PEU and gave more support to PU than PEU. The usefulness of a mobile was expressed by a conversation between 18-25s:

> E. I’d say in general they’re really useful because, obviously you can chat to your friends when you might want to have a normal conversation, but you can use it for more serious things, if you need to get hold of someone you can just call them up.
> S. With smart phones these days you can do so many things on them. You can do general things on them mostly people.
> K. They’re useful for when you’re out and about and your parents can ring you back and check how you’re doing, messaging your friends, asking people about homework.

Also, many unprompted responses referred to the usefulness of the mobile, for example, one of the 8-11 users, referred to the mobile as being “really useful for texting about school work” and simply “I think they’re really, really useful.”

The 8-11 age group also identified PU as an important construct. In 2015, the question ‘I use my mobile phone to find out information’ was identified as having the highest mean score.

The 11-14s also had the highest mean score for this question compared to the other questions. In the reliability analysis, the relationship between the questions for the construct of PU produced a low Cronbach's alpha score in 2013 although this was higher in 2015, suggesting the questions had good reliability in 2015. Again, as discussed for PEU, the low reliability of the construct of PU for the 8-11s could be because the 8-11s do not understand the questions. Alternately, it could be due to the lack of robustness with a 3-point scale.

The constructs of perceived attitude and perceived enjoyment have also been suggested to be important beliefs for mobile phone use (Davis, 1992; Rouibah & Abbas, 2006) Overall, the mean values showed that the majority of users had a positive attitude to mobile phones and that perceived enjoyment gave partial support for Hypothesis 9 and 10. The construct of perceived enjoyment showed a higher mean score when participants were asked about a positive statement than a negative statement. The younger users showed higher mean values of perceived enjoyment than the older users, particularly for the positive statements. Previous studies have shown that teenagers were conscious of handset styles and viewed the mobile phone as a 'fashion' statement or a symbol of personal display (Ling; 2003, 2004; Lobet & Maris, 2003; Lycett & Dunbar, 2000; Skog, 2002). Users chose their phone to communicate an image. In the 'first word' analysis words, such as 'style', 'fashionable' and 'personal' were put forward by participants to convey their first thought associated with mobile phones. Popular phone brands reported were One Touch and Samsung for 8-11s and although Samsung was popular for the older children in 2013, this was surpassed by Apple in 2015. The mobile is a gadget that can be 'worn on the body', and it has been suggested that individuals view the phone as an augmentation of their physical selves (Grant & Keisler, 2001; Hulme & Peters, 2001). This has relevance for the concept of apparatgeist put forward by Katz and Aakhus (2002). Results from the questionnaires show that younger users believe that the mobile improves their self image. The mean judgements are the highest in all age groups for the question ‘Having a funky or cool makes me feel good’, but especially for the 8-11s. This is a question that seems to have greater appeal to participants to the other questions about self-image and gains a more favourable response than the other questions. The 8-11s report that the mobile phone is important to improve their self image. Although the older ages may own a certain brand of mobile to improve their self image, it is less socially acceptable to admit this. One14-18 years old participant remarked, “Self-image is important to some people. It was one of the reasons for getting it (the phone) in the first place.” Possibly. the younger users were more naïve of this’ social norm’ and were able to be truthful about the fact that they believed the mobile will improve their self image. It seems that the questions related to self-image are perhaps ‘too direct’ an approach to get a clear picture of the relationship between the phone and self image. A subtler approach is perhaps a better way forward because of the social constraint of admitting that a phone might be instrumental for improving self image.

Actual system usage in MOPTUM was represented by usage breadth, usage variety and usage intensity. Usage breadth increased with age. Hypothesis 12 that perceived usage breadth will increase over time was not accepted. Mean values for usage breadth decreased from 2013 to 2015 for all ages and show highed variability amongst users.

Hypothesis 13 predicted that perceived mobile usage variety will increase over time. Some results from the questionnaire data supported Hypothesis 13 and some did not. Most functions were within the higher level of importance of the midpoint, except for the alarm for 8-11s, blogging and ringtones in 2013 for the 11-14s, recording a video in 2013, blogging and games for 14-18s. Many functions for 18-25s were below the mid-point of importance. These were exchanging photos, recording a video, email, games, Twitter, the alarm and blogging.

Hypothesis 14 predicted that usage intensity will increase over the two-year period. This included data on reported App use, the volume of calls and texts. Respondents reported that the use of Apps increased for all ages. Call intensity increased with age in 2013. It also increased over time for the 8-14s but decreased over time for the 14-25s. Hypothesis 14 was supported for the younger age groups of 8-14. Hypothesis 14 was also supported for 11-14s and 18-25s for perceived text usage but not for 8-11s or 14-18s and there was much variability, suggesting that over-use of texting was possible for some users.

Hypothesis 15 predicted that usage variety will increase over the two-year period. There was partial support for this hypothesis with a range of reported increased uses and decreased uses. The 11-14 age group showed the most significant differences for perceived usage variety changes between 2013 and 2015 compared to the other age groups. These were for texting, exchanging a photo or a video, recording a video, games, music, Twitter, Facebook and other social networks. This is interesting because the 11-14s are the age group who showe the least variability from 2013 to 2015 in perceived technological advancement, perceived expertise and perceived anxiety with only significant differences for perceived mobile advancement and perceived laptop expertise. No significant differences were found for perceived internet and tablet expertise and anxiety. Thus, perceived skills remained more constant whilst usage variety showed greater change.

The camera functions included exchanging a photo, recording a video, and exchanging a video, which showed a significant increase in use from 2013 to 2015 for 11-14s. The result for exchanging a photo was highly significant, and the effect size was very large. Participants used this function a lot. Not all respondents were enamoured by use of the phone for taking photos as shown by one 18-25s user:

> "Last week I went away to Paris and I was stood in the Louvre looking at the Venus of Milo and about eighty per cent of people around me are looking at it through a camera or phone. That is not, to me, viewing a piece of art. That's viewing a photo of a piece of art which you could do at home from a computer and it's not the same. I think it' just not the same thing." You're not there experiencing it, if you have to look at it through a camera. I can't bear it. I feel like, put down your phone and experience it."

Another conversation talking about the camera function of the phone showed that some users had a certain sceptism about taking photos:

> "There is this association now of having things, like photographic or video images of something, being memories of something.
> A. Yeah.
> K. And this fear that if you don't have a record of what you've done you'll forget it. That's it. It won't exist anymore. Those are your memories.
> Int. They define your existence?
> K. Yeah. Yeah. And verifying the experiences you are having.
> Int. Your identity?
> K. But it's just not true really. I don't think you remember things from the photos. Yeah, the photos are nice to have, but how often do you really go back and look over and over them. Or do you just remember the experiences you have when you see the photos?"

The other significant increases reported were for playing games, downloading ringtones and apps. More 11-14 respondents listen to music in 2015 than in 2013, but this result was not significant. This research finding is different to that of Rees and Noyes (2006) who found that downloading ringtones and listening to music were reported as infrequent uses on the phone. Use of the alarm showed a very minimal increase.

Perceived use of Facebook also decreased for the 11-14s. In a study by Madden et al. (2013) focus group discussions suggested reasons why teenager's enthusiasm for Facebook was waning. Discussion revealed they disliked the increasing number of adults using Facebook, became irritated when their friends on Facebook shared frivolous details and felt drained by the 'drama' they experienced on Facebook. They also felt stressed by the pressure to manage their 'Facebook' reputation but did not want to leave Facebook completely in case they missed out on socialising opportunities. However, for the 14-18s, perceived use of Facebook increased from 2013 to 2015 and for 18-25s it remained the same. For 11-14s, the third most reported use was music and the internet and for 14-18s, music was the fourth most reported use, but for 18-25s music was the most reported use of the mobile. For the 18-25s, the second most reported use was texting in 2013, followed by exchanging a video, then calls, Facebook and the internet. The differences for music, exchanging a video, calls and the internet were significant.

For all age groups perceived use of the internet increased from 2013 to 2015 and this was significant for the 8-11 age group. Use of ‘smart based’ applications on the internet like, Whats App and Instagram and could account for the decreased text use. One user said that she liked to use her phone for, “Programmes. Go on Apps, Instagram, viba. I like using viba, Muzy, YouTube and videostar. Videostar is where you can make a video for free.” For younger children, the questionnaire data showed that there was a perceived increase in receiving and sending emails, recording a video and exchanging photos. For the 18-25s, there were no increases in perceived usage variety functions to support the increase in perceived internet use, although many of the features associated with the internet showed high mean values. Perceived use of the internet for email was low in 18-25s. Use was age specific and changed over time. Geser (2006) investigated the effect of age on usage patterns and concluded that usage intensity increased with age and usage intensity was higher with early adoption age; The earlier the adoption age, the more established enduring usage patterns and attitudes became.

The constructs of usage spaces represented perceived motivations for participants using the mobile. For the 11-14s, the most reported usage space was safety and security both in 2013 and 2015 followed closely by the use of the mobile for relationships and then entertainment. For 14-18s, for both years and for 18-25s in 2013, the most reported usage space was safety and security in both years followed closely by the use of the mobile for relationships. The third most reported motivation for using a mobile was for organising arrangements. Personal information was rated as the fourth most reported usage space for 18-25s, but in 2015 personal information was considered as the most reported motivation for using the mobile. This was followed closely by the use of the mobile for organising arrangements, then expansion, then keeping safe and then relationships. University students testified to the value of expansion, “I would have been lost so many times in London” (without my phone) and “I use maps a lot. I think maps is the saving grace for a lot of countries. I would have got hopelessly lost so many times”. These results show that the motivations for use varied with age and are related to the needs of everyday use for users. The changes for 18-25s would suggest different motivations are becoming important for them.

For the open-ended questions, communication was the most reported consideration in responses to all questions in both 2013 and 2015. In the analysis for ordering Usage Spaces, relationships were the most reported motivation for phone use and organising was the second most reported. However, communication was considered more highly in 2013 than 2015 in both the open-ended questions that asked about the first word thought of, and the ‘like most’ and ‘like least’ responses. For example, when ‘first word’ responses were categorised, nearly two thirds of 11-14s referred to communication in 2013, in contrast to just over a half in 2015. Although texting was the most considered ‘first word’ in 2013 and 2015, this decreased considerably in 2015. Communication had also changed from being the second most popular word recorded in 2013, to the eighth most popular word in 2015. It is suggested that this result has come about due to the diversification of the function of the mobile phone. Texting is still popular but not as much as in 2013. This, as mentioned earlier, is thought to be due to the increase in internet-based applications, like Snapchat, WhatsApp, and other social media. Young users are increasingly owning smartphones with internet-based applications. It is therefore cheaper for them to communicate in this way than texting. The results showed that communication through swopping photos and videos had increased. A growing literature on selfies suggests that a primary function of selfie photo exchange activity is to communicate with friends and others (Nicola, Understanding selfies, Taxonomy and Data, Seminar, May 14, 2018).

Communication was still the main function associated with the mobile phone, but the form of communicating is changing with developments and trends in mobile phone use. For the ‘like most’ category of responses, it was also found that communication was the main category of response. Nearly two thirds of responses involved communication in 2013 and 2015, although this was slightly lower for 2015. The results were similar to those found in Baron’s study in 2011, where it was found that nearly two thirds of participants indicated communication as their ‘like most’ category. The most noticeable ‘like least’ factors were those factors to do with physical and evaluative issues in both 2013 and 2015. In the sample subcategory of independence in the evaluative issues, a positive example was freedom, where the participant commented that she liked ‘the feeling of being kind of free for five minutes while you’re on it’ (the mobile) but in the negative subcategory of dependency, another participant said she felt, ‘That texting can take over your life’. The IPA of the interviews found that the primary use of the mobile phone was for communication purposes. Other themes identified in the IPA analysis were evaluative issues, physical attributes, safety and security, cost and entertainment. The importance of communication was provided by a conversation amongst 11 years old users:

> A. I think it's because we are all starting to rely more and more on technology, communicating, especially this school with twelve hundred people, so they don't all live in one area, so we can communicate with each other. It's a lot easier to communicate with everyone.
> B. We're a social race. We feel like we want to communicate, we have the need to communicate.

Perceived Ease of Use and Perceived Usefulness were considered important beliefs in MOPTUM and TAM. The results of the 'first word' analysis add validity to the consideration of these concepts in the model, as participants selected first words 'easy' and 'simple' supporting the belief of Perceived Ease of use. However, many more 'first words' are associated with usefulness, for example, convenient, handy, necessary, practical, essential supporting the concept of Perceived Usefulness. Prensky (2001) commented on how digital natives enjoy a fast and immediate approach to using technology. It can be seen from the 'first word' responses that participants value speed by suggesting the words, 'quick', 'fast', 'instantly'. One participant in the interviews commented on the value of immediacy, "A text message contact that would have taken two days, I can just have in one day."

Factors that participant's 'like least' in 2015 were physical factors. This was considerably higher in 2015 and nearly half of responses were in this category. Participants were clearly not satisfied with 'physical' aspects associated with owning a mobile phone. These physical difficulties are to do with charging the battery, the lack of signal for the phone and the internet, wi-fi and waiting for the phone to load.

The majority of 'first' words recorded were positive, rather than negative showing how much young users enjoy their phones. The question for the 'first word' that participants think of when they think about their mobile phone did not reveal the physical dissatisfaction users have with the phone. However, when asked specifically about what they 'like most' and 'least', this dissatisfaction with the physical aspects of the phone were revealed. This supports the need to apply a mixed method approach with a range of questions as these responses were revealed in this question and the interviews. Other categories were issues around safety and concerns to do with cost.

Although the issue of safety was ranked quite low in the factors that users 'like most' about their phone, a fifth in 2013 and barely a handful in 2015 for 11-14s, when the users were asked to rate the importance of usage spaces, safety and security was assessed as the most important. The interviews also reveal that many users value the safety and security that the phone affords them. This can be seen in the following comments from the interviews, mobile phones "makes me feel safer". "Well, like really, like say, if you went somewhere, like, if you could drive when you're older and like, if you got lost, you could always ring or text your parents to tell them where you are, and then they could guide you or something, through talking on the phone or something". Also. phones are "good because they can help you if you're lost or need something, then it saves time, you can just call someone" and "If someone took you, you could record it, so you could play it back and listen to it". The results showed that a high number of participants selected the concept of safety as a factor they 'like least' about mobile phones in 2013 (27%). The issues that participants 'like most' about mobile phones tend to be different to the factors that they 'like least'. For example, the factors they liked about safety were to do with the affordance of the phone in relation to being able to contact other people for help in an emergency, whereas factors they 'like least' tend to be related to cyberbullying and cold calling. One participant discussed how "People can text improper things" and "People are able to get your number and text you, someone you don't know". Another participant commented on how phones "cause bullying and arguing" and "People send horrible messages on social media sites". Fewer participants selected safety as a concept they 'like least' in 2015. This had dropped considerably in 2015. This could be due to a change in awareness from 2013 to 2015. Many schools are providing internet safety awareness both for children and parents.

Cost was mentioned frequently as one of the factors users ‘like least’ about phones. This was further substantiated in the interviews as a reason why they would text rather than call. “Texting is cheaper, and it doesn’t use up your money so much”, “Calling takes a bit more credit than texting”, and “It’s always more expensive to call people”.

Entertainment was a main category identified in the ‘first word’ analysis and a theme identified as a ‘like most/like least’ category. Entertainment was largely thought of in a positive way in 2013 and 2015 for 11-14s, with the occasional participant being irritated by the excessive use of participants playing games on their phones. Twice as many participants considered entertainment as important in the question about what participants ‘like most’ in 2015 than in 2013. This would suggest entertainment is becoming a more popular function of the mobile phone. Also, ‘fun’ was mentioned as one of the top 10 words in both 2013 and 2015. This would suggest that the diversification of the phone for entertainment is increasing in importance. Many users watched films on Netflix, use the phone to send ‘selfies’ and used internet applications and many other entertainment-based functions. In the interviews, one participant said she liked using her phone, “because you can get like Facebook, Snapchat and that there’s all new games and stuff”.

One of the research areas addressed by this area was to find out about the level of participants’ awareness of possible health risk associations with the mobile phones. So as not to alarm younger users, this was not asked directly in the interviews, but it was hoped that some awareness might be elicited from the open- ended questions.

The literature review showed that there were many everyday health concerns associated with mobile phone use. The most reported place to keep a mobile for all ages is in a pocket. For 8-11s, nearly a half carried their phone in a pocket in both years. In 2013, three quarters of 11-14 years old users kept their phone in a pocket, and this decreased slightly by 2015. In this age group, fewer users carried their phone in a bag and those carrying a phone in their hand had doubled from 2013 to 2015. For 14-18s, nearly two thirds kept their phone in a pocket and this decreased by 2015. For 18-25s, under half of users carried their phone in a pocket in 2013 and this increased by 2015 whilst two female users carried their phone in a bra.

Participants have an awareness of possible health concerns but are unsure of the scientific implications, whether the concerns are 'real' or not. One conversation of 18-25s shows the uncertainty around this subject:

> B. Yeah, I wouldn't want to keep my phone in my pocket. Is there a risk of cancer?
> A. Isn't it about your ovaries or something like that?
> A. Yeah, and boys always have their wallet and mobile phone in their pocket. It's really bad.
> B. Because their pockets are so much bigger than ours.
> A. Initially. it's so much more-risky.

Another 18-25 participant commented on the concern to do with keeping a mobile in a pocket, 'People told me that keeping a phone in your pocket increases the chance of getting prostate cancer. But I mean…. I sort of think now that I should probably do some research into the possible risks. I don't want to say the risks (pauses) The positives outweigh the risks. Yeah?'. Another user commented 'I do I think about keeping it in my pocket and then I do sometime think, hang on a minute if it's been in my pocket for a while, I'll put it in my bag instead.' Mobile phone radiation can affect sperm morphology and fertilization potential in men from mobile proximity to the groin area (Falzone et al., 2011). Furthermore, a review on male reproductive function of experimental studies with animals and humans, found that the effects of RF-EMF showed decreased motility of human spermatozoa, morphometric abnormalities, and increased oxidative stress. Men using mobile phones were found to have spermatozoa with normal morphology but decreased viability, decreased motility and decreased sperm concentration. (Vignera, Rosit, Condorell, Vicara, D'gata, & Calogero, 2012). Laboratory studies on animals have also found an association with mobile phone radiation and impaired female fertility although causation has not been conclusively established (Gul et al., 2009).

Respondents who reported using their fingers and thumbs the most were the 8-11s in both years whereas the 14-18 years old users reported using their fingers and thumbs the least. Over half of 8-11s report using their fingers and thumbs in both years and a third of 11-14s and 14-18s in 2013. In 2015, just over a half of 11-14s reported using fingers and thumbs. The 18-25s reported using fingers and thumbs more in 2013 than 2015. With reference to single digit use, 8-11s reported using fingers only the most in both 2013 and 2015. This increased from 2013 to 2015, and reported use of fingers only decreased for 18-25s. Very few 11-14s and 14-18s reported using fingers only in both years while nearly half of 11-14s reported using only their thumbs Two thirds of 14-18s reported using only their thumbs in 2013 in both years, followed by university users. Half of university users reported using thumbs only in both 2013 and 2015. Both these age groups showed little change over the two-year period. The biggest increase for thumbs only use was amongst the 11-14 age group, where thumbs only use increased.

It is the single digit users that are most at risk of musculoskeletal problems, from using singular repetitive movements. In the interviews, one user said, "it might hurt your fingers if you text too much". The results revealed that texting is a regularly reported use of the mobile phone. 'Blackberry thumb', pain at the bottom of the thumb or in the muscle of the thumb or wrist can occur through over-use of the thumbs. This is because the evolutionary function of the thumb does not include repetitive usage in this way. Participants showed considerable skill in texting ability. For example, one skilled participant said she could “text without looking”. Using both thumbs for texting is better than using only one thumb and it is advisable not to text at high velocity Interviews revealed an awareness that over-use could ‘hurt your thumbs’ and ‘I don’t want to hurt my thumb bones by texting’ To ease the problem, it is better to alternate between using thumbs and finger (Fowler & Noyes, 2017). It is also suggested that the pad of the thumb rather than the tip of the thumb is used to prevent, awkward, bent postures being created (O’Sullivan, 2013).

Another everyday concern is screen use. The number of hours spent using screen for 8-11s was reported as one and a half hours to 8 hours a day; 13 out of 15 children reported using screens for more than 2 hours a day. This is more than the recommended guidelines from NICE (2008). The highest reported screen use for 11-14s was 10 hours a day and the lowest was one and a half hours. There was a lot of variance in this result, and the participant reporting 10 hours of screen use was probably an excessive screen user. The next participant reported 6 hours’ screen use, so there was a large difference here of 4 hours. Twelve out of 15 participants reported using screens for more than 2 hours a day. The highest reported screen use for 14-18s was 5 hours in a day and the lowest was 1 hour. The variance was small. Twelve out of 15 participants reported using screens for more than two hours a day.

The group of 8-11s interviewed were children who spent time after school, ‘going out to play’ with their friends. Whilst some might experience high screen use, the interviews indicated that the children can successfully co-ordinate their time between play and screen use. For example, one participant said that she “might spend half an hour on the laptop and then go outside to play”. The importance of balancing screen use with outdoor activities and ‘time with nature’ has been documented in an Australian report studying excessive screen use (Martin, 2011).

Boredom was a subject that participants mentioned a lot when they talked about their use of screens. Whether it was their phone, a tablet, a laptop or another piece of technology, the technology was perceived as a gadget that was picked up to alleviate boredom, particularly in the school holidays. As with the 8-11s and the 11-14s, the 14-18s provided evidence of using screens more in the holidays. One participant said, “In the holidays, I spend more time because you need to occupy yourself, it’s more for social aspects”.

Participants in the 14-18 age group commented on the time-wasting capacity of screens and the distracting capacity of using screens concurrently. As discussed, it has been suggested that the academic achievements in GCSEs have been affected by the amount of time spent using screens (Jary, 2016). The participants themselves expressed how they found it difficult to concentrate when they were using more than one screen. Some were disciplined, and some were not, depending on whether they had a course deadline to meet.

Hypothesis 15 predicted that the number of users who multitask will increase over the two-year period. Users reported less multitasking in 2015 than 2013. Hypothesis 15 was not supported. Of those users who do multitask, more users dual task rather than multitask with two or more tasks. Interviews suggest that more user’s reported media multitasking than multitasking with an activity-based task, except for the 11-14s. Users media multitask with:

> “A. My laptop, videos and Youtube.
> B. Go between Ipod, games on the X box, and Facebook.
> C. I alternate between watching videos, websites for homework and watching TV.”

Another conversation gives an indication of how young people multitask:

> "C. I sometimes listen to music when I'm doing my homework & I'll be on the internet researching things on my Ipod. So, I use my Ipod for music, and my phone for researching.
> A. I'd say it depends what you're doing. If you're doing homework you are going to be more focused.
> B. Listening to a bit of music. You switch back and forth."

Hypothesis 16 predicted that the number of users who multitask will report increased media multitasking increase over the two-year period. Reported media multitasking decreased over the two-year period amongst 11-14 years old respondents; but activity-based multitasking doubled. The reason for these results was not clear. The results could be due to a shift towards greater awareness of possible issues with media multitasking or perhaps a move towards a more active lifestyle, presenting the user with more possibilities for multitasking when involved in an activity. Alternatively, it could be due to an increase in ownership and greater use of mobile phones in general. Reported volume of calls in 2013 and 2015 was very similar for those users who made under 10 texts a day, but there was a big difference for users who made over 10 texts a day. The results for reported volume of texts and calls showed an increase from 2013 to 2015 (from 8% in 2013 to 20% in 2015). In addition, those users making over 30 texts a day increased from 2013 to 2015 (from 8% in 2013 to 20% in 2015). This means a few 11-14s are making a high number of texts. Texting is an activity that seems 'easy' to multitask with, for example, activities like walking, jogging, cooking. For example, one participant, said, "Calling is hard if you are doing something, but if you are texting, you can carry on with what you're doing." Some 'activity' tasks can be carried out independently, whereas others are social tasks. It is perhaps more 'socially acceptable' to 'walk and text' with a friend in 2015 than it was in 2013. However, Schabrun's (2014) analysis of gait performance in 18-29 years old users suggests walking and using the phone is not recommended. Individuals walked more slowly along with other postural effects when using their phone. This was thought to be due to the increased cognitive demands placed on working memory and executive control during the performance of dual tasks. Users had little visual awareness of their surroundings while they were using their phones, making the possibility of bumping into something more possible.

Overall, the increase in multi-tasking with activity-based tasks for 11-14s, could be due to this being a more accepted social paradigm of behaviour in everyday life in 2015 than in 2013. Many users reported multitasking with watching television. One user commented on how “Texting you can do all the time You can be, like, watching a programme and texting or you can be walking down the road and texting.”

‘Digital natives’ seem to be adept at using attentional capacity to multitask but as has been found, previous results of research in this area have shown varying results. Lui and Wong (2012) found that high Media Multi-tasking Index (MMI) scores correlated with improved performance on some attentionally complex tasks. Alkzahabi and Beker (2013) found that heavy media multitaskers showed better ability to move from one task to another. Baumagartner et al. (2014) found that frequent multitaskers were more able to ignore distractors in the Eriksen Flankers Task. Wilmer et al. (2017) found that heavier multitaskers were better than light multitaskers in their ability to absorb and integrate information from different places in attention tasks. In contrast, many studies using the MMI have found poorer executive control over attention (Ophir et al., 2009, Moisala et al., 2016). A study in 2016 (Theoretical review, 2016) also found that 12-16 years old users who media multitask often in daily life amongst 12-16 had poor executive function ability.

The data collected here does not offer speculations on the effectiveness of the multitasking behaviour but can suggest opportunities for future research, for example, it would be interesting to see if there was a difference between cognitive performance measures for multitasking with activity as opposed to media-multitasking. There is a need for future research in this area, including experimental work on how adept young people are at using attentional resources for task switching and the speed at which they achieve this.

Social concerns were investigated through the questionnaires and the interviews. In the interviews one 18-25 user asserts, “from a psychology perspective, I would worry about the associated social and health risks of continually being on your phone”. Questionnaire data shows who users preferred to contact; either friends, parents or siblings. Nearly all ages reported contacting their friends most, except for 8-11s and 14-18s in 2015 who reported contacting their parents most. Siblings are the next group of people that users reported that they like to contact except for the older age group. For the 18-25s, partners were reported to be contacted as much as much as parents in 2013 and more than parents in 2015. It was found that friends were contacted most by 11-14s, followed by parents or guardians and then siblings. A conversation between 8-11s revealed the individuals they like to contact and some of the reasons why:

> E. They are good for keeping in contact with split up parents.
> D. They are good for keeping in contact with people. Because we are going off to different schools, they are important for us.
> R. Moving up to secondary school. By using our phones, and Ipads, we can keep in contact everyday, and we can get to know our new school mates before we start school.
> R. They are good for keeping in contact with your family. I talk to my family a lot.

Another user expressed her depencdence on her phone and the different way she used the phone according to who she was contacting. “They’re so practical and it’s very easy to become so reliant on them because just before getting this new phone, I didn’t have a phone for a week, and I found it so difficult, because, I think just the way we make plans have completely changed. For example, when I’m meeting my Grandma, when I make plans with her, we will arrange to meet at the station at quarter past seven at Exit Number 3, sort of like that, and we make that plan the week before, but when I make plans with my friends now, it’s more like we’ll go shopping on Saturday, and people don’t expect to have to say a place, stick to it, not to be able to say I’m ten minutes late on the bus. So, I think part of why they are so important is because they have changed our social organisation.”. For young people, using the phone in this way is part of ‘normal behaviour’ representing the dramatic shift in user behaviour.

Phones were used daily for regular contact. Face-to-face contact was the way 8-11s reported they like to contact others in 2013, followed closely by texting and calling on the mobile. In 2015, talking on the phone is reported in preference to face to face contact, followed by texting. For 11-14s, face to face contact was reported as the preferred way of contact in 2013, followed by texting, then Facebook and then talking on a mobile. In 2015, texting was reported as the preferred way of contact to face to face. This was followed by talking on the phone and then Facebook. For 14-18s, face to face contact was reported as the way of contact that was liked most in 2013, followed closely by texting. In 2015, texting was the preferred way of contact for 14-18s, followed by Facebook and then talking face to face. The next medium 14-18s reported they like to use for contact was the landline and then talking on the mobile. Results for 14-18s showed a similar pattern to the results for 11-14s. Face to face contact was the medium 18-25s liked most in both years, followed closely by texting in 2013. This changed in 2015, and texting dropped considerably as a chosen method of contact. Internet based applications were used more, for example, Facebook. Emailing and Skype, although talking on a mobile was still preferred to these methods of communicating. These results were representative of the dramatic shift in user behaviour for communicating with others. Technology based contact was reported as being preferred to face to face contact for 8-18s in 2015. This was a surprising result but when the advantages of using the internet or texting were considered, it can be seen why. With texting, email and Facebook, the user is afforded social distance and social control over the discourse. The user has 'chance to plan, contemplate, and edit one's comments more mindfully and deliberately than in the more spontaneous and simultaneous mode of communicating face-to-face' (Burgoon & Walther, 1990, p.71) Responding to a text or instant message can be less overwhelming than the intimacy of face to face contact. The ability to control social discourse, is also possible with incoming calls. The user can leave incoming messages unread or unanswered and choose to respond at a later time. Use of call identity allows calls to be screened and conveniently go to voicemail. For the more creative user, 'camouflage services' can be utilised, for example, users can simulate the noise of traffic, so that a user can make it look like they are stuck in traffic and validate being late, while they could be sitting in a café (Baron, 2008).

Questionnaire data reported an increase in the use of social networks. From the interviews, it was seen that much of this was due to instant messaging activity. Baron comments on the advantages of instant messaging for allowing possibilities for manipulating communication (Baron, 2008). For example, providing the possibility for social affinity groups, away messages and being able to carry out different conversations at the same time. Madden's study (Madden, 2013) previously discussed, found that teenagers expressed more enthusiasm for Twitter and Instagram because they felt they were more able to communicate on these sites.

Baron (2009) and Ling and Yttri (2002).found that calling was used for micro-coordination when an instant response was needed, for example, one participant said she used her phone "to know something really quickly" and for co-ordinating arrangements", "I think, virtually everyone has one now, like at weekends, people like, in secondary school use them to work out when they can meet up and stuff, and people just use them all the time. They've just become part of our lives basically”. “That’s how it’s become for arranging to meet up with everyone and stay in contact with everyone, that’s sort of what everyone does now. Sort of call each other all the time”. “I haven’t got time and I know they’ll answer” and “I would prefer to call, just because it’s quite hard, not hard, but, it takes a long time to text but in a phone call you can get everything done much quicker”. "I think so, I think it depends on how you view it though, because I think there is a certain necessity for a mobile phone for physically having a phone on you, which actually in today’s society, in reality, it is the way people contact each other.”

The interviews showed that calling also facilitates hyper-coordination as the preferred way of communicating because young people like to “hear the tone or expression in people’s voices”. Listening to the human voice is active but texting is passive. Receiving a call and hearing the human voice captures “the essence of the person” (Baron, Radio 4, June 11, 2014) The interviews also indicated that when participants want a more ‘meaningful’ contact, they preferred to call. “I would say it’s definitely about being able to convey my emotions “. And “Talking is nicer than texting, it feels better, like you’re not explaining everything”. Users like to call because “you can get a sense of how the other person is feeling”. “I think I only want to ring if it’s a really personal issue or if someone’s upset about something. And I want to talk to them to find out how they’re feeling because with texting, you don’t get to know how they’re feeling”. Texting would take a long time if she was trying to have a conversation, “Just because you can have a conversation, like an hour’s conversation. To cover that conversation, you would have to send lots of long or short texts and quite much of your money”. Other reasons for calling were for an immediate response, “I like calling because you get more information and you know the answer straight away, but with texting, you don’t get the answer straight away.” Calling was also preferred for sorting out conflict, “Texting can be awkward. If you have an argument, when you are texting, you can get a wrong impression from a text. You can get more meaning and expression in calling.” “If you’re being sarcastic, people might misunderstand in a text. The decision to talk or text was also dependent on who was being contacted, for example, one participant said she would use calling if, “I want to speak to my family. I wouldn’t text my Mum or Dad.” “It’s nice to hear their voice, you can actually give someone your expression”. Calling was also reported as important for an emergency, “if there’s an emergency it’s important to call. You can use your expression, because it’s an emergency.”

Texting was also used for micro-coordination. Questionnaire data showed text was used considerably more for micro-coordination in 2015 than in 2013. The mobile was also reported as being important for contact in an emergency, and texting friends to communicate to say, ‘Hello and have a chat. All other reasons for texting were greater in 2013 than in 2015. In the interviews, one respondent said, “It is easier to text”. Texting allows users chance to communicate at a time that is convenient. It also saves users from become embroiled in extended conversations. “If you don’t want to talk to them, you can send a text. Texting is also convenient, “It’s like if you are just asking someone for like homework. Like, do we have homework that needs to be in tomorrow? It’s just like quicker and easier to text; like you don’t have to call and ask about stuff. It’s just like ....gets to the point....” Other reasons for texting rather than calling were to do with cost, noisy surroundings or poor reception, as evidenced by these participants”. It depends what the noise is like round you because sometimes it’s really noisy, you might not be able to hear them if you ring them”. “If you call someone on the phone it might cut out because the range isn’t that good”. Texting is preferred “rather than calling because sometimes I can’t hear what they’re saying. If they tell me to write something down, sometimes I get it wrong, so I just find texting easier, because they can, like, tell you what it is they want to say."

Users decide whether to text or talk according to what message needs to be communicated and why they want to make contact (Baron, 2009, Ling & Yttri, 2002). Text messaging, like TV and the internet, has become a part of the everyday life of many teenagers. "Through SMS, teens hate, love, gossip, mediate and express themselves even when the writer lacks the courage to call or in situations where other communication channels are inappropriate" (Kasseniem & Rautianen, 2003, p. 171). Texting can be useful if a user finds social interaction difficult, "I'm quite awkward on the phone, I think. So, in a text, you can think about what you're gonna say and you can revise it." The social importance of texting is shown by an 11-14 in the comments, "They can be good if you are lonely & you want a friend, you can text them." and for building relationships without having to engage in face to face contact. "If it's kind of like the first time you are friends with somebody, you'd probably send them a text." Another use of texting is for situations where calling is not appropriate

> If I'm at work and I can't really talk on the phone, it's easier to text then.
> A. Right. I don't like calling people say if I'm sat with my Mum. When it's not convenient to talk. I don't know, if I'm in a social situation with my friends, it's quite rude so I'd rather just text and then come back to the conversation with them."
> "Certain individuals it's better just to text. You get an instant response, a little bit less like waffley, and awkward. I don't know. Yeah, I guess it's quicker to text. You can just send a text and forget about it. "

One participant chose her technological gadget for communication by, "What's nearest. If you're out and about, it'd probably be texting but if you're at home, you'd use Facebook on a laptop". Some reported use texting to resolve conflict as "like a way of getting out of an argument" and where she might not be able to engage in face to face contact. "You wouldn't say it as a 'real' person, but by texting, it's like, it protects you, like a bubble, so you can say it by text." Although, she gave evidence that she is aware that she might be misunderstood in a text, "On the hand, texting is more like to be misunderstood."

Katz and Aakhus (2002) introduced the concept of perpetual contact to explain user behaviour with mobile phones. This thesis enquired about perpetual contact or ‘always on’ behaviour. Participants showed a similar behaviour pattern in 2013 and 2015. For the questions asking users about keeping their phone all the time, wanting to be able to text or called at all times and being able to use their phone to keep in touch no matter whereever they are, it was found that the desire for ‘perpetual contact’ increased with age. It also increased from 2013 to 2015 for all ages. However, a higher number of younger users reported turning their phones off when they went to bed. Those leaving their phone on overnight increased with age and time until the 18-25 age group. At this age, the behaviour changed. Respondents reported that more 18-25s turned their phone off their when they went to sleep in 2015 than in 2013. For those reporting that they left their phone on overnight, there was the possibility of sleep disturbance from calls or texts during the night. The mobile phone has become such an essential part of individual’s lives that many don’t want to part with their phone even when sleeping. However, sleep disturbance from mobile phones has become a problem for many young people (Thomee, Harenstam & Hagberg, 2011). There was some discrepancy in what participants reported. In both 2013 and 2015, the number of respondents who said they turn their phone off did not match the number who say they slept with their phone on. It could be that respondents report that they turn their phone off because they think that this was the response expected. It can be seen that many young people were reluctant to be parted from their phones, even for sleeping. Sleep disturbance was a problem for some respondents. Some young users were exercising appropriate sleep hygiene, but some were not. Encouraging good sleep hygiene and training is appropriate to improve the behaviour. But further research on the consequences on the implications of poor sleep hygiene is also necessary.

This need for perpetual contact can lead to problematic and excessive use, leading to an addictive type of behaviour. Comments from the interviews showed that respondents were aware of the possibility of becoming addicted to their phones. One 11-14 years old respondent said “I think they could get quite addictive. If you have a routine of going home or texting your friends, listening to music and playing games and um, it’s something to do when you’re bored as well, you can just, yeah, go on your phone”. Also, “People just use them all the time.” One participant describes her phone use “It’s like now, because pretty much everyone has a mobile phone. It’s pretty normal now to be using it and checking it all the time.” Walsh, White, & Young (2008) suggest that characteristics of mobile phone behaviour are contributing to addictive behaviour rather than a propensity to addictive behaviour *per se*. Following the logic of apparatgeist and perpetual contact would imply that characteristics of the mobile phone influence the usage behaviour of users. There is no doubt that use of the mobile phone affords many advantages in everyday life, but there is a fine line between what is acceptable and what is not. When problems are found with emotional behaviour, academic attainment, sleep problems and a multitude of detriments to well-being and sleep problems, then usage behaviour needs to be addressed.

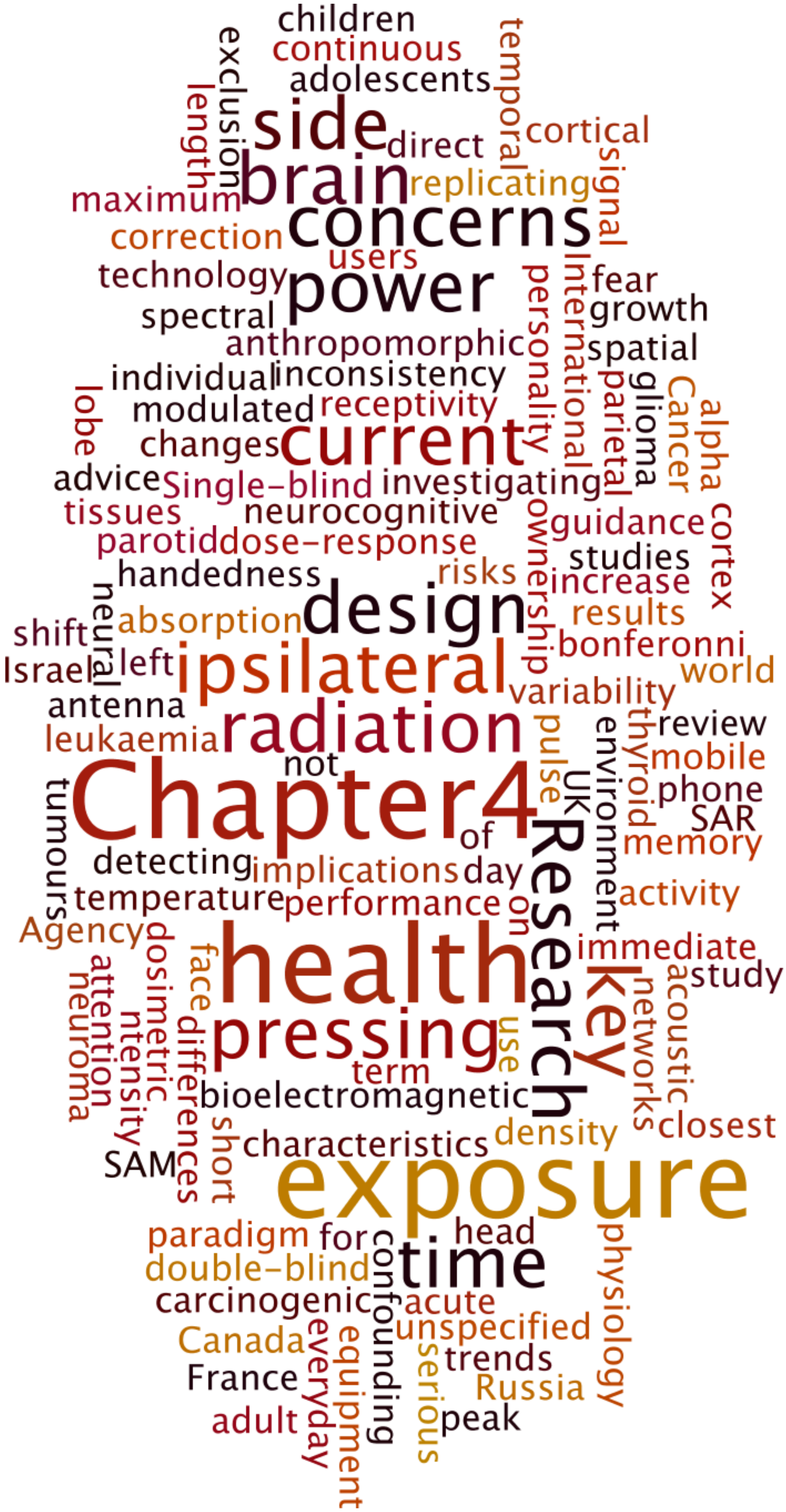
In conclusion, Chapter 3 finds support for the hypothesis that there is a dramatic shift in usage behaviour and communication. This was shown by the results of data presented from the questionnaires and interviews. Ownership reported by young people showed a big increase with all 18-25s owning a mobile. Many respondents view themselves as skilled users of technology and there is a strong relationship between perceived expertise and perceived anxiety. Perceived usage intensity reflects the high investment of young people in mobile phone use. Perceived usage variety reflects changes in usage patterns between 2013 and

2015. Motivations for mobile phone use are illuminated in the results about usage spaces. The qualitative data supports the findings reported in the questionnaires and the interviews provide an understanding of the motivations for use. It is concluded that there is a need for developing awareness of possible health issues so as to amend behaviour before the issues become problematic. Further research directions and limitations of this research are discussed in Chapter 7 in the General Discussion.

3.10 Summary of Chapter 3

Analysis of the first word, the like most/like least responses to mobile phone use and the interviews were analysed. Analysis of first word responses showed that the words Communication, Games, Fun, Call, Technology, Social are thought of in both 2013 and 2015. The most common theme that can be observed is communication and words related to communication, for example, contact, connect, social and call. The ‘like most’ responses found that communication was the main category of use and the ‘like least’ factors, found that factors to do with physical and evaluative issues were the main category in both 2013 and 2015. This was higher in 2015. Participants were clearly not satisfied with the ‘physical’ aspects associated with owning a mobile phone. These physical difficulties were to do with charging the battery, the lack of signal for the phone and the internet, wi-fi and waiting for the phone to load. The main themes identified from the Interpretative Phenomenological Analysis (IPA) of the interviews were communication, evaluative issues, physical attributes, safety and security, cost and entertainment.

Physical, cognitive and social concerns of everyday use of mobile phones were identified and data was collected through questionnaires and interviews. Physical concerns were musculoskeletal effects, hearing, vision, headaches, and damage to fertility. Cognitive concerns were to do with attention and multi-tasking. Social concerns were to do with communication, sleep. dependence, addiction. It was concluded that there is a need for future study and for developing awareness of possible health issues so as to amend behaviour before the issues become problematic.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Chapter 4

Mobile Phone Use and Radiation Effects

A review of RF EMF effects of mobile phones in attention and memory tasks is presented in Chapter 4. A check list is then created for future experimental investigations to encourage a standardised approach in Chapter 6. This includes general procedures for experimental work and specific procedures for considering the effects of RF EMF effects from mobile phones.

4.1. Introduction: Current Health Trends

In the 1960's, individuals smoking in their homes was a common phenomenon. With the increase in awareness about the health consequences of smoking cigarettes in 2018, the habit has been confined, to a large extent, to designated outside areas (Fowler & Noyes, 2017[1]). Most smokers are sensitive to subjecting others to the ill effects of the habit. This behaviour change might be relevant to the current ambiguity surrounding the possible health concerns of mobile phone use (Fowler & Noyes, 2015[2]). With growing awareness about the possible health effects, our behaviour patterns might prompt a paradigm shift or the need for change in a similar way as to that which has occurred with smoking. For example, the effect of RF EMF radiation from mobile phones has been described as "the smoking gun of the twenty first century" by a brain a specialist (Llewellyn Smith, 2015). The patient of the specialist had been diagnosed with an acoustic neuroma, a brain tumour that grows on a nerve in the brain near the ear. The patient was a regular mobile phone user. Many fear serious health risks from the use of mobile phones. Currently, the World Health Organisation classifies the RF effects of mobile phones as possibly carcinogenic (International Agency for Research on Cancer, 2011).

4.1.1. Radiation Concerns

A meta-analysis of long-term phone use found an association with ipsilateral glioma and acoustic neuroma (Hardell, Carlberg, Soderqvist, Hansson & Mild, 2008) and tumours in different parts of the face and head. The risk of parotid gland tumours (Loon, Ahlbom & Christensen, 2009; Sadetski, et al., 2008), heart tissue cancer (Hertsgaard & Dowie, 2018) and leukaemia (Cooke, Laing & Swerdlow, 2010, Kauffman, Anderson, & Issaragrisil, 2009) have been suggested and there is also concern that the thyroid gland (Tinnisword, Furse, & Ghandi, 2008), and parts of the brain (Utton, 2002)) might be affected.

Box 5: What is an Ipsilateral Tumour?

An ipsilateral tumour is a tumour on the same side of the head that the phone is used on.

As discussed in Chapter 3, health concerns have been expressed towards children as time spent on screens can be up to eight hours a day for children under eleven years old (Fowler & Noyes, 2017). With lengthy and multi-faceted use of mobile phones, it is important to identify the effects of RF EMF emissions from mobile phones. The interviews and the 'first word' analysis showed that participant awareness of the potential effects of RF EMF effects from a mobile phone are apparent for only a few users. The words 'brain', 'radiation' and 'headaches' are recorded in the 'first word' responses, suggesting minimal awareness of health concerns. In the interviews, participants expressed concern about possible health concerns, although there was a tendency to 'brush them under the carpet' because of the advantages gained from using the mobile. One 14-18 participant was concerned about when she used her phone next to her ear, 'you have the radiation, and like, I also heard that at night time, if you don’t have a background light, and you are concentrating on your phone, it puts more strain on your eyes, that kind of thing’. Interview Group 5 of the 14-18s had the following dialogue about health concerns:

> C. I’ve sort of heard stories but I’m not sure how much to believe.
> Interviewer. What sort of stories?
> C. There’s one about brain cancer and about putting it under your pillow, something like that and it’s by your head when you are asleep so it’s really bad for you, something like that.
> A. I’m never quite sure what to believe about health things like that I don’t really know what to pay attention to.
> B. I try to avoid putting my phone near my head and stuff. I know it’s not really good because of the frequencies and stuff like even though you can’t see them, they’re still there and they do do stuff to people.
> Interviewer. So, how do you know that?
> B. Um, I’ve just researched into it a little bit. I just did it myself.

Another 18-25s user commented, ‘Sometimes, my phone heats up after I’ve been on the phone for a long time, and I wander what that did to me, in terms of the radio waves and stuff. I wander what happened there.’ Another 18-25 participant said, ‘Actually, when I charge my phone I put it on the floor not on my bed, because, it’s like near your head when you’re sleeping and the waves. Also, I heard a rumour or maybe it’s a truth about damage to your head. A conversation in the interviews gives an indication of how participants perceive the health risks:

> Yes, the microwaves or whatever that damage your brain. My Dad tells us because of his job, like you can damage your brain if you are on the phone too long, they, like heat up your brain. You can actually feel it sometimes …
> B. Yeah
> A. I feel hotter when I’m on the phone … um … so, I guess there is that health risk if I’m on the phone for a long time. I don’t like getting really hot.

RF EMF effects are particularly important for children because of their developing brain (Giedd, 2004) and thinner skulls, thus there is the possibility of greater Specific Absorption Rate (SAR) of energy into the head from a mobile phone. Many studies have linked children’s mobile phone use to health problems (Mobilewise, 2015). Up until the age of 18, teenagers are potentially more affected by the RF EMF effects because their brains have a higher fluid content. They also have thinner skulls than adults. This means that the penetrative effects are greater, and the specific absorption rate is considerably higher for younger ages than for adults (Ghandi, Lazzi & Furse, 1996). It was found that Magnetic Resonance Imaging (MRI) scans of children aged 5 and 8 showed two times the SAR rate of adults (de Salles, Walsh, White, & Young, 2006). Other studies have shown similar findings. (Peyman Chetrit, & Jarus-Hakuk, 2008). Many children interact with mobile phones at an early age. The Stewart Report (2001) on mobile phone use concluded that children should not use mobile phones until they are over 8 years old, and that older children should keep voice calls to a minimum and only use phones for texting. The radiation transmitted in texting, for example, is 0.03% of that emitted during a phone call (Abramson, et al., 2009).

4.1.2. Current Health Guidance and Advice Worldwide

Many countries have provided guidance on the use of mobile phones with the intention of protecting the brain and the head from possible carcinogenic effects. The UK Government guidelines advise young users to text rather than talk on their mobiles and to only use voice calls for essential calls and in an emergency. Guidelines also suggest that headphones and hands-free equipment should be used when possible (Government Advice, 2017). Canada and France have similar recommendations to the UK but provide more specific guidance. For example, a child in Canada is encouraged only to use a mobile in an emergency if they are over 8 years old, and recommendations for teenagers suggest calls are limited to less than 10 minutes. France has gone further than both the UK and Canada by placing a ban on the sale of phones to children under 6 and advertising of mobile phones to children under 12 (National Commitment to the Environment Cell Phone Statute, 2010). The French Government have made it compulsory for mobiles to be sold with earphones and comprehensive pictorial government guidance about mobile phone use is provided. The Russian Ministry of Health advises young people under 18 years not to use the devices and the Israeli Health Ministry advises caution (Lean, 2009). Thus, it can be seen there is concern in many countries about the use of mobile phones and the possible health risks.

An Independent Expert Group first raised concerns about the potential vulnerability of children in 2000 (Stewart, 2000) and in 2004 the World Health Organization held an expert workshop. The RF EMF effects are considered not only for children but also for the pre-natal development of the embryo and the foetus as some studies have found a genotoxic effect. A meta-analysis of 101 publications of RF EMF radiation showed that 49 studies reported a genotoxic effect while 42 did not (Hardell, et al., 2008).

4.1.3. Empirical Studies investigating the RF EMF Effects on Cognitive Performance

Reviews have been carried out on empirical studies investigating the effects of RF EMF on cognitive performance (Hamblin & Wood, 2002; Barth, et al., 2008; Barth, Ponocny, & Winker, 2012; van Rongen, et al., 2009; Valentini, et al., 2007; Valentini, Ferrara, Preshaghi, Gennaro & Curcio, 2010; Marino & Carubba, 2009; Juutilainen, Hoyto, Kumlin & Naarala, 2011; Kwon & Hamilainen, 2011). These have oscillated between cause for concern and no concern. In 2007, Valentini et al. carried out a comprehensive review and suggested that RF EMFs may have an effect. In 2010, a further systematic review and meta-analysis was carried out. It was concluded that mobile phone-like EMF effects do not appear to induce changes (Valentini et al., 2010). Barth and his team (2008) carried out a meta-analysis of the neurobiological effects due to RF EMF exposure emitted by Global System for Mobile Communications (GSM) phones. It was concluded that RF EMFs may have a minor impact on human attention and memory. Following a further meta-analysis, Barth et al. (2012) suggested that there are no significant effects of RF EMFs emitted by GSM and Universal Mobile Telecommunications Systems (UMTS) on cognitive performance. However, a recent review by Zhang, Sumich & Wang (2017), suggests that there is a need to reconsider whether there is an effect of mobile phone RF EMF exposure and that this issue should be explored further. This is due to the findings of recent studies on neurocognitive functions (Lv, et al., 2014; Goshn, et al., 2015; Roggeveen, van Os, Lousberg, 2015). The conclusions of Zhang et al. (2017) confirmed the opinions of other researchers about the many inconsistencies in this field but also suggested that there should be further empirical investigations. In the light of these concerns, a critical review of empirical studies over the last 20 years was undertaken and experiments to do with the effect of mobile phone exposure were carried out. The review of empirical studies is discussed in this Chapter and then experiments that were carried out are discussed in Chapter 5. The aim of the review is to explore the inconsistencies and ambiguities that pervade the domain with the aim of gaining insight and understanding as to why the findings in experiments investigating mobile phone RF EMFs in adults, adolescents and children are so variable.

4.2. Method

For the review, a search was carried out through PsycINFO. Combinations of terms included "exp attention", "attention span", exp perception", "perceptual disturbances", "mental disorders", "exp memory", "memory disorders" "cognitive impairment" "cognitive effect". The criteria for inclusion in the review are based on participants performing a cognitive task whilst using a mobile phone. The structure of the review in Table 4.1 is modeled on a previous review by Regel & Acherman (2011) but different criteria of importance for RF EMF effects on cognitive performance are identified..

4.3. Results

Older empirical studies investigated RF EMF effects on cognitive performance by either using direct, acute mobile phone exposure or usage data as their assessment criteria for mobile phone exposure. More recent studies have also used dosimetric equipment to assess RF EMF exposure levels (Guxens, et al., 2016) and some have used a Specific Anthropomorphic Mannequin (SAM) (Trunk, et al., 2013). Table 4.1 shows 49 studies that were carried out with adults whilst Table 4.2 focuses on 10 studies that were carried out with adolescents (13-18 years) and children.

Table 4.1 RF EMF Effects on Cognitive Performance in Studies involving Adults

Study	RF EMF Exposure				Experimental Design				Cognitive Task (s)						Key findings
	Parameters	Side	Duration	Set Up	Sample (age)	Handedness	Blinding	Exclusions	Practice session	Duration	Response Hand	Time Effects	Dose Dependent	Corrections to Analysis	
Preece *et al.* 1999 Choice reaction time (CRT) task Memory recall Spatial Memory task	915 MHz (217 Hz) 0.25 W mean power 915 MHz analogue 1 W mean power			Mounted on the head with an adjustable cap. Antenna (Ant) over the L temporal lobe (TL)											CRT result could be due to an effect on the angular gyrus. ↓ Reaction Time (RT) in CRT for analogue MP copy
	Study 1	L	25-30		18 9 M 9 F	R 14 L 4	DB	M	√	-	-	-	-	√	
	Study 2	L	25-30		18 9 M 9 F	R 16 L 3	DB	M	√	-	-	-	-	√	
Freude *et al* 2000 $_{\text{ERP}}$ Visual monitoring task (VMT) VMT, Finger movement task & 2 stimulus task (CNV)	916.2 MHz (217 Hz) 577 µs pulse width 2.8 W peak power $SAR_{1\,g}$ = 1.42 W/kg SAR_{10g} = 0.882 W/kg			MP in direct contact at the ear											
	Study 1	L	-		20M (21-30)	R	SB	He	√	-	R	-	-	-	↓ slow brain potential (SP)
	Study 2	L	-		19M (21-26)	R	SB	He	√	-	R	-	-	-	Performance n.s. ↓ SP Performance n.s.
Koivisto *et al.* 2000 $_{\text{ERP}}$ Simple RT task (SRT) Vigilance (VT) Subtraction (ST)	902 MHz (217 Hz) 577 µs pulse width 0.25 W mean power	L	60	Mounted in an acrylic cradle Antenna over posterior area of L temporal lobe	24M 24F (18-29)	R	SB	N	√	60	R	-	-	√	↓ RT (SRT) ↓ RT ↓ false alarms (VT) ↓ Subtraction Time (ST) Neural structures critical for these functions thought to be in the pre-frontal cortex.

Jech *et al* 2001 ERP Narcolepsy-catoplexy patients No task &MP Adapted visual oddball task	Motorola d520 900 MHz (2, 8, 217 Hz) 577 µs pulse width 2 W max. power $SAR_{10\ g}$ = 0.06 W/kg	R	45	MP fixed to the R ear using a cap	9 M 13 F	R 20 L1 B 1	DB	H N	√	3 (x4)	R	√	-	-	No change in EEG after EMF exposure. RT to targets ↓ by 20ms. in oddball task
Croft *et al* 2002 ERP Auditory task	Nokia 5110 900 MHz (217 Hz) 577 µs pulse width 3.4 mW mean power	R	20	MP placed radial to the scalp over posterior cortex	16 M 8 F (19-48)	R 20 L 4	DB	-	√	12.5	R	-	-	√	MP exposure altered resting electroencephalogram (EEG)
Eldestyn & Oldershaw 2002 Spatial span forward & backwards (SSW, SSB) Digital span forwards & Back-wards (DSF & DSP) Serial Subtraction (SS)	900 MHz SAR = 1.19 W/kg	L	38	Held MP to ear	38	4	SB	Cf A		8	-	√	-	-	After 15 mins EMF effects immediate verbal memory (SSW) ↓ visuospatial working memory (SSB) ↑ sustained attention (SS)
Hamblin *et al* 2002 Auditory & visual oddball, Wisconsin Card Sorting Task	Modified Nokia 6 110 894.6 MHz (217 Hz) 576 µs pulse width 2 W peak power SAR = 0.87 W/kg	R	60	MP cradle placed over electrode cap over R temporal lobe	8 F 4 M (21-29)	R	SB	H	√	30	-	-	-	√	↑ RT (Auditory oddball)
Lass et al. 2002 Modified TMT Picture to Word Recall task Paired letter task	450 MHz (7 Hz) 50% duty cycle 1 W output power SAR = 0.0095 W/kg	R	10-20	Single generator model & an amplifier. Antenna located 10cm from the R side of the head	63 M 37 F Mean Age 21.4 Matched homogenous group	-	SB	N	-	10-20	-	-	-	-	↑ variance of errors (Modified TMT) ↓ errors (Picture to word recall task) ↑ variance of errors (Paired letter task)

Haraala *et al* 2003a$_{rCBF}$ N back (0-3)	Factory model GSM 902 MHz (217 Hz) 577 µs pulse width 0.25 W mean power SAR_{10g} = 0.993 W/kg SAR_{peak} = 2 W/kg	L	45	Mounted on the head Antenna located 17 mm over L inferior temporal lobe	14M (21-35)	R	DB	Cf S M	-	-	-	-	-	-	n.s. ↓ in regional cerebral blood flow (rCBF) bilaterally in auditory cortex but thought to be from the battery
Haraala *et al.* 2003b 9 cognitive tests 2 test sessions in 2 independent labs	Factory model 902 MHz (217 Hz) 577 µs pulse width 0.25 W mean power SAR_{10g} = 0.993 W/kg SAR_{peak} = 2 W/kg	L	65	GSM MP mounted on the head with an adjustable rubber EEG head cap. Antenna 4cm over the posterior part of the L hemisphere	64 32 M 32 F (20-42)	R	DB	M	√	65	R	-	-	-	n.s. No immediate EMF effects on human cognitive function or that effects are so small they only occur occasionally
Lee *et al* 2003 Trail making task (TMT) Sustained Attention to Response task (SART)	Nokia 3210 1900 MHz	R	30	Mounted on the right side of the head on the right ear	78 19 M (18-20)	R	SB	M N	√	25	-	-	√	-	↓ RT in SART but not for accuracy Attention tasks may be differentially affected and might be dose dependent, only having an effect with time. Need to consider time course in the future
Smythe & Costall 2003 Word recall task	Ericcson A2618 884 MHz SAR = 0.79 W/kg	L	15	Held a MP to the ear	33 M 29 F (18-53)	R	SB	H V	-	18	-	-	-	-	↓ spatial errors in males but not females
Zwamborn 2003 Visual selective attention task Memory comparison & Dual tasking	GSM 945 MHz (217 Hz) 577 µs pulse width UTMS 2140 MHz, DCS 1940 MHz SAR_{10g} = 0.064 mW/kg	-	-	Signal generator connected to an amplifier, antennae transmitting	Complaints Group 11M 25 F (43- 67) Non- complaints 22 M 14 F (28-64)	-	SB	C Cf D E Hi Mh	√	-	-	-	-	-	8 out of 30 significant results.2 in GSM & 1 in UMTS for CG; 2 in DCS & 3 in UMTS on NCG 2 sessions am. & pm.Thermal ↑ 0.12° brain, 0.25° C in the skin.

Curcio *et al* 2004 Acoustic Simple RT (ASRT) Acoustic CRT (ACRT) Subtraction VS letter & cancellation tasks	Motorola Timeport 260 902.4 MHz (217 Hz) 0.25 W mean power SAR = 0.5 W/kg,	L	45	Held by a helmet 1.5cm from the parieto-temporal areas. Dummy phone on the R ear	10 M 10 F (22-31)	R	DB	D M Mh N Sr Mc	-	22	R + L	√	-	x	↑ speed RT (ASRT) ↑speed to targets (ACRT) Effects of RF EMF shown after a minimum of 25 minutes exposure No difference in R + L hand responses
Hamblin *et al.* 2004 ERP Auditory oddball task	Modified Nokia 6110 894.8 MHz (217 Hz) 576 µs pulse width 2 W peak power SAR = 0.87 W/kg 2 sessions in 2 labs 1 week apart, Week 1 sham and/or Week 2 exposure	R	60	Mounted in a MP cradle over an ECI electro cap over the right temporal region	4 M 8 F (19-44)	R	SB	D H N Mh Sr	√	30	L	-	-	√	↑ RT N100 amplitude & latency ↓ with the ↓ larger over midline & R hemisphere P300 latency to targets was delayed in the L frontal & L central sites. MP exposure may affect neural activity close to the phone, but as this was a small sample size, cautious interpretation is appropriate
Haraala *et al.*, 2004 nback task (0-3)	Nokia 6100 GSM 902 MHz (217 Hz) SAR_{10g} = 0.99 W/kg, SAR_{peak} = 2.00 W/kg 2 sessions in 2 labs, 32 in each session	L	65	Adjustable rubber cap Antenna over L inferior temporal lobe	64 32M 32 F (20-24)	R	DB	M	√	65	-	-	-	√	n.s. It is possible that EMF effects are so small that these are only detected sometimes

Hinrichs & Heinze, 2004 ERP Verbal memory retrieval	1870 MHz (217 Hz) 0.125 W mean power 1 W peak power $SAR_{1\ g}$ = 1.14 W/kg SAR_{10g} = 0.61 W/kg	L	30	Signal generator, This is applied by an antenna which is located close to the left ear, at $30^{o.}$	12 10 F 2 M (18-30)	-	DB	MN V	√	10	-	-	-	√	n.s. although early (350-450ms) task specific component was changed indicating an interference of EMF & item encoding
Maier *et al.*, 2004 Auditory discrimination task	Motorola GSM 920 MHz 2 sessions same time each morning. 2 sessions: Day 1: Testing, then a 50 mins relaxation period followed by further testing Day 2: Testing was repeated	L	66	Stereo ear phones + MP, antenna positioned 4cm to L ear	11 (23-43)	-	DB	M	-	66	R + L	-	-	-	9 out of 11 ↓ performance, significant at p = 0.0105. Restrict MP use generally but for high risk groups, e.g. the elderly, children, and ill people
Besset *et al.*, 2005 22 neuropsychological. test battery	900 MHz (217 Hz) 576 µs pulse width SAR = 0.54W/kg 2 sessions with 2 randomly assigned groups that are matched for age, gender & intelligence	L + R	120/ Day 5 days a week for 4 weeks	Held with preferred hand	54 27 M 28 F (18-40)	R 47 L 8	DB	DHM	-	120	-	-	-	-	n.s. MP use has no effect on cognition after a 13- hour rest period
Rodina *et al.*, 2005 Visual masking task (VMT)	450 MHz (7 Hz) 50% duty cycle 1 W output power SAR = 0.0095 W/kg	R	5-7 x 8	Signal generator + amplifier + A 10cm from R side of head	10 4 M 6 F (19-32)	L + R	SB	Cf A M	√	3-8 (x 8)	-	-	-	-	↑ errors (VMT) Significant difference found when both stimuli need to be recognised correctly

Schmid *et al.*, 2005 4 visual perception tasks	UTMS 1970 MHz (5 Hz) High exposure: $SAR_{1\,g}$ = 0.63 W/kg SAR_{10g} = 0.37 W/kg Low exposure:1/10 of high exposure	L	-	Signal generator with antenna mounted in a headset with stereo headphones over the left temporal lobe	58 29 M 29 F (20-40)	-	DB	M	√	-	-	-	-	-	n.s. Only acute effects of exposure investigated here, so scope for future study of after effects of acute exposure and long-term effects
Aalto *et al.*, 2006$_{rCBF}$ nback letter task (1)	Factory model 902 MHz (217 Hz) 577 µs pulse width 0.25 W mean power SAR_{10g} = 0.743 W/kg SAR_{peak} = 1.51 W/kg	L	51	Antenna located over left inferior temporal lobe	12 (23-27)	R	DB	A BCf MS	-	-	-	-	-	-	n.s. Local ↓ in rCBF
Eliyahu *et al.*, 2006 Spatial item recognition “FACE” Verbal item recognition “LETTER” Spatial compatibility “SPAT” Spatial compatibility “SIMON”	Nokia 5110 890.2 MHz 576 µs pulse width 2 W peak power 2 experimental sessions of 1 hour with 5 mins break in between	L+R	120	Mounted on the R ear & the L ear with intermittent transmission to R or L side	36 M (19-27)	R	SB	ACf M Sr	√	120	L+ R	√	-	√	Exposure of L side of the brain slows down L hand response time in the second part of the experiment. Found in 3 of 4 tasks and was very significant in one task. Significant effect for responding hand, RT ↑ for R hand in the “FACE” task
Hamblin *et al.*, 2006 $_{ERP}$ Auditory and visual oddball tasks	Modified Nokia 6110 895 MHz (217 Hz) 576 µs pulse width 2 W peak power SAR_{10g} = 0.11 W/kg 2 sessions 1 week apart	L+R	30	MP mountd over temporal region and an inactive MP on the other side of the head	120 46 M 74 F (18-69)	R108 L12	DB	Mh N Hi	√	15	-	-	-	√	n.s. No replication of previous findings (Hamblin, 2004). No significant differences for RT or auditory or visual event related potential (ERP)

Keetley *et al.* 2006 Simple (SRT) & Choice RT (CRT) Trail making Task (TMT)	Nokia 6100 0.23 W mean power	L	60	Modified non-metallic helmet +MP Antenna 1.5cm from L ear	120 58 M 62 F	-	DB		√	30	-	-	-	x	↑ RT in SRT & CRT tasks ↑ performance TMT Future studies with fMRI to show neurophysical changes & also long-term effects of EMF
Papageorgio *et al.* 2006 Working memory task Digit span Wechsler Auditory test	900 MHz 64 mW mean power Matched for age & gender. Tasks performed twice with a two- week interval	R	-	Signal generator with non-modulated signal. Antenna located 20cm next to the right ear	19 9 M 10 F (21-25)	R	DB	M H	√	-	-	-	-	√	↑ P50 evoked by low frequency exposure (500 MHz). ↓ in P50 evoked by high frequency exposure (3000 Hz)
Russo *et al.* 2006 Simple & 10 choice RT Vigilance Subtraction	888 MHz GSM PM SAR_{avg} = 1.4 W/kg SAR_{peak} = 1.51 W/kg 888 MHz CW SAR_{avg} = 1.4 W/kg	R+L	35/ 40	Mounted on the head with a “cage/cap”, Antenna close to the head	168 69M 99 F (17- 41)	R+L	DB	M Mc V	√	35/ 40	-	-	-	-	n.s. No replication of previous studies. Need for sufficient power in future studies
Terao *et al.* 2006 Pre-cued RT	Manutshit 800 MHz (50 Hz) 6.7 ms pulse width 270 mW mean power SAR_{10g} = 0.054 W/kg	R	30	MP simulator connected to hand held handset, Antenna 2cm from the head	16 9 M 7 F (25-52)	R	DB	HiMM h N	√	6/7	R+ L	-	-	-	n.s No short-term effect on cortico- visual motor processing
Cinel *et al.* 2007 Auditory discrimination task replicating Maier et al.’s study (2004)	Nokia 6100 GSM 902 MHz (217 Hz) SAR_{10g} = 1.14 W/kg, SAR_{peak} 11.2 W/kg888 MHz CW SAR_{avg} = 1.4 W/kg2 sessions with an interval of 40 mins	L+R	40/ 45	Mounted on the head with a “cage/cap”, Antenna close to the head	168 114 F 54 M (18-42)	-	DB	Mc	√	35/ 40	-	-	-	√	n.s No lateralisation effects from exposure of R and L side of the head

Fritzer *et al.* 2007 Neuropsychological tests	900 MHz (2, 8, 217 1736 Hz) SAR = 24 mW/kg (whole body) SAR_{max} = 1 W/kg (head) Over 6 nights	Top Head	405- 525	Antennae array 30 cm from top of the head. Refers to further set up details being found in Huber et al. (2003)	20 10 (22-36) exposure group 10 (23-37) sham	-	-	D M Sr Sw	-	-	-	-	-	-	n.s. No short term or cumulative long-term EMF effects are revealed
Haraala *et al.* 2007 Replication of previous nback task (0- 3) (Haraala *et al.*, 2003, 2004)	Nokia 6100 2 conditions tested: Pulsed: 902 MHz (217 Hz) 577 µs pulse width 0.25 W mean power Not pulsed (but CW): 902 MHz CW 0.25 W mean power SAR_{1g} = 1.1W/kg SAR_{10g} = 0.738 W/kg SAR_{peak} = 1.18 W/kg	L+R	90	Signal generator & a linear power amplifier connected to MP antenna by a cable	36M (21-26)	R	DB		√	45	R	-	-	-	n.s. No effect of EMF effects for modulation or hemisphere
Irlenbusch *et al.* 2007 Visual threshold experiment	902 MHz (217 Hz) SAR_{1g} = 0.022W/kg SAR_{10g} = 0.010 W/kg (Eye tissues) Testing same time, same day of the week	-	2x60 (2x 30)	A spiral antenna behind a screen fed by a MP and power amplifier in an enclosed chamber	33 21 M 12 F (19-27)	-	SB	M Sr V	√	2 x 3(	-	-	-	-	n.s.
Krause *et al.* 2007 ERP Auditory memory 0-3back	Nokia 6110 Pulsed 902 MHz (217 Hz) 577 µs pulse width 0.25 W mean power Not pulsed: 902 MHz CW 0.25 W mean power SAR_{1g} = 1.1 W/kg SAR_{10g} = 0.738 W/kg SAR_{peak} = 1.18 W/kg	L+R	2x -27 2 x -40	Signal generator a linear power amplifier, Antenna 20mm from the posterior temporal lobe on the L & R side of head	72 36 (21-25) 36 (20-25)	R	DB	M	√	-27 -40	R	-	-	-	n.s. No difference for side of head. EMF effects difficult to capture systematically but effects may be subtle, variable & difficult to replicate

Regel *et al.* 2007a Simple Reaction time (SRT) task 2 choice reaction time (CRT) N back: 1, 2 and 3 back tasks with consonants	900 MHz (2, 8, 217, 1736 Hz) 50% duty cycle 902 MHz CW ${}_{ps}SAR_{10g}$=1 W/kg EEG measurements taken immediately after, 30 mins after & 60 mins after exposure	L	30	2 planar patch antennas 115mm from the head and above the ear canal	24 M (19-25)	R	DB	A CfDM Mc Mh N S Sr	√	15 (x2)	-	√	√	√	With PM EMF: ↓ RT (2, 3 back) ↑ Accuracy (3 back) Spectral power increased in the waking EEG 30 mins after exposure Non-thermal biological effect of pulsed EMF effects
Regel *et al.* 2007b Simple Reaction time (SRT) task. 2 choice reaction time (CRT) N back: 1, 2 and 3 back tasks with consonants	900 MHz (2, 8, 217, 1736 Hz) 12.5% duty cycle ${}_{ps}SAR_{10g}$=0.2 W/kg ${}_{ps}SAR_{10g}$=5 W/kg	L	30	2 planar patch antennas 115mm from the head and above the ear canal	15M	R	DB	A CfDM Mc S Sr	√	15 (x2)	-	√	√	√	↓ RT (1 back, dose dependent) ↑ Accuracy (Session 1 of 2 back at 0.2W/kg) Dose dependent frequency range in non-REM sleep ↑ of power in the spindle area
Cinel *et al.* 2008 Letter & face n back (0-3) Vigilance Letter & Digit Stroop Sternberg tasks	Nokia 6100 GSM 888 MHz (217 Hz) SAR_{avg} = 1.4 W/kg SAR_{peak} = 11.2 W/kg 888 MHz CW SAR_{avg} = 1.4 W/kg.	**L+R**	45/ 40	Mounted on the head with a "cage/cap", Antenna close to the head	168 44M 122 F (21-23)	-	DB	Mc	√	40/ 35	-	-	-	√	n.s. ↓ RT Stroop Test but maybe a Type 1 Error No effect of modulation. No effect of lateralisation
Unterlechner *et al.* 2008 Vienna RT Vigilance Vienna determination	UTMS 1970 MHz (5 Hz) High exposure: $SAR_{1\,g}$ = 0.63 W/kg SAR_{10g} = 0.37 W/kg Low exposure:1/10 of high exposure	L	-	MP with small helical antenna close to the head	40 20 M 20 F (21-30)	R (87.5%) L/B (12.5%)	DB	A Cf M P S Sr W	√	30 (x3)	-	-	-	√	n.s.
Kleinogel *et al.* 2008	900 MHz (GSM, 2, 8, 217 Hz)	L	30	Shielded set up with a	15 M (20-35)	R	DB	M	√	11	-	-	-	-	n.s.

Auditory oddball	UTMS 1950 MHz GSM & UTMS high: ${}_{ps}SAR_{10g}$=1 W/kg UTMS low: ${}_{ps}SAR_{10g}$=0.1 W/kg			small broadband antenna over the L ear											
Luria *et al*. 2009 Spatial WM Task	890.2 MHz 577 µs pulse width 2 W peak power	R+L	60	Mounted on the R ear & the L ear with the antenna 1.5 cm from the head	48 M (no age given)	R	SB	A Cf D H Hi M N Sr V	√	5 (x12)	L+ R	√	-	√	↑ RT of the R hand responses under left side exposure condition. Only correct responses analysed. Time dependent effects are found
Wilholm *et al.* 2009 Morris Water Maze	884 MHz GSM ${}_{ps}SAR_{10g}$=1.4 W/kg 2 groups tested: 1.Symptomatic: reported sensitivity to MP use 2. No symptoms	L	150	Simulator, patch antenna on the L side of the head	42 21M 21 F (18-45)	-	DB	B HpM Mh Sr P	-	-	-	-	-	-	↑ performance & ↓ distance travelled during the Morris Water Maze trials for the 'symptomatic' group. EMF effects are subtle and may only be detected in those who have a sensitivity to MPs
Okano *et al.* 2010 Saccades task	1.95 GHz 0.27 antenna input power, 250 mW	L	30	MP held over the L ear 2cm from the head, powered from a simulator.	10 3 M 7 F (24-47)	R	DB	M	√		L+ R	-	-	√	n.s. Changes that occurred in tasks are the same with or without EMF exposure.
Sauter *et al.* 2011 Attention: Divided attention: Test for Attentional Performance (TAP), Selective attention from the Vienna Test System) & vigilance	GSM 900 SAR_{10g} = 7.82 W/kg (for 1W input power) WCDMA (Wideband Code Division Multiple Access) SAR_{10g} = 2 W/kg	-	7 hrs 15m	Cushioned light weight head worn antenna Well-being questionnaire SAM used for dosimetric assessment	30 M (18-30)	R	DB	DMM hN S Sr	√	45 (x2)	-	√	-	√	Some time of day effects found for divided and selective attention. Effects of time of day are more consistent than EMF exposure effects. These tests are appropriate for

tasks, WM tasks: nback (0-2)	(for 1 W input power) All tests presented twice, morning and afternoon														detecting very small changes in performance and show that it is important to consider daily routine in studies of EMF effects
Curcio *et al.* 2012 Go-No-go task	Motorola Timeport 902 MHz (8, 217 Hz) 0.25 W mean power SAR_{peak} = 2 W/kg	R	45	MP held by a helmet in position of typical use, 1.5cm from the ear tragus, antenna at the tempo-parietal area	20 M (19-25)	R	DB	A CfD HiM Mh N Sr Mc	√	45	-	-	-	√	n.s. No changes on brain blood oxygen level dependent (BOLD) response
Mortazavi 2012 Visual RT task	Nokia N78 GSM SAR_{peak} = 1.23 W/kg Each test given 5 times with 10 min intervals. Usage data on low, moderate & frequent use	R	50	Demographic information	160 122 M 38 F (18-31)	R	SB	Mh	√	50	R	-	-	-	↓ RT for acute short-term exposure Not in usage data for low, moderate & frequent users Bioeffects of RF EMF exposure are only observable immediately after an exposure
Schmid *et al.* 2012 $_{ERP}$ 2 choice RT task (CRT) Simple RT task WM nback	900 MHz (217 Hz) 577 µs pulse width 900 MHz (14 Hz) 23 µs pulse width SAR_{peak} = 2 W/kg Tasks presented in a fixed order. Questionnaires rating current mood state & well-being given	L	90 (3x 30)	Centre of the 2-planar antenna was 42 mm vertically above the ear canal at 1.15mm from the ear	30 M (20-26)	R	DB	A D CfM Sr Mc	-	90 (3x 30)	R	-	-	√	n.s. ↑ in spindle frequency range in non-REM sleep following 14 Hz pm. condition. Similar ↑ in 217 Hz pm. but not significant. pm. RF EMF alters brain physiology. Time course of RF EMF effects varies across studies
Vecchio *et al.* 2012a $_{ERP}$ Visual go/no go task	902 MHz (8, 217 Hz) 0.25 W mean power	L	2 x 45	Active MP positioned on the L side of	11 8 M 3 F	R	DB	A CfM Sr	√	2 x 10	R	√	-	√	↑ RT to go stimuli in the post than the pre-exposure period. Less

	SAR_{peak} = 2 W/kg SAR_{max} = 0.5 W/kg 2 sessions separated by a week			the head on a metallic helmet, 1.5cm between the ear and the phone, with an inactive phone on the R	(24-63)			Mc							power ↓ of high frequency alpha rhythms. Suggests peak amplitude of alpha ERD & RT to go stimuli are modulated by the effect of GSM-EMF on the cortical activity
Trunk *et al.* 2013 Auditory Oddball task	Nokia 6650 UMTS SAR_{max} = 1.75 W/kg $SAR_{10g \geq}$ 2 W/kg A Specific Anthropomorphic Mannequin (SAM) was used to assess exposures. Same time of day for experiments	R	2 x 30	Patch antenna 4-5mm from the ear above the tragus (connected to an amplifier and then to the MP signal source) mounted on a plastic head set	2 groups 17 8 M 9 F (18-25) 26 14 M 12 F (20-32)	-	DB	CfFH N	√	2 x 30	-	-	-	√	n.s. No effect of 30 mins 3G MP on EEG spectral power in any frequency band No reporting of substantial thermal sensations when asked about thermal perceptions in each exposure session
Trunk *et al.* 2014 Visual oddball task	Nokia 6650 3G UMTS SAR_{max} = 1.75 W/kg SAR_{10g} $\geq$ 2 W/kg 4 conditions: No MP & no caffeine, caffeine only, MP only, caffeine & MP. Sessions same time of day either at 8am or 2pm with 2-7 days between sessions	R	4 x 15	Patch antenna 4-5mm from the ear above the tragus (connected to an amplifier and then to the MP signal source) mounted on a plastic head set	25 14 M 9 F (18-38)	R	DB	A CfM S	√	8 x 15	-	-	-	-	n.s. No synergistic or interactive effect of UTMS MP exposure with caffeine on basic neural or cognitive measures
Mohan *et al.* 2016 Auditory task	Exposure usage was assesed and 3 groups created: more than 5 years	-	-	Usage data	180 90 M 90 F (17-25)	D	SB	DEi H	√	-	-	-	-	√	n.s. Chronic mobile phone exposure does not have

	use, less than 5 years use and no use 2 sessions		detrimental effects on cognition

Study: ERP: Experiments involving event related potentials (ERP): rCBF: Experiments involving regional cerebral blood flow (rCBF)
RF EMF Exposure: UD: usage data; MP: mobile phone; SAR: specific absorption rate (average/peak spatial); Ant: Antennae; TL: temporal lobe; L: left side; R: right side; L+R: left and ride side exposure; GSM: Global System for Mobile Communications; UTMS: Universal Mobile Telecommunications; WCDMA: Wideband Code Division Multiple Access; PM: Pulse modulated; CW: Continuous Wave (carrier frequency only)
Experimental Design: M: males; F: females; R: right handed; L: left handed; age given in brackets; B: Both; SB: single blind; DB: double blind; Exclusion criteria: A: No alcohol prior to the experiment; B: brain health: C: no claustrophobia; Cd: no cognitive disorder; Cf: no caffeine prior to the experiment; D: no drugs prior to the experiment; E; no epilepsy; Ei: no ear infection; H: no hearing problems; Hi: no head injury; M: medically healthy and not taking medication; Mh: mentally healthy, no mental health issues in the previous 6 months: Mc: no mobile calls for a specified number of hours prior to the experiment; N: no neurological disorders; P: physically healthy; S: no smoking 24 hours prior to the experiment; Sr: regular sleep cycle; Sw: not doing shift work: V: normal vision: W: not over-worked; √: carried out; - not carried out
Results: ↑: significant increase; ↓: significant decrease; n.s.: non-significant effect compared to no exposure condition; pm: pulse modulated; T: trend; RT: reaction times

Table 4.2 RF EMF Effects on Cognitive Performance in Studies involving Children & Adolescents

Study	RF EMF Exposure				Experimental Design				Cognitive Task (s)						Results & Key findings
	Parameters	Side	Duration	Set Up	Sample (age)	Handedness	Blinding	Exclusions	Practice session	Duration	Response Hand	Time Effects	Dose Dependent	Corrections to analysis	
Lee *et al.* 2001 Symbol Digital Modalities Test (SDMT), Stroop Colour Word Test (SCWT), Trail Making Test (TMT)	UD Matched for age & gender.	-	-	-	37 MP users & 35 non-users (15-16).	R	DB	P M	√	-	-	√	√	-	3 tasks of attention ns. but one task showed a mild facilitating effect. ↑ performance TMT thought to be related to frontal activation.
Haraala *et al.* 2005 Reaction Time (RT) tasks, N back and Vigilance task	Factory model GSM 902 MHz (217 Hz) 577 µs pulse width 0.25 W mean power $SAR_{1\,g}$ = 1.44 W/kg $SAR_{10\,g}$ = 0.99 W/kg SAR_{peak} = 2.07 W/kg	L	65	Mounted on L side of the head with an adjustable cap. Antenna over L temporal lobe.	16 M 16 F (10-14)	R	DB	M	√	50-65	B	-	-	√	n.s. There is a need for studies to achieve more consistent SAR parameters.
Preece *et al.* 2005 Cognitive drug research tests modified for children	Nokia 6110 902 MHz (217 Hz) 0 W power 0.25 W peak power 2 W peak power $SAR_{max\ brain}$ = 0.28 W/kg	L	30	Plastic ear defender in a cradle.	9 M 9 F (10-12)	R	SB	M	√	30	B	-	√	√	No evidence to suggest that children are more sensitive to EMF effects although there was a trend of decreased accuracy.
Krause *et al.* 2006 Auditory memory task	Nokia 6110 902 MHz (217 Hz) 577 µs pulse width 0.25 W mean power	L	-	MP attached using an earmuff, Antenna	15 (10-14)	R	DB	M	-	-	R	-	-	-	n.s. Brain oscillatory responses transformed in the 4-8Hz and 15Hz frequencies.

	SAR < 2 W/kg			20mm from posterior temporal lobe.											
Abramson *et al.* 2009 Cognitive health battery including Stroop	UD Questionnaire data collected showing median number of texts, calls & MP usage.	-	-		13 M 144 F (12-13)	-	-	Cd M D	-	-	-	-	-	-	↑ RT on WM tasks but ↓ accuracy. ↑ RT on simple & associative tasks. Suggests impulsive behaviour strategy.
Thomas *et al.* 2011 Cognitive battery & Stroop	Longitudinal Questionnaire data collected.	-	-	Usage data derived from the Australian Mobile RF Phone Exposed Users' Study (MoRPhEUS).	236 (12-13, 13-14)	-	-	Cd	-	-	-	-	-	-	Participants with more voice calls and SMS at baseline showed less ↓ in RT over the 1-year period for both an RT task and the nback task.
Leung *et al.* 2011 Auditory oddball N back	Nokia 6110 2G 894.6 MHz (218 Hz) Mean output of 250mW SAR_{10g} = 1.7 W/kg SAR_{peak} = 2 W/kg 3G 1900 MHz Mean output of 125mW SAR_{10g} = 0.7 W/kg	R + L	55	Cradle with MP (2G or 3G) placed either side of the head with external antenna on each side of the temporal lobes.	41 (13-15) 42 (19-40) 20 (55-70)	R + L	DB	A Cf D H Hi M Mh S	-	√	-	-	-	√	↓ accuracy in the nback with 3G for all groups but highly significant for adolescents. Event related alpha (ERA) affected in the 3G condition. Augmented N1 found in 2G condition.
Loughran *et al.* 2013 SRT, CRT 1, 2 n back	GSM 900 MHz, SAR_{ps} 1.4 W/kg (high SAR) GSM 900MHz, SAR_{ps} 0.35 W/kg (low SAR).	L	30	Seated between 2 planar antennae.	12 M 12 F (11-13)	R	DB	Cf Cd D M Mc Pe Sr	-	-	R	√	-	√	n.s
Schoeni *et al* 2015	UD Exposimeter (portable measurement	-	-	Longitudinal; Exposure usage data from MP	439 (11-14)	R + L	-	-	-	-	-	-	√	-	Call length related to ↓ in figural memory over 1 year.

Verbal & figural memory	device) SAR values created from previous studies.			operators and & a time activity diary.											
Guxens *et al.* 2016 Cognitive tests from the Amsterdam Born Children and their Development (ABCD) Study	UD	-	-	Retrospective questionnaire data on MP exposure sources collected from mothers in the child's 7th year.	2354 (5-6)	R + L	-	-	√	-	R + L	-	-	√	↑ visuomotor co-ordination with RF-EMF indoor sources and higher personal MP use. ↑ inhibitory control and cognitive flexibility.

Study: ERP: Experiments involving event related potentials (ERP): rCBF: Experiments involving regional cerebral blood flow (rCBF)
RF EMF Exposure: UD: usage data; MP: mobile phone; SAR: specific absorption rate (average/peak spatial); L: left side; R: right side; L+R: left and ride side exposure; GSM: Global System for Mobile Communications; UTMS: Universal Mobile Telecommunications; WCDMA: Wideband Code Division Multiple Access; PM: Pulse modulated; CW: Continuous Wave (carrier frequency only)
Experimental Design: M: males; F: females; R: right handed; L: left handed; age given in brackets; B: Both; SB: single blind; DB: double blind; Exclusion criteria: A: No alcohol prior to the experiment; B: brain health: C: no claustrophobia; Cd: no cognitive disorder; Cf: no caffeine prior to the experiment; D: no drugs prior to the experiment; E; no epilepsy; Ei: no ear infection; H: no hearing problems; Hi: no head injury; M: medically healthy and not taking medication; Mh: mentally healthy, no mental health issues in the previous 6 months: Mc: no mobile calls for a specified number of hours prior to the experiment; N: no neurological disorders; S: no smoking 24 hours prior to the experiment; Sr: regular sleep cycle; Sw: not doing shift work: V: normal vision: W: not over worked; √: carried out; - not carried out
Results: ↑: significant increase in cognitive task; ↓: significant decrease in cognitive task; n.s.: non-significant effect compared to no exposure condition T: trend; RT: reaction times

4.3.1.1 Acute Exposure

With regard to adults, 11 studies found that acute exposure improved cognitive performance on attention tasks and short-term memory tasks whilst 13 studies found no improved cognitive performance. Acute exposure refers to the short term, immediate and direct effect of exposure. Two studies, Lee, et al. (2001) and Keetley, Wood, Spong & Stough (2006) found both improved and reduced performance. Schmid, et al. (2012) found an effect on brain physiology but this was not reflected in cognitive performance measurements.

Five out of 10 studies investigating RF EMF effects in adolescents and children are concerned with acute exposure. One study found support for an effect of acute exposure on human cognitive function (Leung, et al., 2011) but the remaining four studies found no evidence for cognitive effects on attention and memory (Haraala, Bergman, Laine, Revonsuo & Hamailainen, 2005, Krause, et al., 2006; Loughran et al., 2013) although Krause et al. (2006) found brain oscillatory responses are transformed in the 4-8Hz and 15Hz frequencies.

4.3.1.2. Usage Data

Two out of 49 adult studies reported based their exposure metric on usage data. Both Mortazavi, et al. (2012) and Mohan, Khaliq, Panwar & Vaney (2016) did not find RF EMF effects on cognitive performance from this method. The study of Mortazavi et al. (2012) is interesting because the team considered acute effect of exposure and usage data. Acute exposure found significant results, but usage data did not, revealing a further inconsistency in bioelectromagnetic research results.

In contrast to adult studies, half of the studies with children and adolescents used usage data to investigate the effect of RF EMF exposure. All of these studies found a significant effect of RF EMF effects on cognition (Lee et al., 2001; Abramson et al., 2009; Thomas, et al., 2011; Schoeni, Roser & Roosli, 2015; Guxens et al., 2016). Using usage data as the exposure variable for phone use has been criticised because high and low usage assessment can vary considerably. Besset, Espa, Dauvilliers, Billiard, & de Seze (2005) pointed out that the duration of exposure in the study of Lee et al. (2001) ranged from 3 to 454 hours (median=62 hours). No information was given on how long use was. If usage data is to be used to assess the amount of exposure, the variability needs to be identified. The identification of outliers might also influence the extent of the variability.

Given that usage data assesses use over time, this can be an important way to assess mobile phone exposure effects. Often, exposure data is obtained through questionnaires on phone usage. With young children, there is a high possibility that this might be over-estimated. For example, when usage data was correlated with phone records, it was found that mobile phone use was over-estimated (Schoeni et al., 2015). Self-reported call duration was seven times higher than operator recorded calls. It is possible to employ a back-up system to check exposure assessments, as in the study of Schoeni et al. (2015), but it is of concern that the discrepancy is so high.

4.4. Technology. Users, Environment: Factors affecting Empirical Studies

The following section presents factors which contribute to the high variability in empirical studies. These relate to the technology itself, the user and the environment. Each will be considered in turn.

4.4.1. The Technology

4.4.1.1. Technology: Mobile Phone Characteristics

Mobile phone characteristics refer to the range of features associated with the functioning of the mobile. These include the carrier frequency, the mean and/or peak power output, the type of pulse modulation, pulse width or duty cycle, pulse density, the duty cycle, and the SAR. Table 4.1 and Table 4.2 show the parameters used for each study and reports the brand of phone. The quantity and quality of information about mobile phone characteristics varies considerably from study to study. The result of this is that information on power (W), power density (W/m^2) or SAR (W/kg) are difficult to compare between studies. Most, but not all studies report the SARs. The SAR refers to the amount of energy transfer to biological tissue per units of time and mass (Versschaeve & Maes, 1998) These vary from 0.1-2.0 W/kg, for example, 0.23W/kg (Wilholm, Lowden, Kuster, Hillert & Armetz, 2009), 0.25W/kg (Curcio, et al., 2004; Keetley et al., 2006), to a peak exposure of 2.00W/kg (Haraala, et al., 2003a).

Some studies describe the type of mobile phone signal that is used. These can be pulse modulated or continuous. Modulated signals can be thought of as an arrangement of pulses or recurring signals which have a particular way of describing that signal apart from all others. They occur in an on-off pattern, which can either be sharply pulsed in quick bursts or smooth and rhythmic (Blackman, 2009) and may affect normal, linear, non-biological functions plus also having an impact on biological cells, tissues, and organs with which they come into contact. Pulse modulated RF EMF (PM) have more effect on cognitive performance than continuous wave (CW) (Schmid et al., 2012). Regel et al. (2007a) suggested that pulse modulations are essential for RF EMF generated variations in brain physiology. It was found that alpha activity was significantly increased during and immediately after exposure from pulsed RF EMFs. Mechanisms that generate alpha occur in thalamic and nonthalamic structures (Lopes de Silva, 1991). Regel, et al. (2007a) suggested that the thalamus and associated sub cortical areas may be structures that are most sensitive to RF EMF as alpha has consistently been shown to be affected by RF EMF. Pulsed, but not continuous RF EMF increases aspects of sleep EEG (Huber, et al., 2002; Regel et al., 2007a). Croft, et al. (2002), D'Costa, et al. (2003) and Hinrikus, Parts, Lass & Trulick (2004) also found that pulsed RF EMF exposure affected alpha activity during exposure and immediately after exposure. A further study by Krause, Pesonen, Haraala & Hamailainen (2007) found that exposure to RF EMF exposure had an impact on brain oscillatory responses in the alpha frequency range (8-12Hz). Croft et al. (2008) found that mobile phone exposure altered brain activity in young adults, particularly in the alpha (8-13Hz) index of neural activity. These studies provide evidence for RF EMF effects in sleep spindle frequency range (12-15 Hz) and spectral power in the alpha range (8-12 Hz). They also confirm that the type of signal can affect the outcome of whether the RF EMF has an effect in cognitive tasks, so it is important to consider how the signal is produced, whether it is pulsed or continuous.

Those studies that report minimal information about mobile phone characteristics risk the possibility of failing to notice factors that might influence the effects of RF EMF exposure on users. A number of studies reported minimal information. Eldestyn & Oldershaw (2002) specify that the mobilephone operated at 900MHz with a SAR of 1.19/kg of exposed body tissue. Smythe & Costall (2003) refer to how EMF exposure was produced using an Ericcson A2618s that operated at 1800 MHz with an SAR of 0.79W/kg whilst Lee et al. (2003) only specify that a 1900 MHz Nokia 3210 mobile phone was used. Mortazavi et al. (2012) reports the type of phone, a Nokia 78GSM and that the highest SAR value under the INCIRP guidelines for use of the device at the ear was 1.23W/kg. These studies do not report the position of the atenna, the pulse width or the power output. These factors are not always consistent throughout a study and could be influential in effecting the results. For a more robust approach, regular measurements throughout a study are recommended.

4.4.1.2. Technology: Experimental Equipment Set Up Variation

An important part of the experimental design is the way in which the exposure set up is developed. The exposure set up controls the amount of RF EMFs emitted. Experimental set ups have varied. Edelstyn & Oldershaw. (2001) and Curcio et al. (2004) instructed participants to hold a phone to the ear whilst Haraala et al. (2005) used a factory model with an adjustable rubber cap. Russo, Cinel, Boldini, Defeyer and Mirshekar-Syahkal (2006), and Cinel, Boldini, Fox and Russo (2008) attached the phone on the participant's head. It was kept in place in a cage-like cap. A microphone was positioned at the mouth and an ear piece at the ear. Keetley et al. (2006) used a modified non-metallic helmet with the phone clipped to it, and Terao, Okano, Furubayashi and Ugawa (2006) used a handset connected to a mobile phone simulator.

Haraala et al. (2005) commented on the lack of uniformity in exposure set ups between studies. Some researchers used an ordinary phone in their experiments, while others simulated the parameters of the mobile phone. For example, Edlestyn and Oldershaw (2002), Lee (2003), Smythe & Costall (2012) used an ordinary mobile phone to test the effects of RF EMF exposure. Both Eldestyn & Oldershaw (2002) and Smythe & Costall (2003) refer to how the participants held a phone to the left ear; Lee et al. (2003) refer to how the phone was mounted on the right side of the head, oriented in the natural position for use with the earphone over the right ear. No information is provided about how the phone was mounted. Mortazavi et al. (2012) refers to how the phone was placed on the participant's right ear. It is not clear from this description whether the phone was placed on the right ear by the researcher or the participant. Did the participant hold the phone? How did the phone stay in place? In this area of research, it is important to be clear about these factors, so any effect of confounding factors can be identified.

Experiments carried out with simulated parameters included those by Krause et al (2007) and Preece et al. (1999). Krause et al. (2007) used a signal generator and a linear power amplifier instead of a mobile phone. Use of such apparatus creates artificial set ups for participants using the mobile phone. If SAR variables and location are not carefully controlled, this could be a confounding factor that contributes to inconsistency in results. For example, when a phone antenna is operational a total radiating power (TRP) is created. The nearer the antenna to the human, the greater the energy that is absorbed into the body. The TRP of the phone then decreases due to the absorption of energy by the human body. The implications of this is that effective functioning of the area affected, typically areas of the brain, could result. In addition, it has been suggested that the way in which the exposure system is attached on the head can influence the specific absorption rate (Preece, et al., 1999). Schonborn et al. (2002) emphasised how the nearness of a mobile phone to the user’s head can affect the amount of absorption of part of the RF EMF into the brain. This depends on many things, for example, the intensity of the RF EMFs. Since maximum absorption of RF EMF occurs in tissues closest to the antenna (Dlhouy, 1996), many studies report the closeness of the antenna on the phone to the ear and/or the head.

Table 4.1 and 4.2 show the position and closeness of the antenna to the side and/or regions of the head, if reported by researchers. There is a wide variation in these studies as to where the antenna is positioned and how far away from the head the antenna is. For example, Koivisto et al. (2000a, 2000b) positioned the antenna over the posterior area of the left temporal lobe, 4cm away from the head. Keetley et al. (2006) positioned the antenna 1.5 +/- 0.5cm from the head by the left ear. Haraala et al. (2003a, 2005) positioned the antenna over the left posterior temporal lobe. Cinel et al. (2008) positioned the antenna lightly behind the ear and close to the head. If the antennae are positioned at different distances away from the head, the amount of RF EMF will vary and make a difference to the cognitive effects found in studies.

It has also been suggested that the pre-frontal cortex is affected by RF EMF exposure (Edlestyn et al., 2001). However, areas of the brain that are closest to the antenna in everyday use are the parietal and the temporal lobe, not the pre-frontal cortex (Edelstyn et al. 2001). This team suggested that the effects of RF EMF exposure are facilitated by a vaso-dilatory response with changes in cognitive processes associated with these areas**.**

In addition, language areas located in the left inferior temporal gyrus, left superior temporal gyrus and lateral inferior parietal cortex have been implicated in fMRI studies (Herhotz, 1996; Sadato, et al., 1998) and thus, RF EMF effects may vary due to the nearness of the antennae of the phone. A more recent study using positon emission topography (PET) identified an increase in brain metabolism in the region nearest to the antenna (Volkow, et al., 2011). No significance was found for whole brain metabolism, only in the region nearest the antenna, the orbitofrontal cortex and temporal pole. These findings confirm the importance of allowing for the nearness of the antennae to the head and the associated brain area in cognitive studies investigating RF EMF effects.

4.4.1.3. Technology: Mobile Phone Networks

With reference to phone networks, some studies have compared different generation phones and report the use of different phone standards, GSM, UTMS or Wideband Code-Division Multiple Access (W-CDMA). Most second-generation phones (2G) use the GSM standard which pulses at 890-960 MHz and 1710-18880 MHz (GSM900 and GSM1800 respectively) signals at 217 Hz. Most third generation (3G) phones use the UMTS, W-CDMA air interface standard. This does not have periodic pulse modulation content and functions at a higher frequency range of 1900-2170 MHz Research suggests that the frequency composition of the signal is important for bioeffects related to the mobile phone. Leung et al. (2011) showed an effect of acute 3G exposure on human cognitive function. Accuracy was not affected by overall exposure, but in the 2G condition an augmented N1 was found. All participants performed less accurately on the n-back task during the 3G exposure, but this was only significant with adolescents. No effect of 2G or 3G was found on reaction time. Event related alpha (ERA) was affected in the 3G condition with increased early ERA and slower late ERA. This result shows that although no effect was reflected on cognitive performance, there was a change in alpha activity.

4.4.1.4. Technology: Length of Time of Phone Exposure

Nine out of 49 experiments carried out with adults (Croft et al., 2002; Edelstyn & Oldershaw, 2001; Lee, Lam, Yee & Chan, 2003; Curcio et al., 2004; Eliyahu, et al., 2006; Regel et al., 2007a, Regel, et al., 2007b; Luria, Eliyahu, Haruveny, Margliot & Meiran, 2009; Vecchio, et al., 2012a) considered the length of time that it takes before mobile phone exposure has an effect on brain tissue and subsequent performance. The length of time RF EMF exposure has been found to vary from 10 minutes to 150 minutes (Croft et al., 2002; Lass et al., 2002) to 405-525 minutes (Fritzer, et al., 2007). Two out of 12 studies with children (Lee et al., 2001;

Loughran, et al., 2013) considered time as a factor in their experiments. In the study of Loughran et al. (2013), for example, EEG was recorded during cognitive tasks at 0, 30 and 60 minutes.

Croft et al. (2002) found variations in frequency suggesting that cortical activity is very sensitive and only causes an RF EMF effect at specific intensities and a certain length of time is needed for an effect to build up and be seen. Curcio et al. (2004) also considered the time at which exposure influenced performance and suggested that 25 minutes was needed to find changes in physiology and cognitive performance. Edelstyn and Oldershaw (2002) assessed exposure in their study in six cognitive neuropsychological tasks lasting a total of 45 minutes. They assessed at three time-points; the first point was prior to mobile phone exposure, then at 15 minutes and at 30 minutes. Significant differences are evident in two tasks of attentional capacity after 15 minutes (digit span forwards and spatial span backwards). This was thought to be due to changes in the parietal and temporal lobe which are closest to the antennae rather than the pre-frontal cortex. Eliyahu et al. (2006) found a significant slowing effect after 40 minutes of EMF exposure in a spatial item recognition task. Regel et al. (2007b) recorded waking EEG during baseline, immediately after, 30 and 60 minutes of pulse modulated (PM) exposure when participants are performing cognitive tasks. Table 4.1 shows decreased RT and an improvement in accuracy in the n-back task. Participants were significantly quicker in the 2-back and 3-back tasks. In the 3-back task, accuracy improved with time, suggesting that exposure duration or more demanding cognitive load was affecting the result, or both. After RF EMF exposure, it was found that alpha activity significantly increased after 30 minutes but it was not apparent after 60 minutes. The effect appeared and disappeared within this time window. This suggests that RF EMF effects may take time to have an effect.

Luria et al. (2009) replicated a previous experiment (Eliyahu et al., 2006) and confirmed the finding of a time dependent effect. The actual time dependent effect was, however, different to the previous experiment in that RF EMF effects were found in the first two blocks. These decreased with time. An experiment is often divided into a series of trials making up a block, so the first two blocks might be sensitive to learning effects. Schonborn et al. (2002) found increased RT and lower high-frequency alpha event related desynchronization (ERD) in the go/no go task after 45 minutes exposure, thus suggesting enhanced cortical neural efficiency after this time period. Volkow et al. (2011) found that there was significantly higher brain glucose metabolism in the orbitofrontal cortex and temporal pole in the active phone condition after 50 minutes exposure. These were areas nearest the antenna. Whole brain metabolism was not affected. Brain glucose metabolism is used as an indicator of brain activity.

Out of the two studies that considered time effects in studies on children and adolescents, one found significant effects of exposure and one did not. Lee et al. (2001) found a small mediating effect on attention. Improved performance was found in a trail making task. Loughran et al. (2013) recorded the waking EEG at three-time points after exposure at 0, 30 and 60 minutes. No results were significant for adolescents of 11-13 years old. It was thought that the teenage brain might be able to adapt to external influences or small stressors due to the plasticity of their brains. Many studies with adults have found that RF EMF exposure can affect the alpha frequency range in the waking EEG (Croft, et al., 2002, 2008, 2010; Huber et al., 2002; Curcio et al., 2005; Regel et al., 2007a). Croft, et al. (2010) found no effect of pulse modulated RF EMF on the EEG of young 13-15 years old participants although an effect was found with older participants adults, aged 19-40. It was thought that this could be due to the plasticity of the brain of the 13-15 years old participants.

4.4.1.5. Dose-Response Relationship

Only four of 49 experiments carried out with adults (Croft et al., 2002; Lee et al. 2003; Regel et al., 2007a, 2007b) considered a dose dependent relationship between mobile phone exposure and an effect on brain tissue and subsequent performance. Croft et al. (2002) thought that the length of RF EMF exposure was important for whether an effect was found. Lee et al. (2003) concluded that attention tasks might be differentially affected in a dose dependent manner. A facilitating effect was found in a Sustained Attention to Response Task (SART) after 30 minutes of EMF exposure time. It was speculated that this could be due to a thermal effect. This was thought to be due to localised heating from the electromagnetic wave received. This led them to speculate that the facilitation effect may not be observed immediately after exposure due to the time needed for the physiological changes to take place (Preece et al., 1999). Regel et al. (2007b) found a dose-response relationship in the 1-back task. Table 4.1 shows the dose dependent effect for reaction time for this experiment. The meta-analysis of Barth et al. (2008) suggested that some of the negative results of performance in cognitive tests could be brought about by an increase in temperature in brain tissue. Others have suggested that thermal changes are so minimal that they are unlikely to contribute to functional brain changes (Wainwright, 2000).

Three out of 12 studies (Lee et al., 2001; Preece et al. 2005; Schoeni et al., 2015) carried out with children considered a dose dependent relationship of effect. Different exposure intensities of 0, 0.025 or 2 W are employed in the experiment of Preece, et al. (2005). Trends towards faster RTs, accuracy, were found with higher exposure intensity compared to the control but none reached significance. Schoeni et al. (2015) assessed RF EMF exposure from usage data from questionnaires and mobile phone operator records. In this one-year longitudinal study, it was found that performance of memory was negatively associated with longer phone use. It was also related to RF EMF dose. It is difficult to compare usage data studies directly with acute exposure experimental results, but this study indicates that RF EMF dose is possibly an important factor for memory performance over time. In their review, Kwon and Hamalainen (2011) emphasised the importance of investigating dose-dependent effects of exposure in future studies, including dose effects with stronger signals.

4.4.2 The Users

4.4.2.1. The Users: Exclusion Criteria and Pre-Study Information Gathering

Exclusion criteria for study involvement showed high variability. These ranged from no exclusion in three adult studies with nine categories of exclusion in other adult studies (Regel et al., 2007a; Luria et al., 2009; Curcio et al., 2012). In the studies involving children and adolescents, the highest number of exclusion criteria was eight (Loughran et al., 2013). The majority of studies required participants to be neurologically healthy (Koivisto et al., 1999, 2000; Preece et al., 1999, 2005; Hamblin et al., 2002; Lee et al., 2001, 2003; Edelsytn & Oldershaw, 2002; Curcio et al., 2003; Haraala et al., 2003; Smythe & Costall, 2003; Maier & Maier, 2004; Besset et al., 2005).

Some studies considered specific exclusion criteria associated with the object of investigation. Russo et al. (2006) used a visual task and asked participants if they had normal vision. Investigators using an auditory task asked participants if they had normal hearing (Smythe & Costall, 2003; Besset et al., 2005) and when sleep was being investigated, participants are asked if they had difficulty sleeping (Eliyahu et al., 2006). Sleep factors, for example, are thought to be an important confounding variable because of the relationship of sleep with the pre-frontal cortex and attentional functioning (Muzur, Pace-Schott & Hobson, 2002).

The RF EMF effects appear to be sensitive, so it is important to consider all possible factors that might have an impact on cognition. Whilst special requirements are often demanded for an experiment to create a controlled environment, Type 2 variance can occur when restrictions are implemented. This is when an error has occurred in the analysis and there is a failure to reject the false null hypothesis (false negative). For example, some studies asked participants not to have consumed tea, alcohol or coffee prior to the experiment (Unterlechner, Sauter, Schmid & Zeitlhofer, 2008), either for 3 days before the experiment (Regel et al., 2007a, 2007b), 24 hours before (Edelstyn et al., 2002; Haraala et al., 2007) or on the day of the experiment (Rodina, Lass, Ripulk, Bachmann & Hinrikus, 2005). Having to abstain from caffeine consumption for a heavy coffee drinker may lead to a participant suffering withdrawal effects in an experiment. This could, in turn affect performance. (Regel et al., 2011). An alternative approach to exclusion was for the researcher to gather information on these variables, for example, Eliyahu et al. (2001) collected information on alcohol and caffeine consumption, through a questionnaire, so possible correlations between caffeine consumption and the effect of RF EMF effects could be carried out. Despite inherent variability in measurement, it is important to gather information about participants, especially in the context of phone use. Few studies found out information on calling habits. Considering the amount of mobile phone usage is important for research in this area.

It is also important to consider individual and personality differences of participants (Cook, Thomas & Prato, 2002). ‘Personality’ is often defined as a characteristic or baseline cognitive or behavioural state of a human (Sugiura, 2000). For example, smoking and arousal state can affect resting EEG, leading to significantly different frequency band dominance (Cook, et al., 1995). Croft et al. (2002) discussed how alpha activity is sensitive to alterations in alertness changes over the course of an experiment, so if an individual's alertness changes, so too will alpha, error variance and the likelihood of failing to detect a phone-related alpha change. If factors like these are controlled, this can lead to decreasing the variance. Persinger (1993) postulated how personality types can be differentially affected by RF EMF exposure. Cook et al. (2002) commented on the fact that this is an area that has largely not been pursued and may account for electro sensitive individuals (NIEHS Working Group Report, 1998). To be able to rule out confounding variables, the need to have a homogenous sample is necessary. Another approach would be to gather demographic information on the sample, so that personality traits could be analysed as a co-variate, then they can be ruled out as a factor of influence (or further analysed if they do have an effect). Mood and state of arousal (Crasson, Legros, Scarpa & Legros, 1999) have also been found to be important indicators of RF EMF receptivity.

4.4.2.2. The Users: Lateralised effects, Handedness and Key Pressing Behaviour

Studies varied in terms of what factors are taken into consideration and/or reported with respect to, lateralised effects, handedness of participants and key pressing behaviour. For example, some studies instructed participants to hold the phone to the right or left ear or side of the head or to use the right or left hand to hold the phone whilst others specified position of the phone and handedness. Other studies did not report these. A few studies recorded whether participants are right or left handed, as it was thought that this might also influence performance whereas a few studies considered key pressing behaviour in their experimental design.

4.4.2.3. The Users: Lateralised effects, Right and Left Side Exposure of the Head

Nine adult studies (Krause et al., 2000; Besset et al., 2005; Eliyahu et al., 2006; Hamblin et al., 2006; Russo et al., 2006; Cinel, Boldini, Russo & Fox, 2007, Cinel et al., 2008; Haraala et al., 2007; Luria et al. 2009) alternated the position of the phone at the left and the right ear and investigated possible lateralised effects in the right and left hemisphere of participants. Eliyahu et al. (2006) and Luria et al. (2009) reported a lateralised effect of RF EMF conditions. Besset et al. (2005); Hamblin, Wood, Croft, Stough & Spong (2006); Russo et al. (2006); Cinel et al. (2007, 2008), Haraala et al., (2007) and Krause et al., (2007) found no significant differences in RF EMF effects in cognitive behavioural performance between the right and left sides. Krause et al. (2007) did however find expression of activity in different event-related desynchronisation (ERD) and event-related synchronisation (ERS) in EEG power between exposure sides in the control condition in an auditory memory task. This was an unexpected result and it was acknowledged that there was no logical explanation for it. The only study that carried out right and left side exposure in the studies involving children and adolescents was Leung et al. (2011). A significant effect for accuracy was found in the n-back task but no difference in performance was reported for exposure side.

4.4.2.4. The Users: Lateralised Effects, Left Side Only Exposure of the Head

Twenty-three adult studies positioned the phone on the left side of the head (Preece et al., 1999; Freude, 2000; Koivisto et al., 2000b; Eldestyn & Oldershaw, 2002; Haraala et al., 2003a, Haraala, et al., 2003b, Haraala, et al., 2004; Smythe & Costall, 2003; Curcio et al., 2004; Hinrichs & Heinz, 2004; Maier et al., 2004; Schmid et al., 2005, 2012; Aalto, Haraala, Bruck, Hamalainen, & Rinne, 2006; Keetley et al., 2006; Regel et al., 2007a, 2007b; Kleinogel, et al., 2008; Unterlechner et al., 2008; Wilhom et al., 2009; Okano, et al., 2010; Vecchio et al., 2012). Eleven of these studies (Preece et al., 1999; Koivisto et al., 2000b;

Eldestyn & Oldershaw, 2002; Smythe & Costall, 2003; Curcio et al., 2004; Maier et al., 2004; Keetley et al., 2006; Regel et al., 2007a, 2007b; Wilhom et al., 2009; Vecchio et al., 2012) reported significant cognitive effects of mobile phone exposure and 12 reported non-significant findings. In the latter group however, three studies reported cortical activity although there are no significant effects on cognitive performance. Haraala et al. (2003a) reported decreased cerebral blood flow, whereas Hinrichs and Heinze (2004) found an effect in the left hemisphere. In conclusion, some studies have reported altered brain physiology due to RF EMF effects and the time course of RF EMF effects vary across studies.

Four out of the 10 studies with children and adolescents carried out studies with the mobile phone positioned on the left side of the head (Haraala et al., 2005; Preece et al.,2005; Krause et al., 2006; Loughran et al., 2013). Three found non-significant effects for cognitive tasks (Haraala et al., 2005; Krause et al., 2006; Loughran et al., 2013) although Krause et al. (2006) found that RF EMF emitted by mobile phones influenced brain oscillatory responses during cognitive processing in 10 to14 years old. The positive result found by Preece et al. (2005) showed there was a significant decrease in accuracy in cognitive tasks.

4.4.2.5. The Users: Lateralised Effects, Right side Only Exposure of the Head

Thirteen adult studies (Croft et al., 2002; Hamblin et al., 2002, 2004; Jech, et al., 2002; Lass et al., 2002; Lee et al., 2003; Rodina et al., 2004; Terao et al., 2006; Papageorgio, et al., 2006; Curcio et al., 2012; Mortazavi et al., 2012; Trunk et al., 2013, Trunk, et al., 2014) and none of the studies involving young people positioned the mobile phone on the right side of the head; nine (Croft et al., 2002; Jech et al., 2002; Lass et al., 2002; Lee et al, 2003; Hamblin, Wood, Croft, & Stough, 2004; Rodina, et al., 2004; Papageorgio et al., 2006; Mortazavi et al., 2012) reported significant cognitive effects of mobile phone exposure and four reported non-significant findings. Specific areas affected in these empirical studies did not specify where the effect was most apparent.

4.4.2.6. The Users: Lateralised Effects, Top of the Head Exposure

Only three adult studies (Fritzer, et al., 2007; Irlenbusch, et al., 2007; Sauter, et al. (2011) and no others used an RF EMF source worn on the top of the head. Sauter et al. (2011) reported significant cognitive effects of mobile phone exposure whilst no significant effects are reported in the other two studies (Fritzer et al., 2007; Irlenbusch et al., 2007).

One study did not report positioning of the phone in their experiment (Zwamborn, Vossen, Leersum, Ouwens, & Makel, 2003). Eight significant results out of 30 are found in their study. Another adult study (Mohan et al., 2016) used usage data to assess the effect of mobile phone exposure on cognitive performance and reported no RF EMF effects from chronic exposure.

In conclusion, the results for RF EMF exposure on the right and left side of the head for adult studies show three times as many non-significant results (7:2). Exposure to the left side of the head show a similar number of positive and negative results (11:12) whereas exposure to the right side of the head show twice as many significant results to non-significant results (9:4). Exposure to the top of the head show similar results of effect versus no effect (1:2). For studies with children, there are more non-significant results for all exposure conditions. From this analysis, exposure affects the right side of the head more than the left side.

4.4.2.7. The Users: Lateralised Effects and Handedness

Another factor to consider is whether participants use their right-hand or left- hand for everyday phone use and motor manipulations. An analysis of adult studies showed that nine studies recruited both right and left-handed participants. Four found a significant effect of performance and five found no significant effect. Twenty-seven studies recruited right-handed participants: 16 found a significant effect of performance and 11 found no significant effect. Two studies recruited left-handed participants. One study found a significant effect of performance and one study found no significant effect. Eleven studies did not specify handedness: four found a significant effect of performance and seven found no significant effect.

An analysis of studies with children and adolescents found there are five studies which recruited right handed participants (Harraala et al., 2005; Preece et al., 2005; Krause et al., 2006; Loughran et al., 2013). Three studies recruited right and left- handed participants (Leung et al., 2011; Schoeni et al., 2015; Guxens et al., 2016) and handedness was not specified in two studies (Abramson et al., 2009; Thomas et al., 2011).

4.4.2.8. The Users: Lateralised Effects, Right and Left Side Exposure with Handedness

Three adult studies carried out right and left side exposure with individuals who are right and left-handed. For example, Luria et al. (2009) observed the effect of lateralised effects with right and left side exposure and had recruited right-hand participants. An increase in RT was found under left side exposure. No studies are carried out with right and left side exposure and left handedness. Two studies are carried out with right and left side exposure and unspecified handedness (Cinel et al., 2007, 2008). No significant results are found.

The study of Leung et al. (2011) carried out right and left side exposure in the studies involving children and adolescents and recruited right handed participants. Decreased accuracy was highly significant for adolescents.

4.4.2.9. The Users: Lateralised Effects, Right Side Exposure with Handedness

Two adult studies carried out right side exposure with right and left-handed participants. Three studies are carried out with right side exposure and right-handed participants (Terao et al., 2006; Mortavazi et al., 2012; Trunk et al., 2014). A significant decrease in RT for acute short-term exposure was found in the study of Mortavazi et al. (2012). Terao et al. (2006) and Trunk et al. (2014) found no significant results. No studies are carried out with right side exposure and left-handed participants. Two studies are carried out with right side exposure and unspecified handedness (Lass et al., 2002; Trunk et al., 2013). Lass et al. (2002) found a significant increase in the variance of errors in a modified trail making task, a significant decrease in errors in a picture to word recall task and an increase in the variance of errors in a paired letter task. Trunk et al. (2013) found no significant results. There are no studies with children and adolescents did not include any studies with right side exposure and handedness.

4.4.2.10. The Users: Lateralised Effects, Left Side Exposure with Handedness

One adult study carried out left side exposure with right and left-handed participants (Preece et al., 1999) whilst 16 studies recruited participants who held or positioned the phone at the left ear and are right handed (Koivisto et al., 1999, 2000b; Freude et al., 2000; Edlestyn & Oldershaw, 2001; Haraala et al., 2003a, 2003b, 2004; Smythe and Costall, 2003; Curcio et al., 2004; Aalto et al., 2006; Regel et al., 2007a, 2007b; Kleinogel et al., 2008; Unterlechner et al., 2008; Okano et al., 2010; Schmid et al., 2012; Vecchio et al., 2012). Nine of these studies found no significant effects and three of these found effects on brain physiology. Six studies found significant effects of cognitive performance. One study carried out left side exposure with left handed participants (Vecchio et al., 2012) and found a significant increase in performance, whilst five studies carried out left side exposure with unspecified handedness (Hinrichs & Heinze, 2004; Maier et al., 2004; Schmid et al., 2005; Keetley et al., 2006; Wilhom et al., 2009). Three studies found significant effects and two found no significant effects of performance.

An analysis of studies with children and adolescents found there are four studies which recruited right handed participants when the phones are positioned on the left side of the head (Haraala et al., 2005; Preece et al., 2005; Krause et al., 2006; Loughran et al., 2013; Preece et al., 2005). All these studies found no significant results of exposure on cognitive performance (although Krause et al., 2006, found that brain oscillatory responses are transformed in the 4-8Hz and 15Hz frequencies). This is a different result to the studies with adults where three studies found effects and two did not. This would indicate that effects are more likely to be found in adults pointing to a difference between adults and children, but the number of studies considered here is too small to draw any definite conclusions.

4.4.2.11. The Users: Lateralised Effects, Unspecified Exposure Side with Handedness

The study by Sauter et al. (2011) with adults did not specify the side of the head for RF EMF source and recruited right handed participants. Variable effects are found in tasks with some showing significant effects of exposure and some not showing significant effects.

An analysis of usage studies with children and adolescents found there are two studies which recruited right and left-handed participants (Schoeni et al., 2005; Guxens et al., 2016) and found significant effects of exposure, one study that recruited right handed participants (Lee et al., 2001) and found a significant effect and two who did not specify handedness (Abramson et al., 2011; Thomas et al., 2011) and found significant effects.

In conclusion, the results for RF EMF exposure for right and left handedness for adult studies showed a similar number of significant results as non-significant results (4:5). Exposure to right handed participants showed more positive results than negative results (16:11) whereas exposure to left handed participants showed a similar number of positive and negative results (1:1). For studies with children, significant results are found whether participants are right and left handed (2), right handed (1), or handedness was not specified (2). From this analysis, significant effects of RF EMF exposure in adult studies are found more often in right handed participants.

4.4.2.12. The Users: Lateralised effects, Handedness and Key Pressing Effects

It is possible that the digits or hand that is used to operate the keys could have an influence on performance in cognitive tasks, as well as whether the participants are right or left handed. Curcio et al. (2003) recorded reaction times from both hands and found no significant difference in performance between right and left-hand use. In contrast, other studies found that there was a difference between left and right responses. Eliyahu et al. (2006) and Luria et al. (2009) recruited right handed participants and positioned the phone on the right and left side of the head to observe possible lateralised effects. Eliyahu et al. (2006) found a slowing effect in left hand responses with the left side EMF exposure condition in one out of four tasks. The task that revealed this result was a spatial item recognition task (SIRT). The same team found an effect in a later experiment with longer RT of right-hand responses under left side exposure (Luria et al., 2009).

Regel et al. (2011) commented on how some researchers have recorded motor responses for pressing assigned buttons on a keyboard (Haraala et al., 2003, 2004, Haraala, et al., 2007; Eliyahu et al., 2006; Russo et al., 2006) on a response or keypad (Krause et al., 2000; Haraala et al., 2003, 2007), a two-button mouse (Krause et al., 2007) or on a specific response box (Preece et al., 1999; Regel et al., 2007a, 2007b). Variable effects are found in tasks with some showing significant effects of exposure and some not showing significant effects. In addition, verbal answers have been recorded (Haraala et al., 2004; Russo et al., 2006) as well as paper and pencil methods (Lee et al., 2003).

4.4.3 The Environment

4.4.3.1. The Environment: Study Design

Previous reviews have commented on how some studies use a double-blind paradigm whilst others do not (Hamblin & Wood, 2002; Regel et al., 2007; Valentini et al., 2007, 2011; Barth et al., 2008, 2012; Kuster et al., 2009; Marino & Carubba, 2009; van Rongen et al., 2009; Kwon & Hamalainen, 2011, 2012; Zhang et al., 2017). Single or double-blind design is shown in Table 4.1 and Table 4.2. A double-blind paradigm is when both the experimenter and the participants are unaware of the conditions of the experiment, and so are less likely to be influenced by any outcome. A single blind paradigm is where only the participants are unaware of the conditions of the experiment. Russo et al. (2006) commented on the fact that use of a single blind paradigm might lead to spurious significant findings, with the possibility of a non-optimal administration of the independent variable. Other researchers and reviewers of this area of bioelectromagnetic research have emphasised the importance of using a double-blind experimental design (Regel et al., 2011) Given the range of inconsistencies in experiments, double blind design is a preferred method for future experiments to ensure a more robust approach.

Sample sizes have varied considerably. Table 4.1 shows the variation in sample sizes for studies with adults and Table 4.2 shows the sample sizes for studies with children. For future studies, it is recommended that larger sample sizes are used. It is also suggested that a power analysis is carried out to ascertain a suitable size.

Studies have been carried out as ‘within participant’ design or ‘between participant’ design. Those with between participant designs (Edelstyn & Oldershaw, 2001; Lee et al. 2001; Smythe & Costall, 2003) are more likely to contains errors due to individual difference in cognitive performance. ‘Within participant’ design is sometimes referred to as a cross-over design where participants carry out all exposure conditions of the experiment.

4.4.3.2. The Environment: Temperature Effects

Some experiments considered how temperature could affect results. Haraala et al. (2005) measured the temperature between the skin and the phone and the skin for some participants. There was an initial rise in temperature but after that, there was little variation. The mean temperature was recorded at 36^{o}C. Haraala et al. (2005) reported that the participants are unaware of any temperature changes when asked and suggests that this is because the temperature changes are so small and gradual, temperature changes would not be noticed. Participants did not detect the changes, so there are no obvious thermal cues to the RF EMF condition.

4.4.3.3 The Environment: Time of Day Effects

Time of day effects (Chapotot et al., 2000; Lafrance & Dumont, 2000; Maquet, 2000) have been found to be important indicators of RF EMF receptivity. In this review, time of day effects have been considered in the experimental design of one adult study (Sauter et al., 2011) and one adolescent study (Loughran et al., 2013). Sauter et al. (2011) tested participants on 9 study days. Tests were carried out in the morning and the afternoon, within a fixed time-frame. Time of day effects are found for the tests on divided and selective attention and working memory. Time of day effects were significant in two tests, showing faster RTs in the afternoon trials. The reason for this was not explained apart from a suggestion that it was thought that decreased RT could have been influenced to some extent by practice and adaptation effects.

Loughran et al. (2013) carried out three different exposure conditions with adolescents aged 11-13 years, at weekly intervals. Each session was performed at the same time of day, but no significant time of day effects are recorded for cognitive tasks.

4.4.3.4. The Environment: Statistical Analyses and Correction Procedures

There has been criticism of previous studies for over-reporting positive findings with a lack of correction for multiple comparisons (Haraala et al., 2005). Correction procedures for statistical significance are carried out when multiple groups are compared with each other. This is to ensure that the results are not subject to Type I errors of analysis creating false positives. Some studies corrected for Bonferonni and others corrected with Greenhouse-Geyser corrections. Studies not reporting correction adjustments are Edelstyn and Oldershaw (2001); Koivisto et al. (2000a); Lee et al. (2003) and Smythe and Costall (2003). These are studies that reported significant results. It has been proposed that if Bonferroni corrections for multiple comparisons had been carried out, the results would lose significance (Haraala et al., 2003). The need for greater attention to methodology and the application of stricter statistical methods to include corrections for multiple comparisons is important for all studies with RF EMF effects (Valentini et al., 2010).

4.5. Discussion

This review has considered a range of factors that could contribute to the high variability, inconsistencies and ambiguities that pervade this domain. The RF EMF effects can have a differential impact on human attention and memory functions and there is much variability in methodology amongst studies. Consistency in methodology is important, to be able to rule out confounding variables influencing performance. If these are controlled, this can lead to a decrease in the variance. This would mean that the power could be increased for detecting a small effect in the experiments. It is also important to clearly identify whether any effect found can be confidently attributable to RF EMF effects rather than confounding factors.

There is much variability in the reporting of the characteristics of mobile phone technology. The implications of this is that there is a lack of consistency in parameters described between studies, making it difficult to make comparisons between studies. For future studies, it is suggested that there is a need to achieve consistent parameters, especially in relation to SAR values. The findings of the review also show how pulsed modulation has been found to have more impact than continuous wave and this effect can be apparent during and immediately after the task has been performed, as shown by an increase in alpha consistently found in many studies. The implications of this are that brain physiology is affected and it has been suggested that the area of the thalamus and associated sub-cortical areas might be areas that are particularly sensitive to RF EMF exposure. There is also much variability in exposure equipment set ups, which are sometimes inefficient. In particular, the positioning of the antennae emitting the RF EMFs differs greatly amongst studies. The implications of this are that the SAR varies and is sometimes SAR is under-estimated. Studies use different generation phones, either 2G or 3G (Leung et al., 2011) which operate at different frequencies and so lead to varying mobile phone related effects. Also, the type of phone standard, whether it is GSM, UTMS or Wideband Code-Division Multiple Access (W-CDMA) has been found to have a differential impact in studies.

It has been found that the length of time before RF EMF exposure has an impact is variable between both adult and child studies. Effects of acute exposure can also occur after exposure has stopped. Volkow et al. (2011) recorded an effect 50 minutes after the exposure had stopped. It has also been suggested that there could be a specific time window for an effect (Regel et al., 2007a). The implications of these findings are that RF EMF effects in studies could be missed. Future experiments need to control for the length of time it takes an RF EMF to show by recording results before the task starts, at intervals during the task and, a wash out period of effect needs to be considered. This has implications for studies carrying out more than one cognitive task due to carry-over effects. A minimum of a 24-hour period between tasks is recommended.

Effects of dose intensity have been shown to have biological effects (Croft et al., 2002; Lee et al., 2003; Regel et al., 2007b). It was suggested that the temporal nature of this effect contributed to the inconsistency in results (Croft et al., 2002).

There is much variability in the reporting of factors affecting the user. Exclusion criteria for study involvement of the user showed high variability from no exclusions to nine categories of exclusion (Regel et al., 2007a; Luria et al., 2009; Curcio et al., 2012). A homogenous sample is recommended for future studies with robust exclusion criteria. These criteria should accommodate the very sensitive nature of the RF EMFs and consider the impact of substance affecting products (caffeine, alcohol, cigarettes), mobile phone calling habits, personality traits, vision, hearing, alpha activity, sleep, and neurological health. Inconsistent results could also be due to a selective RF EMF effect (Freude et al., 2000). A particular attention or memory task might be shown to be more sensitive to RF EMF effects than other tasks. For example, many research teams have found an effect of RF EMF in the higher cognitive load of the n-back task but not in lower cognitive load, suggesting that cognitive workload can have an influence.

The notable results from the review for lateralised effects on the user recorded that exposure affected the right side of the head (9 studies) more than the left side (4 studies) and exposure that occurred on the right and left side of the head showed three times as many non-significant results (7:2). Exposure with right handed participants showed more positive results than negative results (16:11). Key pressing behaviour showed high variability, making comparisons across studies difficult. It is recommended that replication of previous studies can be a way to preserve consistency but adopting a standardised protocol will implore greater conformity.

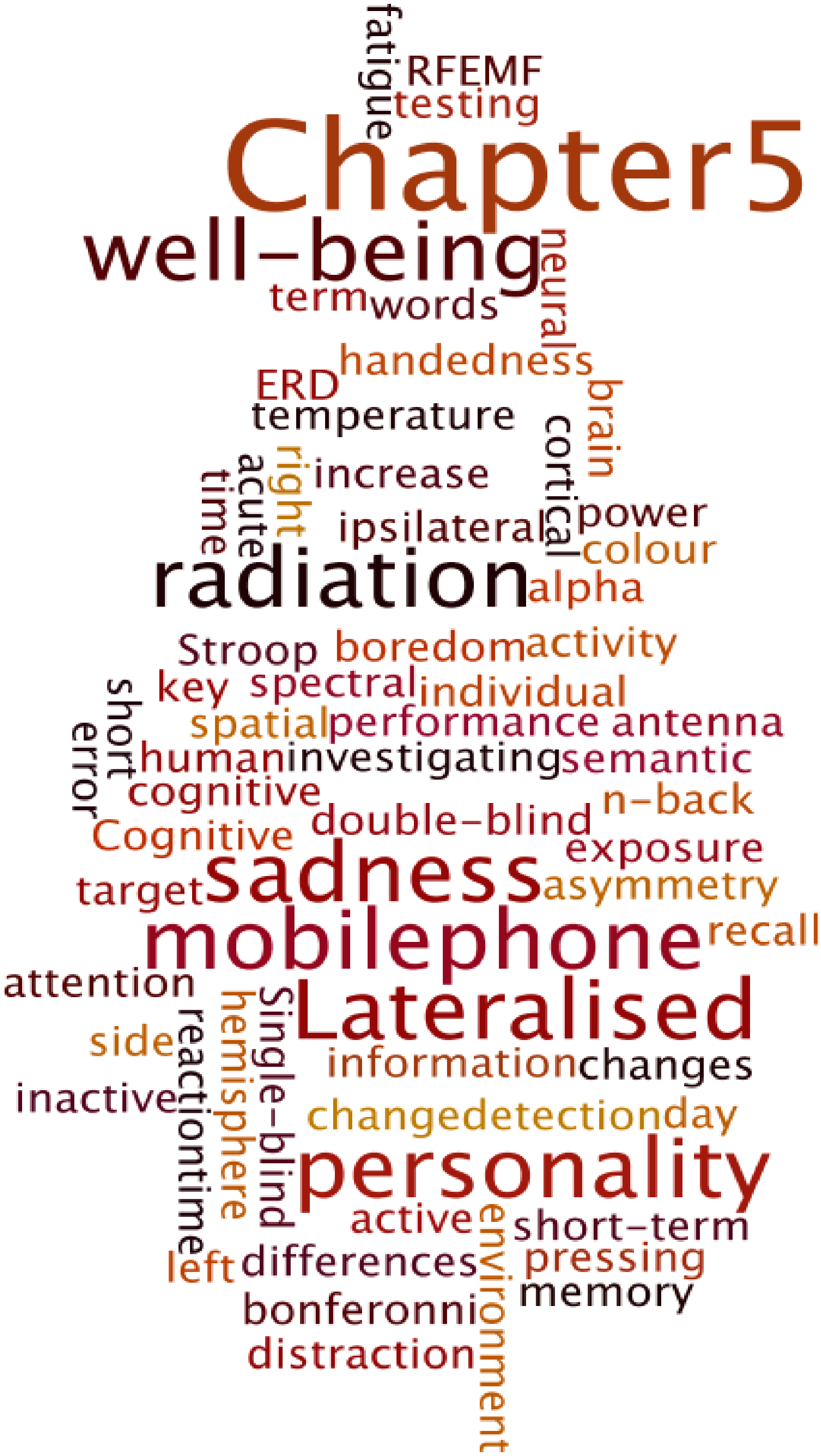
4.7. Conclusions

Many studies have found RF EMF effects in attention and memory tasks in adults and children. It is still uncertain, however, whether mobile phone exposure affects children and adolescents more than adults. It has been previously suggested that the effect of RF EMF exposure might have greater impact on the brain and cognitive function of children (Ghandi et al., 1996) but this is not conclusive. Guidelines in the UK recommend that children and adolescents restrict their mobile phone use, but the Health Council of the Netherlands concluded that there did not seem to be a difference between adults and children in terms of electromagnetic sensitivity. The Health Council suggests that after the second year of life there are no key changes in head development that would affect this. (van Rongen, et al., 2004). In addition, the study of Loughran et al. (2013) concluded that adolescents of 11-13 years did not appear to be more sensitive than adults to RF EMF emissions. It was suggested that adolescents' brains might be more able to adapt to mobile phone like exposures, due to the plasticity of the younger brain.

The conclusions in this review support the finding of the review by Zhang et al. (2017) that the effect of mobile phone RF EMF exposure on brain function and cognitive behavioural measures remain unanswered. Reasons for the ambiguities and inconsistencies in studies have been considered. There is much variation in conditions between the technology used, the users tested and the environmental conditions of experiments. To be able to reliably identify that the effects found in experiments are directly attributable to RF EMFs rather than confounding factors, robust scientific methodology is required. Chapter 6 addresses this and presents a check list for future experiments in this area. Also, in the future, the effects of exposure on short and long-term use must be assessed through further studies on acute exposure and usage data. As studies on usage data enable understanding of the long-term effects, it is recommended that more studies use this method of investigation or a combination of usage and acute exposure methods. Longitudinal studies will usefully add to the current bank of research. Replication of experiments with use of consistent parameters is necessary with a standardised experimental protocol.

4.8. Summary of Chapter 4

Current health issues and guidelines surrounding mobile phone use are discussed. In the light of this, a review is carried out on studies involving investigation of the effects of RF EMF effects on cognitive performance are identified. Reasons for the ambiguities and inconsistencies in RF EMF effects in attention and memory tasks Studies involving acute exposure and usage data are discussed. The factors contributing to the high variability in empirical studies are grouped into technology, user and environmental concerns. Technology areas reviewed are mobile phone characteristics, experimental equipment set up variation, mobile phone networks, length of time of phone exposure and dose-response relationship. User areas covered are exclusion criteria and pre-study information gathering, lateralized effects, handedness and key pressing effects. Environment areas reviewed are study design, temperature effects, time of day effects and statistical analyses and correction procedures. It is concluded that more studies on usage data need to be done in the future, replication of current studies and the implementation of an international standardized research protocol.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Chapter 5

Mobile Phone Exposure and Cognitive Performance

5.1 General Introduction

The review in Chapter 4 investigated the effects of RF EMF in visual short-term memory and attention tasks. Some studies observed improved performance (Mortazavi, et al., 2012; Vecchio, et al., 2012; Guxens, et al. 2016) whereas others showed an impairment (Keetley, et al., 2006) and others found no effect (Cinel et al., 2008, Curcio et al, 2012, Trunk, et al., 2014). Cinel, et al. 2007 and Regel et al, 2007 suggested that RF EMF effects only have an impact when the task requires higher cognitive load. Eliyahu, et al. (2006) found a significant difference in effect between right and left side exposure.

Effects on brain physiology have been found in visual tasks. Freude et al. (2000) carried out a challenging and complex visual monitoring task. No significant effect was found on cognitive performance although a decrease in preparatory slow brain potentials was recorded. These results were replicated in a second experiment 6 months later. Jech et al. (2001) found an effect on the positivity of event related potentials (ERPs) to target stimuli in the right hemifield of the screen in an adapted visual oddball task. It was suggested that the RF EMF improved cognitive performance as reaction time (RT) was significantly shortened by 20ms. Rodina et al. (2007) carried out a visual masking task and found a significant difference with exposure to RF EMF exposure compared to a control group. Mortazavi et el. (2012) found a decreased RT in a visual search task. They carried out two analyses based on acute exposure and mobile phone use data. When the data was analysed, based on usage data of low, moderate, and frequent users of mobile phones, no effects are found. It was suggested that the reason for the different result could be due to the bioeffects of RF EMF exposure only being observable immediately after exposure. In a visual, go/no go, task, Vecchio et al. (2012) found an effect in the post exposure period. RT increased when the ‘go’ stimulus appeared. A decrease in high frequency alpha rhythms was found suggesting a peak amplitude of alpha event related desynchronization. It was concluded that the RT to ‘go’ stimuli was modulated by the effect of RF EMF on cortical activity. From these studies, it can be seen that RF EMF effects from mobile phones have been found to affect brain physiology in visual tasks as reflected in cognitive performance measures.

In addition to visual tasks, effects of RF EMF exposure have been found in auditory tasks and investigations of cortical excitability. Croft et al. (2002) investigated the effects of RF EMFs in an auditory task. Results showed that exposure affected activity in right hemisphere sites compared to the left hemisphere sites. Ferreri et al. (2006) investigated the effect of exposure on cortical excitability of each hemisphere as a specific biological function, using transcranial magnetic stimulation (TMS). RF EMF effects were found to modify brain excitability.

Lateralised effects of RF EMF exposure were investigated by Hamblin et al. (2004), Hamblin, Wood, Croft & Stough (2006) Besset et al. (2005); Eliyahu et al. (2006); Ferreri et al. (2006); Russo et al. (2006); Haraala et al. (2007); Krause et al. (2007); Cinel et al. (2007, 2008); Luria et al. (2009). Hamblin et al. (2004) carried out an auditory oddball task which found differential latency effects in the right and left hemispheres sites. Eliyahu et al. (2006) and Luria et al. (2009) identified a lateralised effect of RF EMF conditions in cognitive performance. Eliyahu et al. (2006) found that RF EMF exposure effected the left side of the brain. It was found that the left-hand response times were slower. In contrast, Krause et al. (2007) found no significant effect of RF EMF exposure on cognitive performance, but did however, find expression of activity in different event-related de-synchronisation (ERD) and event-related synchronisation (ERS) in EEG power between exposure sides in the control condition in an auditory memory task. This was an unexpected result and they acknowledged that there was no logical explanation to explain this result. The results of these studies show that there is evidence for differential effects in cognitive performance and/or brain physiology in the right and left hemispheres of the brain.

The experiments here tested the hypotheses that:

1. There is an effect of RF EMF exposure from the mobile phone on cognitive performance of the user
2. That the RF EMF exposure from the mobile phone is lateralised.

Experiments 1, 2, 3, 4 and 5

Participants

Experiments 1, 2 and 3 involve one hundred and twenty healthy, university students (100 female, 20 male). Ages range from 18 to 30 (M = 20.19, SD = 4.25) and all participants were mobile phone users with many years' experience (M = 8.41, SD = 3.40). Participants made on average 3 to 4 calls (M = 3.41, SD = 10.95) and sent over 40 texts a day (M = 44.02, SD = 63.93). In Experiment 4 seventy-eight healthy, university students (58 female, 14 male) were tested in the age range 17-30. (M = 20.58, SD = 4.09). Participants have been mobile phone users for over 8 years (M = 8.621, SD = 2.91). Most started using their phone when they began secondary school (M = 11.82, SD = 2.50). Participants made between 2 to 3 calls a day (M = 2.77, SD = 2.51) a day and just over 40 texts a day (M = 55.32; SD = 74.59). In Experiment 5, forty-eight university students, 24 females and 24 males, were tested in all phone condition in Experiment 5. Participants were considered to be representative of a homogenous population because they were all young adults at university. Ages ranged from 18 to 29 years (*M* = 21.04, *SD* = 2.98). Participants have used mobile phones for 8.5 years on average (*M* = 8.56, *SD* = 2.71) with a range of use of 2-16 years). Mean number of texts participants sent were 38 (*M* = 38.28, *SD* = 36.28) and mean number of calls made are 2 (*M* = 2.29, *SD* = 2.55). The group (n=48) is made up of 67% describing themselves as heavy mobile phone users and 33% as light users. Participants were asked on which side of the head they usually held their phone: It was found that 79% said the right side of the head, 19% the left side of the head and 2% both sides.

Materials

Three GSM 900 MHz Nokia 130 (RM-103) phones were used. The phones had a maximum specific absorption rate (SAR) of 1.28 kW/kg over 10g when held against the head and 0.73 W/kg over 10kg when operated at a separation distance of 1.5 cm (5/8 inch). Nokia phones were chosen rather than smartphones, so there is no wi-fi interference from the phone. A recording, not heard by the participants, was played from a laptop to the phone to create an active phone condition. A socket that was usually attached to the connection to make hands free operation of the phone possible had been cut, so the participant could not tell if the phone was active or not. At the end of the experiment, participants were asked if they if they thought the phone was on or off. No participants could identify whether a phone was on or off. For experiments 1, 2, 3 and 4, one phone was used. Participants positioned the phone next to their head, as if they were making a call. The intention was to have conditions as similar to ‘ordinary’ use as possible. The phone was positioned by the participant over the ear. Participants wore a headband in all conditions to keep the phone in place, including the no phone condition. The antenna of the phone was on the outside of the phone, about 2cm away from the top of where the temporal lobe meets the frontal lobe and the base of the parietal lobe. This varied slightly between participants depending on how they positioned the phone. In Experiment 5, three phones were used. They were positioned by the researcher.

Design

A single blind, between participant design was employed for Experiments 1, 2, 3 and 4. Participants were randomly assigned to one of three conditions: active phone, inactive phone, and no phone by positioning the mobile either over the right or the left ear in the active and inactive phone condition. This was the same for the inactive phone condition and the no phone or control condition. Thus, there were 6 groups: active-right, active-left, inactive right, inactive left, control-right, control-left. For experiment 5, a single blind, between participant design was employed with all participants completing all phone conditions.

Procedure and Ethics

Participants carried out the tasks in Experiments 1, 2, 3, and 4 in either the active, inactive or no phone condition. These were carried out in a small, quiet room. For all experiments, participants gave their informed consent prior to their inclusion in the study and confirmed that they had no known neurological condition or mental health issues. Ethical approval was given by the University of Bristol Ethics Committee.

5.2. Experiment 1. Change Detection Task

5.2.1. Introduction

The effects of short-term memory were investigated in a change detection task. To the best of knowledge, this was the first time that this task has been used to assess the impact of RF

EMF exposure on visual task performance. Previous research has investigated the effects of RF EMF exposure in visual tasks but not in a change detection task. Luck and Vogel (1977) demonstrated the capacity of visual working memory to retain information about integrated objects rather than individual features in a change detection task. They found that information about four colours or orientations were retained in visual working memory at one time. In this experiment, the two hypotheses referred to at the beginning of this chapter are tested and the aim of the experiment tested here was to extend knowledge in this area. The first hypothesis referred to whether the RF EMF effects from mobile phone exposure affected short-term memory and the second hypothesis tested whether this effect was lateralised, depending which ear the phone was positioned at.

5.2.2. Method

Design

The change detection task was a counterbalanced, computer based, visual short-term memory task that involves a conjunction of features of colour, shape and orientation (Luck & Vogel, 1997).

Procedure

Participants viewed a sample group of four shapes for 100ms and a test group of four shapes on each trial. Each trial was separated by a brief delay of 900ms. Participants then identified whether the two groups were identical (match accuracy) or different in terms of a single feature (change accuracy). Participants identified any changes in the configuration of the object by pressing a key to indicate if there had been a change. The accuracy of this discrimination was determined by how many items there were in the stimulus group. This was assessed by working out how many items were accurately retained in short-term memory and related to the number of items in the stimulus group. In this study, the task was selected to expand on the range of cognitive tasks that have investigated the effects of RF EMF exposure.

Analysis

Performance was recorded by measuring match accuracy and match reaction time and subsequently change accuracy and change reaction time. Reaction time was the difference in milliseconds between the onset of the test display and the participant's response. It was recorded using MatLabs 'GetSecs' function. Heterogeneity of variance was demonstrated, so data was analysed using the Kruskal Wallis test (suitable for six independent groups, using error rank scores). The Kruskal Wallis Test is the non-parametric alternative to a one way between groups analysis of variance. Scores of three or more groups are compared. Scores are converted to ranks and the mean rank for each group is compared. A post hoc pairwise comparison using Dunn-Bonferroni correction was then used to adjust for multiple comparisons.

5.2.3. Results

Match data

Table 5.1

The effects of mobile phone exposure in a change detection task. The data shows results for match accuracy and match reaction times and change accuracy and change reaction times. Values depicted are the error rankings based on a Kruskal Wallis Test performed on each ear separately.

	Match Accuracy	Match Reaction Time	Change Accuracy	Change Reaction Time
Right ear				
Control(n=20)	29.70	31.30	35.78	27.95
Inactive(n-20)	33.85	29.60	33.25	32.90
Active(n=20)	27.95	30.60	22.48*	29.05
Left ear				
Control(n=20)	31.68	28.75	30.80	26.90
Inactive(n=20)	32.95	32.60	29.50	35.90
Active(n=20)	26.85	30.15	31.20	28.70

*Significantly different from inactive and control phone conditions ($p<0.05$)

When the phone was positioned at the right ear, no effect of experimental condition for match accuracy was found, $X^2(2) = 1.25$, $p = 0.53$. Similarly, there was no effect for match reaction time, $X^2(2) = 0.096$, $p = 0.95$. The error rankings are depicted in Table 5.1. When the phone was positioned at the left ear, no effect of experimental condition was shown for match accuracy, $X^2(2) = 1.41$, $p = 0.49$ or match reaction time, $X^2(2) = 0.50$, $p = 0.78$.

Change Data

When the phone was positioned at the right ear, a significant effect of experimental condition for change accuracy was shown ($X^2(2) = 6.75$. $p = 0.03$). The error ranks are shown in Table 5.1. Upon finding the significant effect result of the Kruskal Wallis test, a post hoc pairwise comparison using Dunn-Bonferonni correction was carried out. This showed that there was a significant difference between the active and the control condition $Z = 2.45$, $p = 0.04$. There was no significant effect for reaction time $X^2(2) = 0.90$, $p = 0.64$ or for the left ear $X^2(2) = 2.98$, $p = 0.23$.

5.2.4. Discussion

In this change detection task, change accuracy performance was improved in the active condition at the right ear by showing fewer errors in the task, confirming Hypothesis 1. It is interesting tht the result was found in the change accuracy condition rather than match accuracy. A condition of change demands a higher cognitive load than no change. Koivisto, et al. (2000a) and Preece, et al. (2005) found significant effects of RF EMF exposure in simple and choice reaction time tasks. These findings were identified in tasks demanding high cognitive load and it was suggested that RF EMF effects have an effect when the task is cognitively demanding. Significant findings have been found in the 3-back working memory task that requires high cognitive load (Krause et al, 2007, Regel et al., 2007) but not consistently in the 2-back task. Regel et al. (2007) found decreased RT in the 2 and 3-back task and increased accuracy in the 3-back task. Whittington et al. (1996) found that RF EMF effects interacted with task difficulty in a visual duration discrimination time. Kazantzis et al. (1998) examined accuracy in a visual discrimination task and found a small increase in accuracy, but only at the most difficult level. These studies suggest that the effect of RF EMF may affect performance when the task draws on parts of the brain that are activated when a task becomes more complex.

Improved performance occurred over the right ear rather than the left ear position of the phone, providing support for Hypothesis 2 that there will be a lateralised effect. The right hemisphere has been identified with visual-spatial processing. There is also evidence for right hemisphere advantage for carrying out mental transformations of rigid rotation (Ratcliffe, 1979). Rhodes (1985) suggested that the right hemisphere operates more effectively in the early stages of visual-spatial processing, such as discrimination of colour (Davidoff, 1976) and brightness (Davidoff, 1975) and later stages, such as orientation discrimination (De Renzzi, Faglioni, & Scotti, 1971; Kimura, 1973) and abstraction of geometric relations (Franco & Sperry, 1977). The change detection task utilizes all these capacities.

5.3. Experiment 2. The Stroop Test

5.3.1. Introduction

Different tasks rely on different aspects of human information processing and region(s) of the brain to process task demands. Abramson et al. (2009) found a significant effect of mobile phone exposure in the Stroop test, a test that relies on attentional capacity skills in humans.

Areas in the brain thought to underlie the Stroop performance are the lateral and superior medial areas of the frontal lobes, (Alvarez & Emory, 2006). Abramson's experiment was based on usage data, but the aim of this experiment tests the effect of acute RF EMF exposure on the Stroop Test performance.

5.3.2. Method

Procedure

The Stroop Task required participants to read a few words in the same colour as the printed colour word (the congruent condition) and then read a list of words about colour in different colours to the printed word of the colour (the incongruent condition). Participants were timed with a stopwatch to see if there was a difference in the two conditions of congruency and incongruency.

Analysis

Performance was recorded by measuring the congruent and incongruent reaction times. Stroop effect RTs were calculated by subtracting the RTs in the incongruent task from the RTs in the congruent task. The data collected shows homogeneity of variance, so a one way independent, between subjects' ANOVA was carried out on the data.

5.3.3 Results

With the phone positioned at the right ear, an ANOVA comparing the three conditions, no phone (n=20), inactive phone (n=20) and active phone (n=20) showed no effect of experimental condition for the reaction time value, $F(2,57)$, $p = 0.39$, partial $eta^2 = 0.03$. With the phone positioned at the left ear, an ANOVA comparing the three conditions, no phone (n=20), inactive phone (n=20) and active phone (n=20) also showed no effect of experimental condition for reaction time, $F(2,57) = 0.560$, $p = 0.57$, partial $eta^2 = 0.19$. These results are shown in Table 5.2.

Table 5.2
The mean and standard deviations for Stroop reaction times in all phone conditions: active, inactive and control exposure conditions for each ear separately

	Active		Inactive		Control		
	M	*SD*	*M*	*SD*	*M*	*SD*	p
Right	0.96	0.82	1.74	2.58	1.40	1.63	>.391
Left	0.96	0.88	1.74	2.51	1.39	1.63	>.560

5.3.4. Discussion

No significant effects of acute RF EMF exposure are found for experimental condition or hemisphere in the Stroop test. Cinel et al (2008) and Thomas et al. (2010) found no effect of acute exposure in the Stroop Test. In contrast to the current result however, Abramson et al. (2009), found that the completion time for the incongruent condition of the Stroop naming task was longer for users showing high mobile phone exposure. This measurement was based on the number of voice calls made by participants. It could be that the RF EMF effects of mobile phone exposure do not have immediate consequence, and that the effects of acute exposure have a delayed impact. This would mean that the effects would not be identified in the current study, as measurements are only taken at the time of exposure. For future experiments in this area, experimental design should take this into account by allwing for a delayed impact.

5.4. Experiment 3. The n-Back Task

5.4.1 Introduction

Reduced performance has been found in the n-back task, a short-term memory recall task. Leung et al. (2011) found that adolescents (11-13) performed less accurately. Many parts of the brain are thought to be involved in the n-back task, including the pre-frontal cortex, the frontal and parietal lobes and the hippocampus located in the temporal lobe. The aim of this experiment was to replicate the n back task to see if there was an impact of RF EMF exposure on cognitive performance of the task.

5.4.2 Method

Procedure

Participants decided whether each stimulus in a sequence matched the one that appeared two items previously. Eight phonetically distinct letters were used as stimuli (B, F, H, K, M, Q, R or X). Phonetically distinct letters were used so that participants could identify letters clearly from each other. Response times and accuracy were recorded. The experiment comprised four blocks, which consisted of 48 trials and an additional practice block of 20 trials. Each trial began with a central fixation cross, presented for 500 ms. This was followed by the stimulus in that location for 500 ms and a 2000 ms inter-stimulus interval. Participants then made a “yes’ or “no” response via button press as quickly and accurately as possible.

Statistical Analysis

Performance for the n-back task was recorded by measuring target and non-target errors and reaction times (RTs). Where data collected showed heterogeneity of variance, a Kruskal

Wallis test (for six independent groups, using error ranks) was carried out. As mentioned for analysis of the results in Experiment 1, Chapter 5. the Kruskal Wallis Test is the non-parametric alternative to a one way between groups analysis of variance. Scores of three or more groups are compared. Scores are converted to ranks and the mean rank for each group is compared. Outliers for participant 4, 6 and 10 are removed in the control condition for Right ear for Target data, so n =17 instead of 20 as in all other conditions.

5.4.3. Results

Target data

With the phone positioned at the right ear, no effect of experimental condition for target accuracy was found $X^2(2) = 1.46$, $p = 0.48$. The error rankings are shown in Table 5.3.

Table 5.3

The effects of mobile phone exposure in a 2-back task. The data shows results for targets vs. non-targets and reaction times. Values depicted are the error rankings based on a Kruskal Wallis Test performed on each ear separately.

Phone Condition	Target	Non-Target	Reaction Time
Right ear			
Active(n-20)	27.93	29.35	30.20
Inactive(n=20)	29.93	29.30	31.00
Control(n-20)	34.25	32.95	30.30
Left ear			
Active(n=20)	32.30	30.03	25.00
Inactive(n=20)	28.45	30.95	33.70
Control(n=20)	30.75	30.53	32.80

With the phone positioned at the left ear, no effect of experimental condition was shown for target accuracy $X^2(2) = 0.49$, $p = 0.78$.

Non-target data

With the phone positioned at the right ear, no effect of experimental condition for non-target accuracy was found $X^2(2) = 0.59$, $p = 0.74$. The error rankings are shown in Table 2. When the phone was positioned at the left ear, no effect of experimental condition is shown for non-target accuracy $X^2(2) = 0.03$, $p = 0.99$.

Reaction Time

With the phone positioned at the right ear, no effect of experimental condition for reaction time was found $X^2(2) = 0.25$, $p = 0.99$. When the phone was positioned at the left ear, no effect of experimental condition was shown for reaction time $X^2(2) = 3 .02$, $p = 0.22$. There was a tendency for participants exposed to the active phone condition (25.00) to have considerably lower error ranking than the other two groups (32.80 control, 33.70 inactive) for reaction time in the left ear condition.

5.4.4. Discussion

No RF EMF effects of experimental condition or hemisphere was found in the 2-back task for target, non-target accuracy or reaction time in this study. This is in line with Aalto et al. (2006) and Cinel et al. (2008), who found no significant effect of exposure in the n-back task. In contrast to these results Regel et al. (2007) found participants had significantly faster RTs in the 2 and 3-back tasks, showing performance improved with higher cognitive load. Schmid et al. (2012) also found a trend in the 3-back task showing an effect of performance with higher cognitive load. In the current study, the result for the left ear condition, showed a trend in the active condition. Hinrichs and Heinz (2004) found an early task-specific difference component in event related magnetic fields (ERMF) in the left hemisphere in a verbal memory encoding retrieval task. These results suggest that there could be a differential effect of RF EMF exposure from mobile phones in the left hemisphere. Furthermore, as discussed in Chapter 4, a change in cognitive performance might not always be discerned in cognitive tasks although physiological changes may have occurred (Aalto et al., 2006; Krause et al. 2007; Leung et al., 2011)

5.5 Experiment 4. The Word Recall Task

5.5.1 Introduction

Smythe et al. (2003) found a difference in cognitive performance between males and females in a word recall task, with females showing poorer memory recall than males. In word recall tasks, both semantic and spatial recall skills are involved. Semantic word recall is thought to be processed in the medial temporal lobe and the hippocampal area. Spatial recall is thought to involve the posterior parietal lobe and the right dorsolateral prefrontal cortex and the temporal lobe including the hippocampus bi-laterally. The aim of the experiment here is to replicate the task of Smythe & Costall (2003) to see if RF EMF effects short term memory in the word recall task.

5.4.2. Method

Materials and Procedure

A word recall task carried out by Smythe et al. (2003) is partially replicated for this task. The information for the procedure was taken from the procedure used in the experiment by Smythe & Costall (2003). There were three phases to the testing protocol: acquisition and short- term recall, retention and long-term recall and a further retention and long-term recall phase. Twelve words were arranged within a 2-dimensional pyramid shape. This is shown in Figure 5.1.

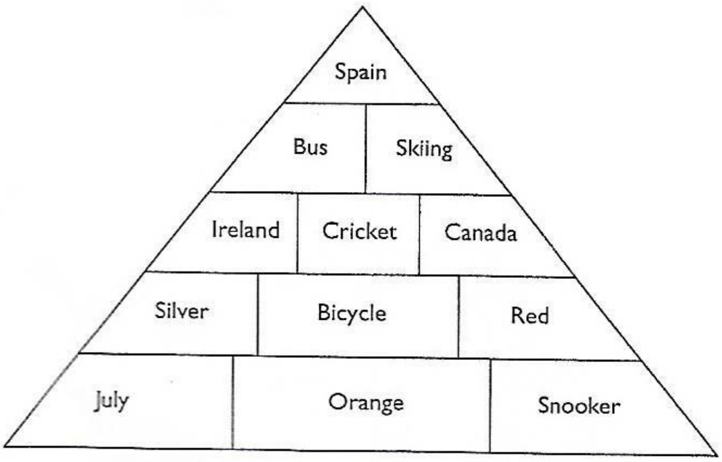

Figure 5.1.
A representation of the word pyramid used as a leaning task for all participants

In the acquisition phase, the experiment was explained to participants. Participants were then shown the words in the pyramid shape and asked to memorize as many words as they could in three minutes. They were also asked to memorise the word placement areas. After three minutes, the pyramid shape was removed, and the participant was asked to read passages from the newspaper aloud. This was to prevent rehearsal. This phase lasted for 12 minutes. Passages had been previously selected from daily newspapers by the researcher, so all participants read the same articles in the same order. After this time, the participants werer given a pyramid template, with no words in it, and asked to recall the correct placement of the words and write the words in the template. This was a slightly different approach to the experiment of Smythe & Costall (2003) where participants also had to draw the pyramid. Participants were given a further three minutes to complete this task. Phone exposure was limited to the acquisition period. Participants were asked to return to the same testing room the following week for a further test. They were not told that they would be asked to recall the words on the pyramid template. They were then asked to recall the words and to write the word on the pyramid in the appropriate place. They were again given 3 minutes to do this.

There was no phone exposure for this. Participants were then asked to return to the testing room a further week later and the same procedure was repeated.

Statistical Analysis

Participants were scored for their ability to recall and position words correctly. Two types of error were created. The first type of error was described as a semantic error. This was determined by how many incorrect words were recalled or were omitted. The second type of error was described as a spatial error. These were words that were incorrectly positioned or omitted. The degree of spatial error was determined in the same way as in the experiment of Smythe and Costall (2003). This was by counting how many Tows and Squares away from the correct position a word was placed. The aim was to find out if exposure affected a participant’s ability to locate words in the spatial configuration. The data showed heterogeneity of variance and was thus subject to non-parametric analysis. As mentioned previously in this chapter the Kruskal Wallis Test is the non-parametric alternative to a one way between groups analysis of variance where scores of three or more groups can be compared. Scores are converted to ranks and the mean rank for each group is compared. The Kruskal-Wallis tests, suitable for three groups, using rank error scores was used. Type 1 errors were set at alpha = 0.05.

5.4.3 Results

Semantic Errors

With the phone positioned at the right ear, no effect of experimental condition for semantic acquisition $X^2(2) = 0.27$, $p = 0.87$ was found. Similarly, there was no effect for the first semantic recall after 7 days $X^2(2) = 1.28$, $p = 0.53$ or the second semantic recall a further 7 days later $X^2(2) = 1.277$, $p = 0.53$. The error rankings are depicted in Table 5.3.

Table 5.4
The effects of mobile phone exposure on semantic recall. Values depicted are the error rankings on a Kruskal Wallis test performed on each ear separately. See results for description of the data

Phone condition	Semantic errors		
	Acquisition	First Recall	Second Recall
Right ear			
Active (n=13)	20.58	22.81	22.38
Inactive (n=13)	20.65	18.04	17.88
Control (n=13)	18.77	19.15	19.73
Left ear			
Active (n=13)	18.96	17.62	19.46
Inactive (n=13)	21.31	21.77	20.77
Control (n=13)	19.73	20.62	19.77

The ranking of errors was very similar for semantic errors in the acquisition phase in the right ear. There was a slightly higher error ranking value in the active phone condition for the first semantic error recall after 7 days (22.81) and second semantic recall after a further 7 days for the right ear (22.38). This, however, was not significant. When the phone was positioned at the left ear, no effect of experimental condition was shown for semantic acquisition $X^2(2) = 0.324$, $p = 0.85$, first semantic recall after 7 days $X^2(2) = 1.04$, $p = 0.59$ and second semantic recall after a further 7 days $X^2(2) = 0.1$, $p = 0.96$. The error rankings were also similar.

Surprisingly, slightly higher error rankings were found in the inactive condition for the left ear in all semantic error acquisition and recall conditions. The lowest error rankings occured in the active condition for all semantic error acquisition and recall conditions, but this was very small and not significant.

Spatial Errors

With the phone positioned at the right ear, no effect of experimental condition for spatial acquisition $X^2(2) = 0.50$, $p = 0.77$ was found. Similarly, there was no effect for the first spatial recall after 7 days $X^2(2) = 2.07$, $p = 0.35$ or the second spatial recall a further 7 days later $X^2(2) = 0.07$, $p = 0.96$. The ranking of errors was very similar for spatial recall in the acquisition phase. In contrast, there was a higher error value in the active phone condition for the first recall after 7 days and the second recall after a further 7 days for the right ear. This, however, was not significant. In the participants with a phone positioned at the left ear, no effect of experimental condition was found for spatial acquisition $X^2(2) = 0.07$, $p = 0.96$, first spatial recall after 7 days $X^2(2) = 0.28$, $p = 0.87$ and second spatial recall after a further 7 days $X^2(2) = 0.48$, $p = 0.79$. The error rankings were very similar, as shown in Table 5.5

Table 5.5
The effects of mobile phone exposure on spatial recall. Values depicted are the error rankings based on a Kruskal Wallis test performed on each ear separately. See results for description of the data.

Phone condition	Spatial errors		
	Acquisition	First recall	Second Recall
Right ear			
Active (n=13)	20.42	23.42	19.42
Inactive (n=13)	20.85	19.35	19.96
Control (n=13)	18.73	17.23	20.62
Left ear			
Active (n=13)	20.50	20.42	19.81
Inactive (n=13)	19.58	18.69	18.62
Control (n=13)	19.92	20.88	21.58

5.4.4 Discussion

In the current replication of the Smythe & Costall (2003) word recall task, no RF EMF effects of experimental condition or hemisphere were found for semantic or spatial recall. Previous experiments had shown significant results in memory recall tasks, for example, Lass et al (2002) found a significant increase in the variance of errors in a modified trail making task and a significant increase in the variance of errors in a paired letter task although a decrease in errors was found in a picture to word recall task. Luria et al, 2009 found a significant increase in RT for right hand responses under left side exposure in a spatial memory recall task. In addition, Wilholm et al. 2009, found a significant improvement in spatial performance in the Morris Water Maze task.

The data for the right ear condition in the current study, although not significant, showed a trend in the active condition for first recall (after 7 days) and second recall (after a further 7 days), with slightly raised semantic and spatial error rankings. Demographic data showed that two thirds of participants (63.5%) used their mobile phone on the right side and a third (30.8%) used their phone on the left side. Greater usage of the mobile phone on the right side of the head, might be a possible explanation for the trends in the recall conditions. Schoeni et al. (2015) found no significant effect of RF EMF exposure in a verbal memory retrieval task. It was suggested that this was due to the brain area that is involved in verbal memory tasks. In the current word recall task, no significant effects were found in either the left or right hemisphere.

Unfortunately, the original finding of Smythe & Costall (2003) that mobile phone exposure facilitates memory in males but not females, could not be explored. This was due to the gender imbalance in the number of participants in the current study. Future experiments need to make sure there are an equal number of male and female participants in the study.

5.6. A Visual Detection Task

5.6.1. Introduction

This experiment has been published in the Congress of the IEA, Proceedings of the 20th International Ergonomic Association (IEA 2018), 619-627, Part of the Advances in Intelligent Systems & Computing book series (AISC, 818)[1].

Chapter 5 provided a review on studies that had carried out investigations on the effects of radiofrequency electromagnetic fields (RF EMF) on cognitive performance. Significant effects were found in in visual tasks (Freude et al., 2000; Jech et al., 2001; Rodina et al., 2007; Mortazavi et al., 2012; Vecchio et al., 2012a, 2012b) and are discussed in the introduction to Chapter 5. Other studies found no significant effects in visual tasks and are discussed in Chapter 4.

Davidson (1992) has discussed the evolutionary significance of cerebral brain asymmetry and the role of emotional processing. The cerebral cortex in humans plays an important role in aspects of emotional behaviour and experience. The anterior cortical regions have extensive anatomical reciprocity both with subcortical centres and with posterior cortical circuits which are critically implicated in emotional behaviour. Brain activation patterns associated with emotional states have been investigated using emotion induction based on either autobiographical memories or external stimuli for pleasant and unpleasant emotions (George et al., 1995; Canli et al., 1998). Areas of the brain previously implicated in aspects of human emotion studies are the prefrontal cortex, anterior cingulate, insula and amygdala (Bechara et al., 1997; Reiman et al., 1997). Historically, it was thought that damage to the left hemisphere was more likely to lead to depressed behaviour compared to similar damage to the right hemisphere (Goldstein, 1939; Gainotti, 1972; Sackeim et al., 1982). For example, the closer the damage to the frontal pole of the left frontal lobe (Robinson et al., 1984), the more severe depressive symptoms are. It was thought that damage to the left frontal region resulted in a deficit in behaviour and experience with a loaded threshold for the experience of sadness and [3]depression. More recent studies and reviews (Harmon-Jones et al., 2010) however have questioned whether the negative emotions of sadness and depression are more specific to the left hemisphere, as findings have shown that lesions anywhere in the right hemisphere can cause difficulties with perception of emotional expressions (for example, Kolb and Taylor, 1991).

A further hypothesis to the two main hypotheses for this experiment wass that the lateralised effect of RF EMF exposure from a mobile phone would be related to well-being.

5.6.2 Method

Experimental Design

This experiment differed from the previous four experiments in that it uses a within participant design. It also recorded the temperature and time of day throughout the experiment.

A visual detection task was designed with 72 dots appearing equally in the left and right visual fields. There are three phone conditions. The first phone condition was an active phone on the right side of the head (active right) and an inactive phone on the left. The second phone condition was an active phone on the left side of the head (active left) and an inactive

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phone on the right. The third condition had an inactive phone on the right side of the head and an inactive phone on the left (both off). This was the control or sham condition. There were 24 unique combinations of active right, active left and both phones that made up the first block of trials and a further 24 combinations that made up the second block. Six trials were run with a State well-being test This was administered at the end of each trial to assess the mood of participants.

Materials

For Experiment 5, a temperature sensor was attached to the back of the active phone with matt black tape so that the amount of heat created by the phone could be measured. The time of day was also recorded. Two questionnaires were used to collect demographic and well-being data. At the beginning of the experiment, participants were asked about their health, health behaviour, mobile phone usage behaviour and personality traits, see Appendix J. At the end of each of the six trials, participants completed an online well-being scale which focused on mood, alertness, and engagement, see Appendix K.

Procedure

Phones were positioned on either the right or left posterior side of the head around the occipital lobe. The antennae on the phones were positioned over the area of the bottom of the posterior lobe, the side of the temporal lobe and the top of the occipital lobe. Participants sat 50cm away from the computer monitor. The centre of the monitor was positioned at eye level and the monitor screen was positioned vertical to the viewer.

There were two practice sessions before the six visual task trials began. One practice session was for the visual search task and the other was for the well-being scale. Participants were requested to fixate on a central stimulus, a cross, at the middle of the screen. The target nearest to fixation was 9.54 degrees of visual angle away from foveation. The closest target to fixation was 8.4cm in the experiment. This means the gap between the nearest edge of the two matrices for dot locations was 16.4cm. Whenever the experimental stimulus, a dot, appeared in either the left or right of the central stimulus on the screen, two keys had to be pressed at the same time, as quickly as possible. The importance of responding "as quickly as possible" but without making mistakes, was emphasised to participants. It was important that all participants maintained a similar level of alertness. Variability in states of alertness could act as a confounding variable as alpha activity (approximately 8-12 Hz) is sensitive to alterations in alertness. If the participant's alertness changes over the course of the experiment and between participants, so too will alpha, error variance and the chance of failing to detect a mobile phone exposure related change which could be caused by a change in alpha (Croft et al., 2002). A potential mistake by participants could have been predicting that a dot would occur, and the button would be pressed too early, so participants were asked not to try and predict where the dot would appear. Instead, they fixated on the centre of the screen and are asked to try not to look left or right. They were informed that if they looked in a half of the screen when a target occurred in the other side, they might miss the target. The keys were "X" and ".". Both hands were used when a response was made, and participants were informed of the importance of using both hands to respond to each detection on each trial.

At the beginning of the experiment, the demographic questionnaire was administered, and at the end of each trial, the well-being scale was completed. The demographic questionnaire can be seen in Appendix H. Questions were related to personality factors that have been discussed in Chapter 5. Participants were asked to answer this as honestly as possible and to think carefully about the responses they gave. At the end of the experiments, participants were thanked and debriefed.

Analysis of Data

Three participants were excluded as outliers as trials were rejected if they are 2M+/-M. Data was therefore analysed for 45 participants, 23 males and 22 females.

5.5.3. Results

A 3-way ANOVA for field, block (trial) and phone showed a significant difference in reaction time in the phone condition, $F(2,88) = 3.24$, $p = 0.04$. This indicated that the phone condition was making a difference to how participants were performing in the task, and RF EMF exposure could be affecting performance. No effect of visual field, $F(1,44) = 2.53$, $p = 0.12$ or block were found, $F(1,44) = 1.85$, $p = 0.18$. The performance of participants was not affected by the visual field as a variable on its own, and the lack of statistical significance concerning block indicated there was not a learning curve effect.

Further analyses indicated no interaction between field and block, $F(1,44) = 0.22$, $p = 0.65$, but a significant difference was found between visual field and phone, $F(1,44) = 3.56$, $p = 0.03$. No interaction between block and phone was found, $F(2,88) = 1.17$, $p = 0.31$, or between field and block and phone, $F(2,88) = 0.13$, $p = 0.87$.

A pairwise comparison between the active right condition and the phones off condition, the active left and the phones off condition showed a significant mean difference, 6.11, $95^{\%}$C.I. = (0.069-12.149), $p = 0.047$, where the active phone on the left yielded slower response times than the inactive phones. The p value was Bonferroni adjusted.

It was shown that RT was faster when the phones are not on (Condition 3), in the right visual field, when the active phone was positioned over the right hemisphere (Condition 1) and in the right visual field compared to when the phone was in the active phone condition over the right hemispheremin the left visual field.

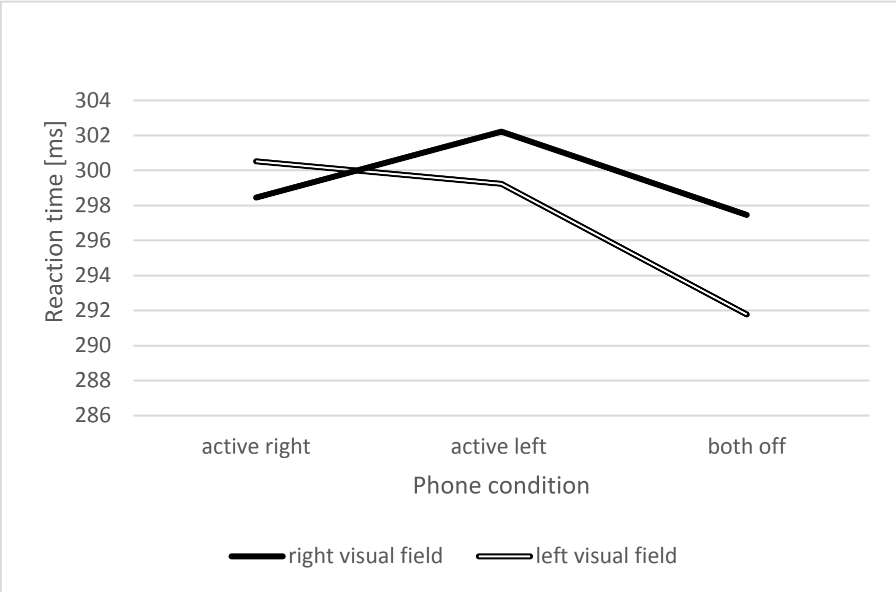


Figure 5.2.
Means for right and left visual fields for reaction time in the three phone conditions of active right, active left and off.

When the active phone was positioned over the left hemisphere (Condition 2), RT was slower in the right visual field. This is represented in Figure 5.2.

Well-Being Variables

Well-being data was analysed using a 2-way ANOVA with two levels of 'block' and three levels of 'phone'. There were three mood variables of interest: boredom, sadness, and physical fatigue.

Boredom

A significant effect of boredom was found, $F(2,88)=3.24$, $p=.04$. A test of within subject contrasts revealed no significance for the active phone over the right hemisphere (Condition 1) when compared to the inactive phone/control condition (Condition 3), $F(1,44) = 3.07$, $p = 0.09$. The result was significant when the phone positioned over the left hemisphere (Condition 2) was compared to the inactive phones/control condition (Condition 3), $F(1,44) = 6.75$, $p= 0.02$. These results show that participants were less bored when the phones were active, and when the active phone was over the left hemisphere.

Sadness

A significant effect of phone condition on sadness was found, $F(2, 88) = 4.23$, $p = 0.17$. Participants reported feeling greater sadness over the left hemisphere (Condition 2) when the active phone was over the right hemisphere (Condition 1) and compared with the active phone over the left hemisphere (Condition 2), $F(1,44) = 7.59$, $p = 0.01$. The result survives Bonferroni modification.

Physical Fatigue

A significant effect was shown for block and phone, $F(2.88) = 7.08$, $p = .010$. Further comparisons showed significance for the right hemisphere when compared to the inactive/ control condition, $F(1,44) = 7.24$, $p = 0.01$ and for the left hemisphere when compared to the inactive/control condition, $F(1,44) = 13.74$, $p = 0.01$. Participants were less physically fatigued when the phone was active.

Temperature

Temperature data was analysed using a one-way ANOVA. It was predicted that there would be an increase of temperature in the active phone condition. Analysis showed that there was an increase of 0.5^{o}C. Further analysis showed that there was a very small difference between the right and left side active phone condition. Participants were not able to detect whether the phone condition was active, inactive, or off, although three individuals commented on a sensation of warmth from where the phone was on the head.

5.6.4. Discussion

The results for the visual dot detection task show that RTs were faster when the phones were active. The RTs were faster for the active phone positioned over the right hemisphere and in the right visual field than when the phone was in the active phone condition over the right hemisphere and in the left visual field. When the active phone was positioned over the left hemisphere, RT was slower in the right visual field.

Eliyahu et al. (2006) found that RF EMF exposure to the left side of the brain slowed down the left-hand response time, in the second later part of their experiment. The effect was apparent in three out of four tasks: a spatial item recognition task (FACE), and two spatial compatibility tasks (SPAT and SIMON). No effect was found for a fourth task, a verbal item recognition task (LETTER). This left sided difference was not, however, thought to be due to a hemisphere dependence, as the task functions affected are related to activities of both hemispheres. A definitive reason for the results was not given.

In a further experiment by this team, Luria et al. (2009) found that the average RT of right-hand responses with left side RF EMF exposure was significantly longer than those of right-side exposure and the control condition. The task performed was a spatial working memory task and the significant results were found only in the first two blocks out of a total of 12 blocks of trials. Again, it was not possible to identify a clear explanation for these results. Differences in the right and left hemisphere functions were considered but it was thought there might be other reasons, for example, phone type and model, the positioning of the phone for the experiment, exposure methodology, exposure time, type of cognitive task. The results of Eliyahu et al. (2006) and Luria et al. (2009), however, are in line with the result in the current experiment. If taken together and with reference to research on cerebral brain asymmetry that supports a right hemisphere advantage for visuospatial analysis (Davidoff, 1982; Young and Ratcliff, 1982; Rhodes, 1983) these results might suggest that different causal mechanisms are operating in the right and left hemisphere. It is suggested they are differentially affected by mobile phone exposure.

Further, Jech et al. (2001) carried out a visual oddball experiment with patients with narcolepsy-cataplexy. The team concluded that the RF EMF from a mobile phone may suppress excessive sleepiness and improve performance while completing the task. It was observed that RF EMF effects occurred in situations when the target stimulus appeared exclusively in the right hemifield. This was thought to reflect an interaction of the RF EMF with the right hemisphere function. It might indicate either a direct stimulating effect of the RF EMF to the right hemisphere neurons or the mobile phone exposure might produce an inhibition of processes which normally reduce the processing of information coming from the left hemisphere. The mobile phone exposure significantly heightened the amplitude without affecting the endogenous complex latency. So, instead of a change in the rate of processing for the target stimulus, there was an improvement in performance while the P3a wave was being generated. These studies, along with the current experiment, give further support to a lateralised effect of mobile phone exposure.

Although an effect of temperature was found in this experiment, this result should be interpreted with caution. The reason for this is that there was no temperature sensor positioned on the inactive phones. If a temperature sensor had also been postioned on the inactive phone, a direct comparison of temperature could be inferred between the active and inactive phone conditions, creating a more robust conclusion.

5.7. General Discussion

Cognitive performance is a useful measure for discerning changes in human behavior, but RF EMF effects can be difficult to capture due to the sensitivity of RF EMF. Of the five experiments carried out, two found significant results. This would suggest that Hypothesis 1, that there is an effect of RF EMF exposure from the mobile phone on cognitive performance, could be supported. However, three experiments found no significant results (although there was a trend in the left ear in the active condition in the n back task condition). For these experiments, the results suggest that the Null Hypothesis should be accepted. A similar conclusion can be deduced for Hypothesis 2. Hypothesis 2 purports that there will be a lateralised effect. The results of two experiments suggest that there was support for Hypothesis 2 that there is a lateralised RF EMF effect of mobile phone exposure on cognitive performance. Three experiments found no effect and did not support Hypothesis 2.

The change detection task found an effect of change accuracy performance in the right hemisphere. A significant difference was found between the active and the control condition, but it was only just significant after Dunn-Bonferroni correction. Although there was a relatively large sample size for the experiment, each independent group was made up of 20 participants. This makes the possibility of a Type II error possible. Previous studies used a range of sample sizes from Vecchio et al (2012) with 11 participants and Preece et al. (2005) with 18 participants through to Mortavazi et al (2012) with 120 and Russo et al. (2006) with 168. Sample size is an important consideration for experiments with RF EMF exposure because if, as has been suggested, there is individual sensitivity to RF EMF, this might only be picked up in a large population. One way to overcome this issue would be to start off with a pre-selected group who have identified themselves as having problems with mobile phones, such as headaches, blurred vision, eye strain or one of the many issues that have reported. However, a study was carried out by Krause (2001) with a group that was pre-selected for having health concerns from mobile phone use and no conclusive findings of effect were established.

The results for the visual dot detection task showed an effect in the right hemisphere and in the right visual field. The RTs were faster for the active phone positioned over the right hemisphere and in the right visual field than when the phone was in the active phone condition over the right hemisphere and in the left visual field. When the active phone was positioned over the left hemisphere, RT is slower in the right visual field.

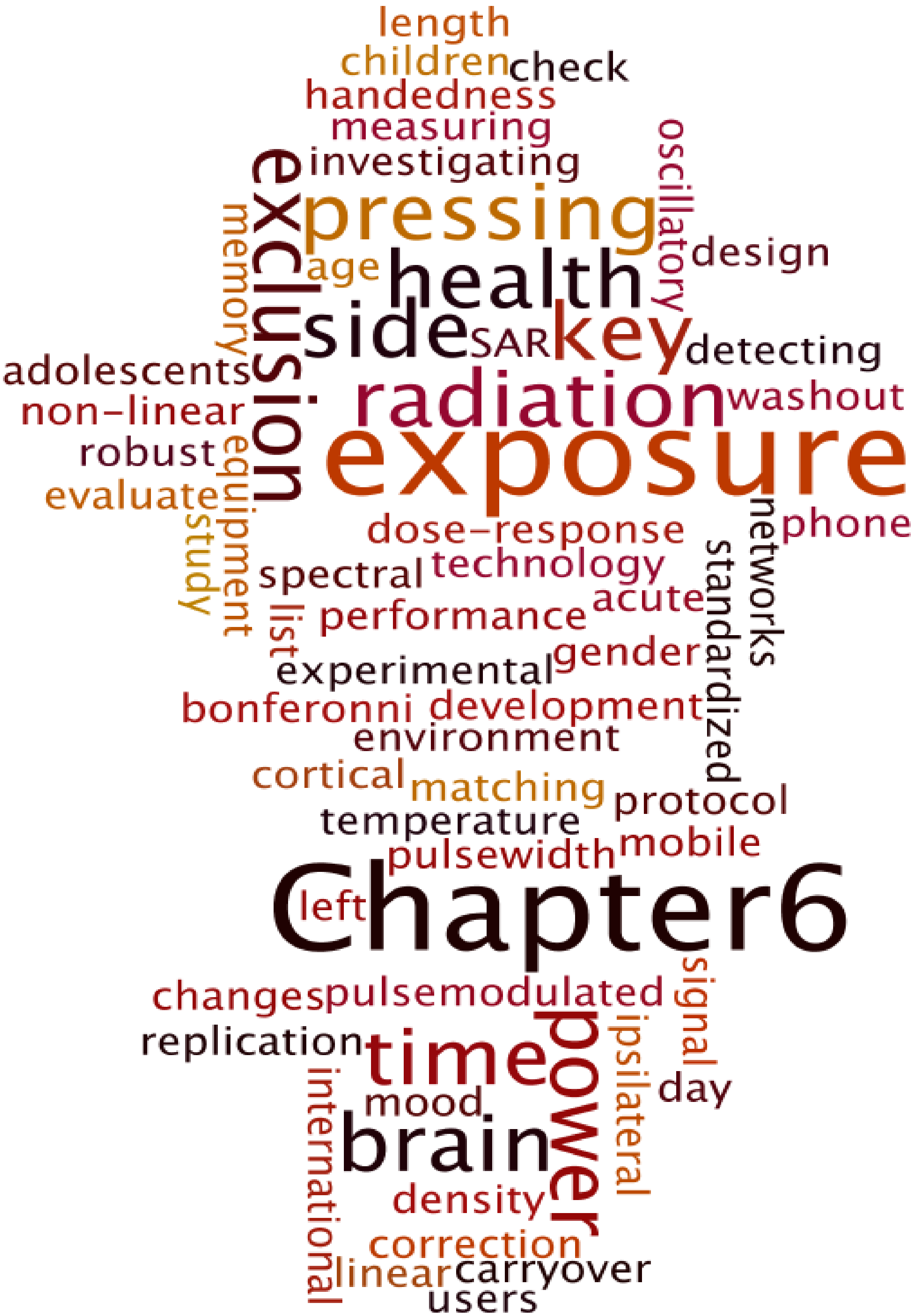
The additional hypothesis for Experiment 5 asked if there was a relationship between RF EMF effects and mood. Participants reported greater sadness when the active phone was over the left hemisphere than when the active phone was over the right hemisphere. They were also less bored when the phones were active especially when the active phone was over the left hemisphere. Finally, participants demonstrated less physical fatigue when the phones were active.

The results for the visual detection task suggest that the effect of the mobile phone exposure created a mood effect and especially over the left hemisphere. Brain activation patterns associated with emotional states have been investigated for pleasant and unpleasant emotions (George et al., 1995; Lane et al., 1997; Canli et al., 1998). George et al. (1995) found transient sadness and happiness affected different brain regions in divergent directions and not merely opposite activity in identical brain regions. Transient sadness significantly activated bilateral limbic and paralimbic structures (cingulate, medial prefrontal and mesia temporal cortex) as well as brain stem, thalamus, and caudate/putamen. In contrast, transient happiness had no areas of significantly increased activity but was associated with increased cerebral blood flow especially in the right prefrontal and bilateral temporal region. In the visual detection, participants seem to be stimulated by the phone being positioned over the left hemisphere by showing less boredom, but at the same time, experience greater sadness. They are also stimulated by the phone in the active condition, but at the same time, being less physically fatigued.

Further investigation of the lateralized effects of exposure is recommended for future studies with the addition of EEG or neuro-imaging analysis, for example, fMRI and/or PET scan analysis, so that any physiological changes can be observed.

5.8. Summary of Chapter 5

Five experiments investigated the lateralised effects of RF EMF exposure from mobile phones in different cognitive tasks. There are three conditions: no phone, inactive phone, and active phone. The number of participants in each experiment varied. Results for the change detection task and the visual dot detection task showed significant results. Reaction times were faster when the phones were switched off in the visual dot detection task, and faster for the active phone in the right visual field when positioned over the right hemisphere than in the left visual field and over the right hemisphere. When the active phone was over the left hemisphere, participants reported greater sadness compared to the active phone over the right hemisphere. Previous studies on asymmetrical brain function suggest deactivation of the left hemisphere increased negative affect. The results for this experiment suggest a potential mood effect is operating. However, results showed no significant effect of experimental condition for the right hemisphere or left hemisphere for the Stroop task, the n back task or the word recall task.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Chapter 6

Development of a Check List for RF EMF Exposure for Experiments Measuring Cognitive Performance

6.1. Introduction

This chapter proposes a check list for experiments measuring RF EMF exposure involving cognitive performance. The aim of this check list is to promote consistency in experimental protocol to ensure a robust methodological process by contributing to the development of a standardised protocol for future experiments. This is shown in Table 6.1. Many of the studies and reviews referred to in Chapter 4 comment on the need for a consistent approach for bioelectromagnetic research. This is due to the many factors outlined in Chapter 4. Chapter 4 shows there is much variability in mobile phone exposure parameters and experimental protocol. There are many limitations to the experimental protocol for Experiments 1, 2, 3, 4 and 5. For these reasons a check list is created. Many factors are fundamental to any experimental protocol, but it is still necessary to identify them in a consistent format, to gain a standardized approach. The check list is used to evaluate the effectiveness of the experimental parameters in the current experiments in Chapter 5. This can add knowledge to the effectiveness of the experiments and also the effectiveness of the check list.

6.2. The Check List

Table 6.1 shows the check list for experiments for investigating the effects of RF EMF exposure from a mobile phone in cognitive tasks.

Table 6.1
A check list for experiments for investigating the effects of RF EMF exposure from a mobile phone in cognitive tasks.

Experimental parameters	Experimental variables
Exposure characteristics	What is the exposure source? What is the brand of the mobile phone? What is the carrier frequency? What is the pulse width? What is the mean output power? How long is the duty cycle? How is the signal modulated? Next to what brain region is the antenna positioned? What is the distance of the antenna from the head? Can another researcher reproduce these conditions?
Mobile Phone networks	Identify what generation phone is used What phone standard is used?
Sample	Assess sample size based on a power analysis. Specify the details of the findings from the power analysis. What are the measurements of head size of participants? Is the sample a homogeneous group and/or (if appropriate) are clear matching procedures applied? What is the gender balance of the study population? What is the age of participants? Are participants right or left handed or ambidextrous? Has a questionnaire been carried out to identify mobile phone usage behaviour? What exclusion criteria is used? Will exclusion criteria affect performance of participants during the task? (for example, caffeine withdrawal or smoking cravings) Has a questionnaire been carried out to identify personality traits?
	What is the key pressing behaviour?
	Is well-being assessed?
Study design	Is the study a between or within participants design? (a within participants design is recommended) Is the study design single or double blind? (a double-blind design is recommended) Is the study a randomised cross-over design? How many experimental conditions will be employed? How long will the wash out period be? Will the task be repeated? If yes, when will this occur?
Task	What cognitive task (s) will be investigated? Why was the task (s) chosen?

	Which cognitive variable is/are being investigated? Has the task (s) revealed effects in a previous test? What region of the brain is/are related to the task (s)? What is the input modality? What is the response modality? Is there a practice session? How complex is/are the task (s) from 0 is not difficult to 5 is difficult? Can the task (s) be repeated in the experiment? If more than one task is used, are there carryover effects in the crossover design?
Time and temperature factors	Will the temperature be monitored throughout the experiment? What time will the task be carried out? (allow for the same time each day) What time will exposure be measured before the experiment? What time (s) will exposure be measured during the experiment? What time (s) will exposure be measured at the end the experiment? What time (s) will exposure be measured at the end of the wash out period?
During the experiment	Record exposure at regular time intervals Specify time intervals throughout the task (for example, every 5 minutes) Is a dose-response relationship considered? Will the participants be able to maintain constant motivation (as far as reasonably possible)? Will the participants be able to maintain constant alertness (as far as reasonably possible)? Will the participants be able to maintain constant vigilance (as far as reasonably possible)?
Analysis	What analysis will be carried out? Is there a need to correct for multiple comparisons? Has information about mobile phone characteristics, mobile phone networks, been related to the outcomes of the experiments?

6.3. Discussion

The check list in Table 6.1 is used to evaluate the experimental protocol in the experiments in Chapter 5. In Experiments 1,2, 3, 4, and 5 in Chapter 5, little information is given about mobile phone characteristics. Information provided is that the phone is a GSM 900 MHz Nokia 130 (RM-103) with a maximum specific absorption rate (SAR) of 1.28 kW/kg over 10g when held against the head. It is important to provide details of the exposure source, brand, carrier frequency, pulse width, phone generation, phone standard and the signal modulation. Information is provided in Chapter 5 regarding the region the antenna is positioned in and the distance from the head. The information provided, however, offers information to be able to replicate the experiment.

The sample size for the experiments in Chapter 5 is created from the literature review rather than carrying out a power analysis. Chapter 4 showed that sample sizes have varied considerably in previous experiments. Table 4.1 shows the variation in sample sizes for studies with adults where the smallest sample size was 11 adults (Maier et al., 2004) and the largest sample size was 168 participants (Cinel et al., 2008). Table 4.2 shows the sample sizes for studies with children and adolescents. The smallest sample size is 15 participants and the largest sample size is 2,354. For future studies, it is recommended that larger sample sizes are used. It is also suggested that a power analysis is carried out to ascertain a suitable sample size. In the current experiments, the head size of participants is not measured and related to exposure output. The sample is a homogenous group in that all participant are students at the University of Bristol. The gender groups are unbalanced with 120 females and 20 males in Experiment 1, 2, and 3. This was addressed for Experiment 5 where an equal gender balance of 24 females and 24 males was implemented. Participants are similar in age. The age range is from 18-30. Participants handedness is recorded but this is not applied to the analysis. A questionnaire is carried out to identify mobile phone usage behavior and participants are neurologically healthy. A demographic profile is recorded by a self report questionnaire and this is shown in Appendix K. Future development of these experiments are to relate demographics to performance. Participants are given instructions on what key to press in each experiment. In Experiment 5, for example, one digit on the left and one digit on the right hand are used and participants are instructed to press a particular key. Key-pressing behavior and personality traits (Cook, Thomas, & Prato, 2002; Persinger, 1993) are discussed in Chapter 4 and 5. In Experiment 5, personality traits are recorded and analysed in relation to performance. No personality traits could be related to performance in this experiment.

The study design in Experiments 1, 2 ,3 and 4 is a between participant design but Experiment 5 is a within participant design. All experiments are single blind. Double blind is preferable to single blind to ensure robust experimental design. Significant findings have been found in experiments with a single blind design rather than a double-blind design although the experiment of Curcio et al. (2004) used a double-blind paradigm. Three experimental conditions of active, inactive and control are employed in all experiments in Chapter 5. There is no wash out period. This is something that would improve the ecological validity of the current experiments. There is no current plan to repeat the task.

The cognitive tasks chosen for investigation are identified. A range of cognitive performance are covered by the tasks and tasks are processed in different areas of the brain. The area of the brain related to the task is identified and discussed in Chapter 4. The input modality is the area of the head and the response occurred through the participant operating the keyboard as instructed. A practice session is provided for each experiment. The tasks range in difficulty with the n back being the hardest task (4), followed by the change detection task (3), then the word recall task (3). The visual detection task (3) is probably the next difficult with the Stroop being the easiest (2). These values are the subjective assessment of the researcher. The task difficulty however can show individual variability. For example, most participants found the Stroop Task straight forward but occasionally a participant found this task difficult. Information about whether the task had revealed effects in previous experiments is provided in Chapter 4. As mentioned earlier, the task is replicable. Experiment 1, 2 and 3 are carried out together. A cross-over design is used for the order of the tasks but carry over effects could have occurred between tasks. Experiment 4 and 5 are carried out at separate times. Experiments 1, 2, 3 and 4 are carried out when participants are available and within work hours. A counterbalanced cross-over design is recommended, with equal numbers of participants experiencing each order. This counteracts any effects of time dependency on the participant's responses, resulting, for example, from learning effects and subsequent improvement in task performance or from fatigue during a study. However, as the transfer effects may not be equivalent, caution is recommended with this design methodology**.** A dose-response relationship is not considered but each task is the same. However, there is some individual variation in how quickly participants complete the tasks. In Experiment 5, a well being assessment was completed between each trial.

As a control measure, the task could have been performed without exposure before or after the task to see if there is any difference in results. As performance is measured through task activity, a wash out period would not provide an exposure measurement. In the future, a systematic form of measurement is recommended. It is important to consider the way in which the exposure system is attached on the head. This can considerably influence the specific absorption rate (Preece et al., 1999). Preece (1999) created detailed equipment for mobile phone exposure measurements. This was subsequently used by Koivisto (2000). For experimental design, a comparable form of measurement was therefore possible. The check list proposes measuring exposure time before, at the beginning of the experiment, during the experiment and after the experiment. Also, measuring at regular intervals is recommended. As mentioned in Chapter 4, time of day effects (Chapotot et al., 2000; Lafrance & Dumont, 2000; Maquet, 2000) have been found to be important indicators of RF EMF receptivity. Sauter found significant effects of time of day. Recordings of the temperature are also recommended. Hyland (2000) suggests that the body can adjust to a temperature rise of 1ºC. If the temperature goes above 1ºC, the body's thermoregulatory homeostasis mechanisms find it difficult to adjust to this level of temperature increase. Temperature is recorded in Experiment 5. Consideration of whether the participants will be able to maintain constant alertness and vigilance is recommended. The effect of alpha has been discussed in Chapter 4 and the sensitivity of alpha to RF EMF effects (Croft, 2002). In Experiment 5, alertness and other well being measures are investigated throughout the task by the completion of the well being scale between each trial. The time is also recorded between each trial.

The type of task carried out dictates the analysis that is carried out and the analysis is corrected for multiple comparisons by Bonferonni or Dunn Bonferroni correction for all significant results in the experiments. With adjustment for multiple comparison, the result can lose significance. Blackman (2009) commented on the trend that Preece et al. (2005) found in RTs in a cognitive test with children. A Bonferonni correction was applied and thus significance could not be verified. Blackman (2009) suggested that a variation in the design of the experiment change could offer a better test for the effect of RF EMF effects n simple RT because it is known that Bonferonni correction is a particularly severe test of statistical significance. Viewpoints differ on the best statistical approach, but to ensure robustness of analysis and avoidance of Type 1 and Type 2 errors, it is recommended that corrections for multiple comparisons are carried out in all bioelectromagnetic research on cognition.

6.4. Conclusion

The experimental protocol of Experiments 1, 2, 3, 4, and 5 are fairly robust but there are some limitations. These include a lack of detail about mobile phone characteristics, a gender imbalance amongst participants, a between participants' design, participants' handedness not being applied to the analysis, temperature not being measured, and time of day effects not being considered. There was also no wash out period although a counterbalanced design procedure was used to account for carry over effects. The information about mobile characteristics and mobile networks are not related to the outcomes of the experiment. Some of these factors are addressed in Experiment 5. These are a gender balance of 24 females and 24 males and a within participant design. The temperature was measured on the active mobile phone and the time of day the experiment was recorded. The experiment was also more robust in that information about mood and personality was elicited. Mood and personality are related to performance outcomes. Although no relationship was found for personality, a relationship was found between mood and exposure. To the best of knowledge, this is the first time that this approach and finding has occurred. A future development of these experiments could be to relate demographics to performance

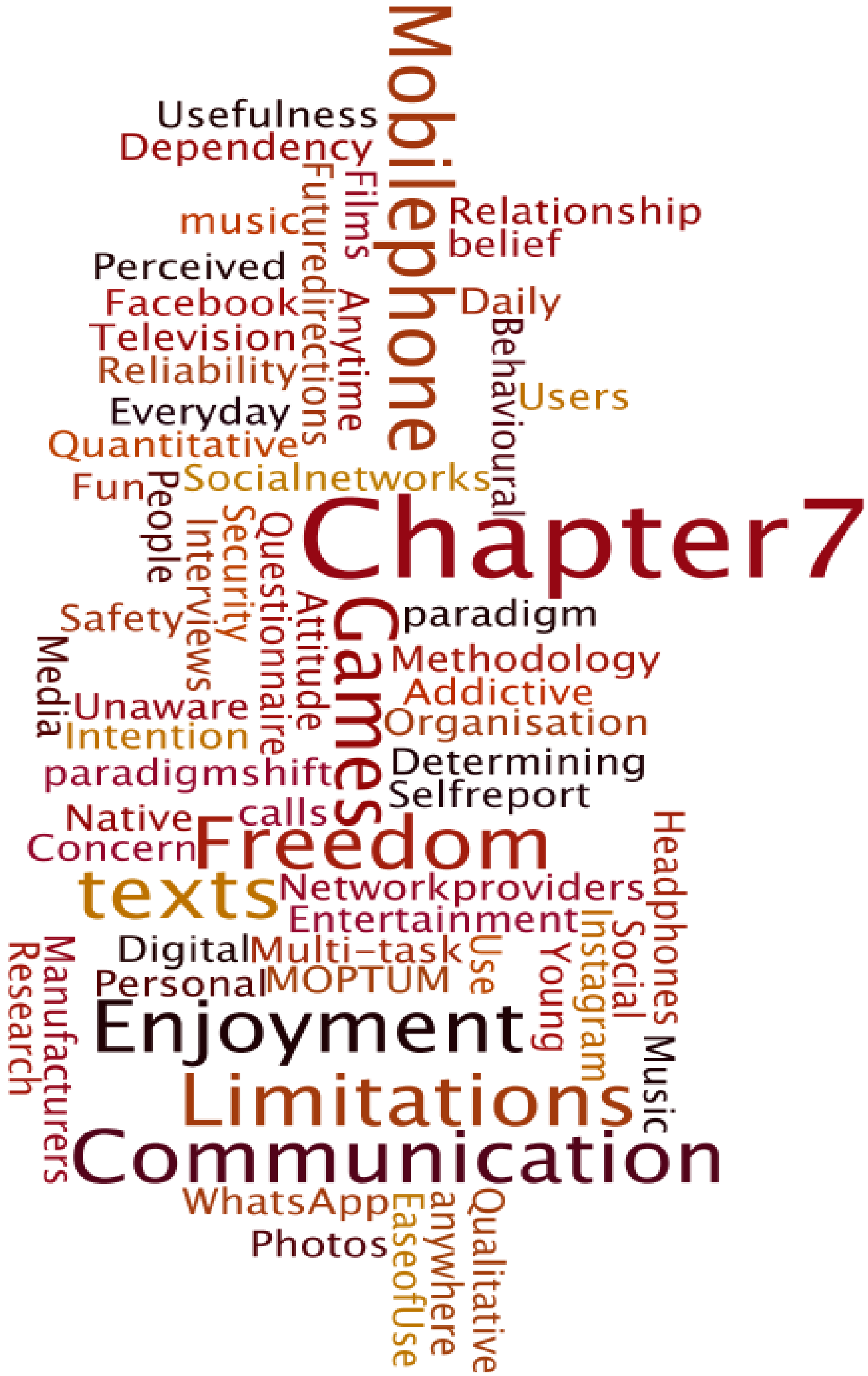
Opinion differs on the impact thermal effects can have on the brain, but, there is also concern about non-thermal effects and "hot spots" (Blackman, 2009). The check list does not accommodate this. "Hot spots" are momentary high intensities of heat production that can occur because of radiation exposures and could have adverse effects on brain tissue. A temperature increase can cause thermal effects but when the intensity of the radiation also affects the equilibrium of the tissues, effects can occur at a neuronal level. Although low, some of the oscillatory frequencies emitted from phones correspond to the oscillatory frequencies found in neuronal tissue (Hyland, 2000). The orderly functioning of the human body is underpinned by oscillatory electrical processes of various kinds (Smith, 1989), each typified by a specific frequency, some of which happen to be close to those used in GSM. Hyland (2000) suggests that non-thermal effects do not have a linear relationship in the same way as thermal effects. Further, non-thermal effects are influenced by the 'condition 'of the user when exposed to the RF EMF. A low intensity field can cause a large response or no effect. Thus, not everyone can be expected to be affected in the same way by identical exposure. This non-linear behaviour is supported by Cook et al. (2002) and Marino and Carubba (2009) who suggest that the inconsistencies in some of the results in bioelectromagnetic research occur because of the nature of how the brain functions and, also how RF EMF effects have impact. The brain is not in equilibrium with its environment and the effects on brain electrical activity are not linearly related to RF EMF effects (Marino & Carubba, 2009)

Deterministic chaos could be a possible explanation for the inconsistent results (Marino et al., 2000). Embracing this understanding of how the brain functions might facilitate our understanding as to why findings are so inconsistent. Cook (2002) suggested that future studies "might consider augmenting traditional linear analysis with non-linear dynamical methods, as there are indications that the electrical activity of the brain may be governed by chaotic dynamics" (Cook, 2002, pp. 153).

In conclusion, a check-list is one step towards a standardised approach to experiments in cognitive performance. Although this might be useful to assess linear thermal effects, it does not address the complexity of possible RF EMF effects and the non-linear behaviour of non-thermal biological effects.

6.5. Summary of Chapter 6

A check list is proposed for experiments measuring RF EMF exposure involving cognitive performance; the aim of which is to promote consistency in experimental protocol and to contribute to the development of a standardised protocol for future experiments. The check list is used to evaluate the effectiveness of the experimental parameters in the current experiments in Chapter 5. It is found the current experiments have various limitations, some of which are addressed in Experiment 5. It is concluded that although a check list is one step towards a standardised approach to experiments in cognitive performance to address linear thermal effects, it does not address the complexity of non-linear behaviour of non-thermal biological effects.


Mobilephone
Usefulness
Dependency
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music
Relationship
belief
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Facebook
Television
Reliability
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Quantitative
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Interviews
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Chapter7
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Intention
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Determining
Selfreport
Native
calls
Concern
Freedom
Headphones
texts
Networkproviders
Entertainment
Social
Instagram
Young
Use
Digital
Multi-task
Personal
MOPTUM
Enjoyment
Manufacturers
Research
Music
Limitations
Communication
WhatsApp
Photos
EaseofUse
anywhere
Qualitative

Chapter 7

General Discussion

7.1 Introduction

Three research questions have been addressed in this thesis. The first research question considered if there was a dramatic shift in mobile phone usage behaviour and communication. The second research question addressed whether the effects of using a mobile phone posed a health risk to the user. The third research question considered if the effect of radio-frequency electromagnetic radiation affected cognitive performance. The findings in the data would suggest an affirmative reply to each question. Each will now be considered in turn. In addition, a summary is provided of each chapter and the main research findings and outputs are shown in Table 7.1.

Table 7.1. Outline of the Main Findings and the Associated Research Outputs

Chapter	Main findings	Research Outputs
Chapter 1	It is suggested that the mobile phone is a successful gadget due to its portability, multi-functional capacity, and constant accessibility and reachability.	
Chapter 2	Physical, social and cognitive concerns are identified in the literature review.	
Chapter 3	Demographic results show that participants perceive themselves as competent users of technology with 11-14s being the most competent group. Some significant relationships are found between low perceived mobile anxiety and high perceived mobile expertise.	
	Results for mobile phone usage (as shown in the results representing the Mobile Phone Technology Usage model) show reported usage is high with beliefs of perceived usefulness, perceived ease of use and enjoyment	Fowler, J., & Noyes, J., (2014). Attitudes and Use of Mobile Phones in Tweens. In (Eds.) Abram, T., Karowski, W. & Marek, T. *Proceedings of the 5th International Conference on Applied Human Factors and Ergonomics AHFE 2014*, July 23-25, Kraków, Poland.

	being important perceived values for participants. Changes in use are identified over the two-year period.	
	The most reported use of mobile phones is communication, mainly texting. This is shown in the 'like most' responses, the Interpretative Phenomenological Analysis (IPA) and the 'first word' analysis. Interviews show some users think the phone could be addictive and experience feeling dependent on it. 72% of 8-11s left their phone on when they went to sleep. (2013).	Fowler, J., & Noyes, J. (2015). From dialling to tapping: Health considerations for young users of mobile phones. In (Eds.) Arezes. P., Baptista, J.S., Barroso, M.P., Carneiro, P., Costa, N. Melo, R., Miguel, A.S., & Perestrelo, G. (Eds.) *Proceedings of the International Symposium of Occupational Safety and Hygiene, University of Guimaraes*, 115-117.
	Physical: Single digit use for mobile phones was high (23.5% of 8-11s, 44.6% of 11-14s use only thumbs); over a third of 8-11s carried their phone in a pocket and over two thirds of 11-14s. Cognitive: Over half of 11-14s multi-task; 8-11s not asked. Social: Two thirds like to have their phone on all the time.	Fowler, J. (2015). Should we worry about health risks of using mobile phones? Feature Article in *The Ergonomist*, 16-17. Fowler, J., & Noyes, J. (2015). Attitudes of Young Users to Mobile Phones. In (Eds.) Sharples, S. Shorrock, S & Waterson, P. *Proceedings of the Chartered Institute of Ergonomics and Human Factors Contemporary Ergonomics & Human Factors*, 363-371. Taylor & Francis.
	Texting allows time for deliberation whilst calling offers time for a meaningful interaction through the voice.	Fowler, J., & Noyes, J. (2015). From dialling to tapping: University students report on mobile phone use. *6th International Conference on Applied Human Factors and Ergonomics (AHFE 2015) and the Affiliated Conferences, AHFE 2015, Procedia Manufacturing 3, 4716-4723*. Available from www.sciencedirect.com.
	Important characteristics of mobile phone use are identified for this age group, for example, immediacy, compulsion, micro-coordination, and the need to keep up to date. Health hazards identified with mobile phone use. Need for further analysis of time spent on phones.	Fowler, J. (2015). Semi-finalist of 3MT (Three Minute Thesis) competition, Health concerns of mobile phone use amongst young users, University of Bristol. Fowler, J., & Noyes, J., (2017). A Study of the Health Implications of mobile phone use in 8-14s, *DYNA Journal*, 84, 200, 228-233. Available from http://dyna.medellinunal.educ.co/ (Invited Paper)
	Current government guidelines recommend not to use a phone for calls next to the head, not to keep a phone under a pillow or in the bedroom, to text rather than call, to use hand free sets. Assess the level of health awareness.	Fowler, J., Noyes, J., (2017) Are there health risks for teenagers using mobile phones? A study of mobile phone use amongst 14-18s? In Arezes. P., Baptista, J.S., Barroso, M.P., Carneiro, P., Cordeiro, P., Costa, N. Melo, R., Miguel, A.S., Perestrelo, G. (Eds.) SHO'17: *Proceedings of the International Symposium on Occupational Safety and Hygiene, Portuguese Society of Occupational Safety, and Hygiene* 115-117.
	Active promotion and application of the government recommendations.	Fowler, J., Noyes, J., (in press) Are there health risks for teenagers using mobile phones? A study of phones in 14-18 years old users, *International Journal of Occupational & Environmental Safety*, 4 (Invited Paper).
	Screen use ranges from 1 and a half to 10 hours in a day; highest amongst 11-14s. Use is influenced by the weather, weekends or school holidays, boredom.	Fowler, J, Noyes, J., (2017). Using screens: how much time are children and young people spending on technology? In Charles, R., and Wilkinson, J. (Eds.), *Contemporary Ergonomics*

	Many screens are used. No government guidelines in the UK but advice from NICE (National Institute for Health and Care Excellence) recommends TV free days and 2 hours limits of use. Guidelines in the USA have recently changed due to recommendations of the American Academy of Paediatricians proposing a Family Media Use Plan for parents and children (2016).	*and Human Factors: Proceedings of the Chartered Institute of Ergonomics and Human Factors,* Taylor & Francis. Fowler, J. (2017). Using screens: How much time do we spend on Technology? Is this healthy for our children and young people? *The Ergonomist*, Magazine of the CIEHF. Fowler, J. (2017). Young users and screen time. *Poster Presentation: Research Without Borders,* University of Bristol. (Competitive).
Chapter 4	High variability in methodology for experiments investigating cognitive effects of radiofrequency electromagnetic fields (RF EMFs).	Fowler, J., & Noyes, J. (2017) Does mobile phone exposure affect attention and working memory? Oral Presentation. *PsyPAG 31st Annual Conference*, University of York, UK.
Chapter 5	No RF EMF effects in a Stroop Test, a nback task, and a word recall task. A significant effect for match accuracy ($X^2(2)=6.75$, $p=0.03$) in the right hemisphere in a change detection task. Significant difference in a post hoc comparison between the active and control phone condition; Dunn Bonferroni corrected ($Z=2.45$, $p=0.04$). Reaction times (RTs) are faster when the phones are active in a visual detection task. RTs are faster for the active phone over the right hemisphere and in the right visual field. This suggests different causal mechanisms are operating in the right and left hemisphere.	Fowler J. E. N., Noyes J. M. (2019) Does Exposure from the Use of Mobile Phones Affect Lateralised Performance and Mood in a Visual Task? In: Bagnara, S., Tartaglia, R., Albolino S., Alexander, T., Fujita, Y. (Eds) *Proceedings of the 20th Congress of the International Ergonomics Association (IEA 2018*). Advances in Intelligent Systems and Computing, 818, 619-627. Springer. Fowler, J. (2018) Does Exposure from the Use of Mobile Phones Affect Lateralised Performance and Mood in a Visual Task? Poster Presentation: *20th Congress of the International Ergonomics Association,* Firenze, Italy.
Chapter 6	Participants are: 1. Less bored when the phones are active in the left hemisphere. 2. Feel greater sadness in the left hemisphere when the phone is active over the right hemisphere. 3. Less physically fatigued when the phone is active A check list is put forward to encourage a more unified approach to experiments. The check list identifies many limitations in the current 5 experiments in Chapter 5.	Fowler, J., & Noyes, J. (under review) Towards a standardised procedure for investigating the effects of mobile phone exposure on cognitive task performance, *Bioelectromagnetics* (Chapter 4 and 6). *International Journal of Occupational and Environmental Sa*
Chapter 7	RQ1. Technological media is the preferred way of contact to 'face to face' for 8-11s, 11-14s and 18-25s in 2015. 8-11s prefer to talk and 11-14s & 18-25s prefer to text. Overall, data suggests a paradigm shift in the way users communicate. RQ2. Use of mobile phones poses a health risk in many ways. RQ3. Two out of five experiments show that RF EMF exposure from mobile phones affect cognitive performance in a lateralised way.	

7.2 The First Research Question

To answer the first research question, mobile phone usage behaviour was investigated by participants completing three questionnaires and interviews. Questions are guided by The Mobile Phone Technology Usage Model (Van Bijon, 2006). This considered determining and mediating factors for mobile phone usage behaviour and actual system usage as represented by usage breadth, usage intensity and usage variety. Data on communication was elicited from the questionnaires and the interviews. Questions were influenced by previous research of Baron (2008, 2009) and Maddell & Muncer (2004, 200e). MOPTUM considered Perceived Ease of Use, Perceived Usefulness, Attitude, Behavioural Intention and Social Influence. The hypotheses of MOPTUM predicted that these beliefs are necessary for mobile phone use. Users had a positive attitude to mobile use although there were also also negative aspects to use. Social influence was strong and was represented by responses to questions representing the concept. Behavioural intention to use the phone was evident by high ownership amongst all ages and mean responses to questions related to the concept. Mobile phone ownership showed saturation levels of ownership amongst the 18-25s, near saturation for the 11-14s and 14-18s and for the younger users of 8-11, two thirds owned a mobile. The results show that Perceived Ease of Use and Perceived Usefulness were important beliefs for mobile phone use. The results show that Percieved Enjoyment was also an important belief. This was not included in the MOPTUM model. It was suggested, based on the results of the questionnaire and the interviews that Perceived Enjoyment was a factor that needs to be included in a model of mobile phone technology usage for this user group. With the diversification of function of the mobile, Perceived Enjoyment was a belief that was as important as Perceived Ease of Use. The highest mean values were found for Perceived Usefulness and then Perceived Enjoyment, followed by Perceived Ease of Use. However, the mean values for Perceived Ease of Use showed less variability than those for Perceived

Usefulness and Perceived Enjoyment. A triangulation of the quantitative and qualitative results also revealed that Perceived Enjoyment was an important belief. This was supported by the ‘first word’ analysis. Younger users seemed to attach greater importance to Perceived Enjoymnet than older users. ‘Games’ was the second word mentioned after texting in both years and then ‘fun’ by 8-11s. A similar pattern was found for 11-14s but not for 14-18s and 18-25s. For the 14-18s, Perceived Ease of Use was important. This was shown by 14-18s mentioning the word ‘easy’ as the third word in both years whereas for the 18-25s Perceived Usefulnness was an important belief in both years as shown by reference to the words ‘convenient’ and ‘useful’. Communication was still the primary function of the mobile, but functions associated with Perceived Enjoyment have increased in importance, as mobile phone functions have proliferated. Much of the functionality around communication was seeking enjoyment as a primary motivation. The sharing of photos, videos, selfies, text messages, Instagram, Snapchat messages, Whats App and group contact through Facebook were important motivations for ‘social connectedness’ and ‘perpetual contact’ with others. The drive for contact was through a need for social contact and sharing of things that are important to the user. These results show a ‘technological celebration’ of individual and social group enjoyment.

The digital immigrants might ‘grieve’ previous social norms of face to face contact, but the results for these user groups show that contact through technological media has high relevance for the 8-11s,11-14s and 14-18s. For these age groups, technological media is often the preferred way of reported contact to face to face in 2015. The most important way of contact for 8-11s was talking on the mobile and face to face contact was the second most reported; the 11-14s and the 14-18s reported preferring to text rather than have face to face contact. The advantages of contact through texting, instant messaging and social media affords the user with time to think about what the user wants to say and how they want to communicate their message. ‘Techno-contact’ might not persist as the preferred way of contact throughout the life of the user and might be an age specific behaviour. The most desired form of contact was with friends, family and partners, but for 8-11s, 11-14s and 14-18s, ‘techno-contact’ has many advantages. It would be interesting to learn more about this pattern of use. For example, the findings about face to face contact do not reveal whether this change to ‘techno-contact’ is a temporary phenomenon related to the age of the user, or whether it is a changing trend for future usage behaviour. The 18-25 age group reported preferring face to face contact, so the results here seem to suggest that ‘techno-contact’ is a preferred way of communicating in pre-adolescence and adolescence. Alternatively, it could be indicative of the dramatic shift in usage behaviour with reference to usage behaviour and communication.

Immediacy is a concept that was highly valued by young people and evidenced by their ability to dual and multi-task rapidly. The value of immediacy was particularly valued by university students and was evidenced in the IPA, ‘first word’ analysis and interview comments. The approach of young people, as ‘digital natives’, is that of immediacy. Texting and internet applications such as email and WhatsApp, allow instant and immediate responses. Communication was still the biggest affordance of the mobile phone but new ways of communicating continue to evolve through photo exchange, selfies, video exchange, and social media.

Overall, the data collected here showed many changes in mobile phone usage behaviour and communication have occurred, which suggests a dramatic shift in user behaviour in ways of communication.

Methodological Limitations, Insights and Improvements

A strong contribution of this research was the triangulation of the results from the quantitative and qualitative data in the questionnaires and the interviews. This approach is useful to gain a wide range of research scope. Eliciting information through questionnaires allows for a large population sample. Carrying out interviews with a small group of individuals allows the researcher to find out more detailed information and opinions, thus providing an 'enriched' dimension to the investigation.

One limitation of this research was the lack of reliability of using self-report measures. The rigour of the qualitative analysis could have been facilitated by cross-checking with a team of researchers for the creation of categories for the 'like most' and the 'like least' research, the 'first word' analysis and the IPA. Also, the experimental design could be improved by uniformity with the use of the Likert-type Scale. A 3 point-scale was used for the 8-11s and a 5-point scale was used for the 11-25s. In further study, a 7-point scale is recommended to provide greater reliability and scope for comparison. The analysis of Perceived Technological Expertise and Anxiety could be enhanced by investigating predictors of mobile phone ability through regression analysis.

Wider Implications

The findings about mobile phone usage behaviour have wider implications for users, mobile phone manufacturers and network providers for many reasons. It is evident that the mobile phone is an "essential tool" in the lives of young people today and there are many advantages of use. The mobile phone is a "slim", "awesome" gadget that young users have great affinity for. However, there are also many disadvantages. These include the level of dissatisfaction about 'physical issues' to do with mobile phones. This is seen in the factors that users 'like least' about mobile phones. For example, bad signal for use, the life span of the battery, the need to regularly charge the battery. 'Physical issues' constitute a third of responses about what users 'like least' or 11-14s in 2013 and nearly half of responses for what users 'like least' in 2015. In addition, many users' express dissatisfaction with the expense of the phone "and then paying to use it". These issues need to be addressed by the mobile manufacturers and network providers. However, the more serious concerns for users, mobile phone manufacturers and the network providers are the health concerns associated with mobile phone use.

7.3. The Second Research Question

Many health concerns, both physical and cognitive as well as social were identified in the literature review. The results from the questionnaires and the interviews support the second research question of whether the effects of using a mobile phone pose health risks to the user. These include issues with single digit use of the phone, proximity of the phone to the body, excessive screen use, safety, multi-tasking, dependence and addiction. However, user awareness of health concerns is relatively low. This is illustrated in the interviews reported in Chapter 3 and 4. Users do not want to think about the health concerns because they like using their phones so much. However, behavioural awareness and change with smoking habits has been apparent over the last decade and might have relevance for mobile phone users in the future (Fowler & Noyes, 2015).

Wider Implications

A recent Tweet from the Environmental Health Trust (Devra, August 15, 2018) discusses intentions to reduce cell phone radiation in the U.S. As discussed in Chapter 1, many countries offer guidelines on restricting use of phones for children and ways to avoid direct exposure to the body and head as a precautionary measure against possible ill health effects. In April 2018, the International Agency for Research on Cancer (IARC) reported a global increase of 13% in childhood cancer incidence (Devra, 2018). Many of these childhood cancers are gliomas, a common malignant brain tumor. In the UK, rates of gliomas have increased, especially amongst regular mobile phone users (Moskowitz, 2018). There has been research on general environmental factors that might be contributing to the increase in the incidence in childhood cancer (Knapton, 2016). The effects of mobile phone radiation are a possible factor (Devra, 2018; Hardell & Cardell, 2015; Moskowitz, 2018). Moskowitz (2018) recalls the conclusions of Hardell and Cardell's work that the increase in brain tumours "may be explained by higher risk for brain tumor in subjects with first use of a wireless phone before the age of 20 years taking a reasonable latency period." (Hardell & Cardell, 2015, p. 3).

7.3. The Third Research Question

Following the findings of health concerns with reference to mobile phones, further exploration revealed that RF EMF effects could affect cognitive performance. Many inconsistencies amongst empirical studies are identified and these are discussed in the review in Chapter 4. Some studies found a significant effect of exposure and some did not. Although, cognitive performance change has not always been recorded in studies, neuro-physiological changes have been shown with EEG or neuro-imaging analysis. It is suggested that the third research question of whether the effect of radio-frequency electromagnetic radiation affects cognitive performance is supported by the results.

Methodological Limitations, Insights and Improvements

Five experiments are carried out to investigate the effect of RF EMF exposure on attention and memory. Two out of the five experiments suggested a lateralized effect of mobile phone exposure. The change detection task found an effect of change accuracy performance in the right hemisphere. However, this result is only just significant with Dunn-Bonferonni correction. With Bonferonni correction, significance is not shown. The experiment needs replication to be certain that the response was not due to chance. It also needs to be of longer duration as the task was only twelve minutes long. The visual dot detection task found an effect in the right hemisphere and in the right visual field. The reaction times are faster for the active phone positioned over the right hemisphere and in the right visual field than when the phone was in the active phone condition over the right hemisphere and in the left visual field. When the active phone was positioned over the left hemisphere, reaction time was slower in the right visual field. Participants reported greater sadness when the active phone was over the left hemisphere than when the active phone was over the right hemisphere. They are also less bored when the phones are active and less physically fatigued when the phones are active. Previous research has found transient sadness and happiness affected different brain regions in divergent directions (George et al., 1995). The conclusions from these significant results are that mobile phone exposure creates a mood effect and especially over the left hemisphere. Greater confidence can be seen in the results of this experiment as it used a within participant design and the experimental design is more robust. However, the sample size of 48 participants is small. To have greater confidence in the results, the experiment needs to be replicated with a larger sample size. In addition, it would be interesting to see if the results can be replicated with a double-blind design and adhering to the points identified in the check-list presented in Chapter 6.

Wider Implications

There are many factors that could influence whether a significant impact of RF EMF exposure on condition and hemisphere is found; these are discussed in Chapter 4. The mobile phone comes into proximity with the head and in the light of the links that have been observed for a range of tumours (Loon et al., 2009 Sadetski et al., 2008, Tinniswood, et al.) and potential effects on the brain (Utton, 2017), this is an area of research that cannot be ignored. It has critical public health significance. The aim of the check-list proposed for future experimental work is to contribute towards an international standardised protocol for development by the World Health Organisation. Chapter 5 concluded that a standardised protocol might be useful to assess linear thermal effects, but it does not address the complexity of possible RF EMF effects and the non-linear behaviour of non-thermal biological effects.

One problem that has pervaded empirical studies on the effects of RF EMFs is the lack of the ability to replicate data. If, however, the RF EMF effects are small, subtle and variable, results might be difficult to replicate. With reference to the Popperian philosophy of science, the falsification principles of science would suggest that if one study makes a finding, we should err on the side of caution, particularly as the replication and validation of these studies has far reaching public health consequences.

7.4 Future Directions

There are many areas of concern relating to mobile phone use, and the research carried out left many areas untouched. For example, in the areas of safety, excessive screen use, dependence, addiction, multi-tasking and dependence, further experimental investigation is needed to contribute to understanding these areas. There is much scope for further study around multi-tasking with a mobile phone. Further research with use of the media use questionnaire (Ophir, et al., 2009) could extend understanding of multi-tasking behaviour and experimental investigation assessing cognitive advantage or detriment with this behaviour. This could extend understanding of the effect of media multi-tasking on executive control function. Another area of future study is to further investigate dependent behaviour to shed light on user motivations for this. Further breakdown of some of the categories created in the qualitative analysis would provide more 'in depth' knowledge, for example, the paradoxical attitudes around use. One area is to do with the freedom experienced from being able to be contacted 'anytime, anywhere', but at the same time users feeling a sense of entrapment and compulsion associated with this 'freedom'. The need to have the phone on in case a message is missed and leaving the phone on overnight so as not to miss the call or text. Another area that deserves further study is 'appropriate behaviour' and social etiquette around mobile phone use. For example, whether it is acceptable to have private calls in public places. Many cultural variations have been found in previous studies, specific to cultural norms in different countries (Baron, 2008) A wider implication of use is that of education and awareness for 'safe' use of mobile phones. Government guidelines in the UK recommend use of headphones so the head does not come into direct contact with the head of the user, texting rather talking. It is recommended that if a call must be made, it is kept to a short length of time, but preferably use only in an emergency. However, it is likely many people are unaware of these recommendations.

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APPENDICES

Appendix A

Questionnaire 1: How do you feel about mobile phones?

These questions are part of a research project at Bristol looking into how young people feel about mobile phones. The questionnaire will only be used for research purposes and information will be treated with respect and in confidence. Please answer all the questions. There are no right or wrong answers to these questions. Please ask for help if you need to.

Part A: About you

1. What are the first 3 words that come to mind when you think of mobile phones?

1.
2.
3.

2. What do you like most about mobile phones? ☺

3. What do you like least about mobile phones? ☹

4. Do you get a chance to use a mobile phone?

Yes 1	
No 2	

5. Do you own a mobile phone?

Yes 1	
No 2	

6. If yes, what make of phone do you own? If no, go to Question 8.

Make	

7. If yes, how is your phone paid for?

Pay as you go 1	
Contract 2	
Don't know 3	

8. When on the move where do you keep a mobile phone?

In a bag 1	
In a pocket 2	
Slung on a belt 3	
In my hand 4	
Other. If yes, please say where you keep a mobile phone. 5	

9. Do you use your finger or thumbs when you use a mobile phone?

Fingers 1	
Thumbs 2	
Fingers and thumbs 3	
Other (Please say) 4	

10. When you use a mobile phone, do you do anything else at the same time?

Yes 1	
No 2	

11. If yes, please say what task you carry out. If your answer was No to Question 10, go to Question 12

12. What electronic gadgets do you have access to? Please answer Yes or No

	Electronic Gadget	Yes [1]	No [2]
a	Mobile Phone		
b	Laptop computer		
c	MP3 player		
d	IPOD Touch		
e	Game Console		
f	E book reader		
g	Tablet		
h	Other		

13. Do you own any of the following electronic gadgets? Please answer Yes or No

	Electronic Gadget	Yes [1]	No [2]
a	Mobile Phone		
b	Laptop computer		
c	MP3 player		
d	IPOD Touch		
e	Game Console		
f	E book reader		
g	Tablet		
h	Other		

14. Please tick to say what year group you are

Year 7 1	
Year 8 2	
Year 9 3	

15. Please tick to say if you are a girl or a boy

Girl 1	
Boy 2	

16. Please tick which school you go to

Ansford	
St Dunstans	
Stanchester	

Part B: Using Mobile phones

1. Using a mobile phone – Please tick the statement that best matches what you can do on a mobile phone. Please ONLY tick one statement.

I can learn how to use new mobile phone functions by myself	1
I can carry out specialised tasks on a mobile phone, e.g., updating my phone, Bluetooth	2
I can carry out a range of mobile phone tasks, for example, listening to music, taking photos, calling, texting.	3
I can do simple things on a mobile phone, e.g., making a calling or texting	4
I have never used a mobile phone	5

2. How do you feel about mobile phones? Please tick the statement that best matches what you feel about mobile phones. ONLY tick one statement

I like to find out about the latest model of mobile phone as soon as it is released	1
I like to find out about new models of mobile phone	2
I like using a mobile phone, but I like to wait & see how other people use it before I do	3
I don't like using a mobile phone and wait to see how other people use it before I do	4
I am not interested in using mobile phones and try to avoid using them	5

3. Please tick the appropriate boxes to say whether you agree or disagree with these statements about mobile phones.

	Agree ☺ or disagree ☹	Strongly Agree 1 ☺☺	Agree 2 ☺	Neither agree nor disagree 3	Disagree 4 ☺	Strongly disagree 5 ☺☺
a	I am an experienced user of mobile phones					
b	Mobile phones are fun to use					
c	My mobile makes my life easier					
d	Using mobiles is frustrating					
e	I feel confident using a mobile					
f	I can make my mobile do what I want it to do					
g	I look forward to using a mobile phone					
h	Anyone can learn to use a mobile if they are patient and motivated					
i	Learning to use a mobile phone is exciting					
j	I am confident that I can learn new mobile skills					
k	I am afraid that if I use mobiles more I will become dependent on them					
l	Learning to use a mobile is like any new skill – the more you practice the better you become					
m	I feel that I will be able to keep up with advances in the mobile field					
n	I dislike working with machines that are smarter than I am					

	Agree ☺ or disagree ☹	Strongly Agree 1 ☺☺	Agree 2 ☺	Neither agree nor disagree 3	Disagree 4 ☺	Strongly disagree 5 ☺☺
o	I feel apprehensive about using mobile phones					
p	I have difficulty understanding some of the functions on a mobile phone					
q	I hesitate to use a mobile phone in case I make mistakes					
r	You have to be a genius to learn all the functions on the mobile					
s	I would like to know more about mobile phones in order to use them more					

Thank you for completing this questionnaire – your answers are very much appreciated.

Jo Fowler

Questionnaire 2: Using a mobile phone

Part A: About your phone These questions are part of a research project at Bristol looking into how young people feel about mobile phones. The questionnaire will be used for research purposes only. Confidentiality will be maintained in the research. Please answer all the questions. There are no right or wrong answers to the questions. Please ask for help if you need to.

1. How important do you think these things are if you buy a mobile phone?

	Features	Very important 1	Quite important 2	Not important 3
A	Brand			
B	Model			
C	"Look and feel"			
D	Easy to use			
E	Cost			
F	Network Coverage			
G	Accessories			
H	Quality			

2. Who do you contact on a mobile?

	People I contact	More than Once a day 1	Once a day 2	Once a week 3
A	I contact my friends			
B	I contact my parent or guardian			
C	I contact my brother or sister			
D	Other (please say)			

3. Saving numbers on your phone

How many phone numbers do you have saved on your mobile?	

4. Do you like to keep your phone on?

	On or Off	Always 1	Sometimes 2	Never 3
A	I like to have my phone on all the time			
B	I like to be able to be texted or called at all times			
C	I like to be able to use my phone to keep in touch no matter where I am			
D	I sleep with my phone next to my bed			
E	I sleep with my phone on			
F	I turn my phone off when I go to bed			

5. How do you like to contact people?

	I like to contact people by:	Mostly 1	Sometimes 2	Never 3
A	Talking on a mobile			
B	Talking face to face			
C	Texting on a mobile			
D	Emailing on a mobile			
E	Emailing on a laptop			
F	Skype			
G	Landline			
H	Using facebook			
I	Other			

6. What do you use a mobile for?

	I use a mobile to:	Often 1	Sometimes 2	Never 3
A	Make and receive calls			
B	Send and receive texts			
C	Exchange photos			
D	Record a video			
E	Exchange a video			
F	Use the internet			
G	Send and receive email			
H	Play games			
I	Download ring tones			
J	Download apps.			
K	Play music			
L	Set my alarm			
M	Other			
N	Go on Twitter			
O	Go on Facebook			
P	Blog			
Q	Go on other social networks sites (Please say which sites)			

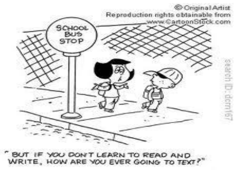
7. Making calls

How many calls do you make on a mobile in a day?	

8. What do you call for?

	Reasons for making a call	Often 1	Sometimes 2	Never 3
A	I use my mobile to call my friends to say hello and chat			
B	I call my friends to keep in touch			
C	I call my friends to talk about how I feel			
D	I call my family to keep in touch			
E	I call to say where I am or check where someone else is			
F	I call if there is an emergency			

9. Texting on a mobile



How many texts do you make on a mobile in a day?	

10. Why do you text?

	Reasons for texting	Often 1	Sometimes 2	Never 3
A	I text my friends to say Hello			
B	I text my friends to keep in touch			
C	I text my family to keep in touch			
D	I text to say where I am or check where someone else is			
E	If I get a cool text I send it to another friend			
F	I text if there is an emergency			
G	I text because it is too expensive to ring			

11. Do you use applications on a mobile?

Yes	
No	

12. If yes, what applications do you download?

	I download the following applications:	Yes 1	No 2
A	You Tube		
B	Games		
C	Sport		
D	News		
E	Shopping		
F	Calculator		
G	Other (please say what application you use if you tick this box)		

13. Please tick how important you find the mobile phone for the following:

Mobile Phone Use	Very important	Important	Nice to have	Not important	Totally unimportant
a. Talking or texting with friends & family					
b. Organizing & arranging meeting with friends and family					
c. Finding out travel directions					
d. Finding out personal information, e.g., phone book, reminders					
e. Finding out non-personal information					
f. Buying things					
g. Looking good because you have a cool phone					
h. Entertainment, for example, listening to music or playing games					
i. Feeling safe because of being able to use the mobile phone in an emergency					
j. Being able to save personal messages & photos					

14. Please order which mobile phone use you find the most important (10) to the least important use (1). You can only use each value once.

Mobile phone use	1	2	3	4	5	6	7	8	9	10
a. Talking or texting with friends										
b. Organizing and arranging meetings with friends & family										
c. Finding out travel directions										
d. Finding out personal information, e.g. phone books, reminders										
e. Finding out non-personal information										
f. Buying things										
g. Looking good because you have a cool phone										
h. Entertainment, for example, listening to music or playing games										
i. Feeling safe because of being able to use the phone in an emergency										
j. Being able to save personal messages & photos										

15. Please tick to say what year group you are

Year 7 1	
Year 8 2	
Year 9 3	

16. Please tick to say if you are a girl or a boy

Girl 1	
Boy 2	

Part B: What do you think about mobile phones?

Do you agree with these statements or disagree? Please tick the appropriate box.	Strongly Agree 5 ☺☺	Agree 4 ☺	Neither Agree nor disagree 3	Disagree 2 ☹	Strongly disagree 1 ☹☹
1. I find mobile phones easy to use					
2. I think using a mobile phone is a bad idea					
3. I feel happy when I get a text					
4. The mobile phone I choose and the way I use it is a way of showing who I am					
5. I feel bad when no-one rings me					
6. I like to have my mobile phone with me in case of an emergency					
7. I find it easy to get a mobile phone to do what I want					
8. I think using a mobile phone is a good idea					
9. I feel annoyed when a call or text interrupts me					
10. Using a mobile phone helps me to learn well					
11. I feel happy when my mobile phone rings					
12. Having my mobile phone with me makes me feel safe					
13. A mobile phone helps me to get things done quickly					
14. I feel bad when no-one texts					
Do you agree with these statements or disagree? Please tick the appropriate box.	Strongly Agree 5 ☺☺	Agree 4 ☺	Neither Agree nor disagree 3	Disagree 2 ☹	Strongly disagree 1 ☹☹

15. I use my mobile phone to manage my school/college work					
16. I use my mobile to find out information					
17. I like to be able to use my mobile to change plans quickly					
18. I use my mobile phone to arrange when and where I am going to meet friends					
19. I use a mobile phone to store phone numbers and birthdays					
20. I sometimes call friends to change the time I am meeting them					
21. I use my mobile phone when I go shopping with a friend					
22. I choose a particular mobile phone to be cool					
23. I use a mobile phone to listen to music or play games					
24. My mobile phone is useful in improving my self-image					
25. I collect photos, letters, notes on my mobile					
26. Learning to operate a mobile phone was easy for me					
27. My mobile says something about my image					
28. I use my phone to help me with my homework					

Do you agree with these statements or disagree? Please tick the appropriate box.	Strongly Agree 5 ☺☺	Agree4 ☺	Neither Agree nor disagree3	Disagree 2 ☹	Strongly disagree1 ☹☹
29. Having a funky or cool phone makes me feel good					
30. I use my mobile to save messages and photos					
31. I find the call log on my mobile to see who has called me					
32. I use a mobile to find out things					

Thank you for completing this questionnaire – your answers are very much appreciated.

Jo Fowler

Questionnaire 3

What do you think about technology, laptops, the internet and tablets?

Questionnaire 3

What do you think about technology, laptops, the internet & tablets?

These questions are part of a research project at Bristol looking into what young people think about technology. The questionnaire will be used for research purposes only. Confidentiality will be maintained in the research. Please answer all the questions. There are no right or wrong answers to the questions. Please ask for help if you need to.

A. Using technology

Please tick which statement describes how you feel about technology: ONLY tick one statement please.

I am a "techie" and like to explore and use new technology as soon as it appears.	5
I am not a technologist, but I like to find out about and use new technology.	4
I am fairly comfortable with technology but wait to find out how other people are using the technology before I use it.	3
I am not comfortable with technology and wait to see how other people are using the technology before I use it.	2
I am not interested in technology and try to avoid using it	1

B. Using laptop computers

1. Please tick the statement that best matches what you can do on a laptop. Only tick one statement.

I can learn new laptop skills by myself 5	
I can carry out specialised laptop tasks 4	
I can carry out general laptop tasks 3	
I can do simple. Repetitive tasks on a laptop 2	
I have never used a laptop 1	

2. Please tick the appropriate boxes to say whether you agree or disagree with these statements about laptops.

	Agree or Disagree	Strongly agree 5	Agree 4	Neither agree nor disagree 3	Disagree 2	Strongly Disagree 1
a	I am an experienced user of laptops					
b	Laptops are fun to use					
c	My laptop makes my life easier					
d	Using laptops is frustrating					
e	I feel confident using a laptop					
f	I can make my laptop do what I want it to do					
g	I look forward to using a laptop					
h	Anyone can learn to use a laptop if they are patient and motivated					
I	Learning to use a laptop is exciting					
j	I am confident that I can learn new laptop skills					
k	I am afraid that if I use laptops more I will become dependent on them					
l	Learning to use a laptop is like any new skill – the more you practice the better you become					
m	I feel that I will be able to keep up with advances with laptops					
n	I feel apprehensive about using laptops					
o	I have difficulty understanding some of the functions on a laptop					

C. Using the internet

1. Please tick the statement that best matches what you can do on the internet

I can learn new internet skills by myself	
I can carry out specialised internet tasks	
I can carry out general internet tasks	
I can do simple repetitive tasks on the internet	
I have never used the internet	

2. Please tick the appropriate boxes to say whether you agree or disagree with these statements about the internet.

	Agree or Disagree	Strongly agree 5	Agree 4	Neither agree nor disagree 3	Disagree 2	Strongly Disagree 1
a	I am an experienced user of the internet					
b	The internet is fun to use					
c	The internet makes my life easier					
d	Using the internet is frustrating					
e	I feel confident using the internet					
f	I can make the internet do what I want it to do					
g	I look forward to using the internet					
h	Anyone can learn to use the internet if they are patient and motivated					
i	Learning to use the internet is exciting					
j	I am confident that I can learn new internet skills					
k	I am afraid that if I use the internet more I will become dependent on it					
l	Learning to use the internet is like any new skill – the more you practice the better you become					
	Agree or Disagree	Strongly agree 5	Agree 4	Neither agree nor disagree 3	Disagree 2	Strongly disagree 1

m	I feel that I will be able to keep up with advances with the internet					
n	I feel apprehensive about using the internet					
o	I have difficulty understanding some of the functions on the internet					

D. Using a tablet 1. Please tick the statement that best matches what you can do on a tablet

I can learn new tablet skills by myself 5	
I can carry out specialised tablet tasks 4	
I can carry out general tablet tasks 3	
I can do simple. repetitive tasks on a tablet 2	
I have never used a tablet 1	

2. Please tick the appropriate boxes to say whether you agree or disagree with these statements about tablets.

	Agree or Disagree	Strongly agree 5	Agree 4	Neither agree nor disagree 3	Disagree 2	Strongly Disagree 1
a	I am an experienced user of tablets					
b	Tablets are fun to use					
c	My tablet makes my life easier					
d	Using tablets is frustrating					
e	I feel confident using a tablet					
h	I can make my tablet do what I want it to do					
g	I look forward to using a tablet					
h	Anyone can learn to use a tablet if they are patient and motivated					
i	Learning to use a tablet is exciting					
	Agree or disagree	Strongly agree 1	Agree 2	Neither agree nor disagree 3	Disagree 4	Strongly Disagree 5
J	I am confident that I can learn new tablet skills					

K	I am afraid that if I use tablets more I will become dependent on them					
l	Learning to use a tablet is like any new skill – the more you practice the better you become					
m	I feel that I will be able to keep up with advances with tablets					
n	I feel apprehensive about using tablets					
o	I have difficulty understanding some of the functions on a tablet					

Thank you for completing this questionnaire – your answers are very much appreciated.

[redacted]

Appendix B

Pearsons Product Moment Correlations for the Constructs of Perceived Ease of Use

8-11s

Table 1

The 8-11 Age Group: Correlations for Perceived Ease of Use (PEU) in 2013

Measures	(1)	(2)	(3)	(4)
(1) I find mobile phones easy to use				
(2) I find it easy to get a mobile phone to do what I want it to do	.20*			
(3) A mobile phone helps me to get things done quickly	.04	.2*		
(4) Learning to operate a mobile was easy for me	.2	.19*	.14	

N=136**p>.01 (2-tailed) *p>.05 (2-tailed)

Table 2

The 8-11 Age Group: Correlations for Perceived Ease of Use (PEU) in 2015

Measures	(1)	(2)	(3)	(4)
(1) I find mobile phones easy to use				
(2) I find it easy to get a mobile phone to do what I want it to do	.46**			
(3) A mobile phone helps me to get things done quickly	.45**	.47**		
(4) Learning to operate a mobile was easy for me	.35**	.48**	.44	

N=136**p>.01 (2-tailed) *p>.05 (2-tailed)

11-14s

Table 3

The 11-14 Age Group Correlations for PEU in 2013

Measures	(1)	(2)	(3)	(4)
(1) I find mobile phones easy to use				
(2) I find it easy to get a mobile phone to do what I want it to do	.43**			
(3) A mobile phone helps me to get things done quickly	.53**	.46**		
(4) Learning to operate a mobile was easy for me	.71**	.53**	.45**	

N=136**p>.01 (2-tailed) *p>.05 (2-tailed)

Table 4

The 11-14 Age Group Correlations for PEU in 2015

Measures	(1)	(2)	(3)	(4)
(1) I find mobile phones easy to use				
(2) I find it easy to get a mobile phone to do what I want it to do	.22**			
(3) A mobile phone helps me to get things done quickly	.12**	.46**		
(4) Learning to operate a mobile was easy for me	.22**	.60**	.47**	

N=136**p>.01 (2-tailed) *p>.05 (2-tailed)

14-18s

Table 5

The 14-18 Age Group Correlations for PEU in 2013

Measures	(1)	(2)	(3)	(4)
(1) I find mobile phones easy to use				
(2) I find it easy to get a mobile phone to do what I want it to do	.43**			
(3) A mobile phone helps me to get things done quickly	.47**	.51**		
(4) Learning to operate a mobile was easy for me	.26**	.37**	.23**	

N=136**p>.01 (2-tailed) *p>.05 (2-tailed)

Table 6

The 14-18 Age Group Correlations for PEU in 2015

Measures	(1)	(2)	(3)	(4)
(1) I find mobile phones easy to use				
(2) I find it easy to get a mobile phone to do what I want it to do	.67**			
(3) A mobile phone helps me to get things done quickly	.53**	.58**		
(4) Learning to operate a mobile was easy for me	.22**	.41**	.18**	

N=136**p>.01 (2-tailed) *p>.05 (2-tailed)

18-25s

Table 7
The 18-25 Age Group Correlations for PEU in 2013

Measures	(1)	(2)	(3)	(4)
(1) I find mobile phones easy to use				
(2) I find it easy to get a mobile phone to do what I want it to do	-.06**			
(3) A mobile phone helps me to get things done quickly	.08	.01		
(4) Learning to operate a mobile was easy for me	.05	-.03	-.05	

N=218 **p>.01 (2-tailed) *p>.05 (2-tailed)

Table 8
The 18-25 Age Group Correlations for PEU in 2015

Measures	(1)	(2)	(3)	(4)
(1) I find mobile phones easy to use				
(2) I find it easy to get a mobile phone to do what I want it to do	.92			
(3) A mobile phone helps me to get things done quickly	.02	.-.09		
(4) Learning to operate a mobile was easy for me	.17**	.04	.09	

N=278 **p>.01 (2-tailed)

Appendix C

Pearsons Product Moment Correlations for the Constructs of Perceived Usefulness

8-11s

Table 1
Pearson Product Moment Correlations between questions on Perceived Usefulness for 8-11-s in 2013

Measures	(1)	(2)	(3)	(4)	(5)
(1) Using a mobile phone helps me learn well.					
(2). A mobile phone helps me get things done quickly	.21**				
(3). I use my mobile phone to manage my school work	1.0	.22**			
(4) I use my mobile to find out information.	.24**	.2*	.36**		
(5). I use my mobile phone to help me with my homework	.15	.04	-.04	.07	

N=168**p>.01 (2-tailed) *p>.05 (2-tailed)

Table 2
Pearson Product Moment Correlations between questions on Perceived Usefulness for 8-11s in 2015

Measures	(1)	(2)	(3)	(4)	(5)
(1) Using a mobile phone helps me learn well.					
(2). A mobile phone helps me get things done quickly	.56**				
(3). I use my mobile phone to manage my school work	.50**	.32**			
(4) I use my mobile to find out information.	.57**	.54**	.34**		
(5). I use my mobile phone to help me with my homework	.35**	.4**	.54**	.41**	

N=208 **p>.01 (2-tailed)

11-14s

Table 3

Pearson Product Moment Correlations between questions on Perceived Usefulness for 11-14s in 2013

Measures	(1)	(2)	(3)	(4)	(5)
(1) Using a mobile phone helps me learn well.					
(2). A mobile phone helps me get things done quickly	.23**				
(3). I use my mobile phone to manage my school work	.52**	.12**			
(4) I use my mobile to find out information.	.47**	.19*	.53**		
(5). I use my mobile phone to help me with my homework	.5**	.17*	.58**	.54**	

N=168**p>.01 (2-tailed) *p>.05 (2-tailed)

Table 4

Pearson Product Moment Correlations between questions on Perceived Usefulness for 11-14s in 2015

Measures	(1)	(2)	(3)	(4)	(5)
(1) Using a mobile phone helps me learn well.					
(2). A mobile phone helps me get things done quickly	.46**				
(3). I use my mobile phone to manage my school work	.45**	.23**			
(4) I use my mobile to find out information.	.26**	.34**	.46**		
(5). I use my mobile phone to help me with my homework	.38**	.41**	.46**	.35**	

N=208 **p>.01 (2-tailed)

14-18s

Table 5

Pearson Product Moment Correlations between questions on Perceived Usefulness for 14-18s in 2013

Measures	(1)	(2)	(3)	(4)	(5)
(1) Using a mobile phone helps me learn well.					
(2). A mobile phone helps me get things done quickly	.36**				
(3). I use my mobile phone to manage my school work	.44**	.25**			
(4) I use my mobile to find out information.	.38**	.3*	.46**		
(5). I use my mobile phone to help me with my homework	.5**	.32*	.54**	.36**	

N=164**p>.01 (2-tailed) *p>.05 (2-tailed)

Table 6

Pearson Product Moment Correlations between questions on Perceived Usefulness for 14-18s in 2015

Measures	(1)	(2)	(3)	(4)	(5)
(1) Using a mobile phone helps me learn well.					
(2). A mobile phone helps me get things done quickly	.26**				
(3). I use my mobile phone to manage my school work	.45**	.25**			
(4) I use my mobile to find out information.	.57**	.61**	.35**		
(5). I use my mobile phone to help me with my homework	.48**	.37**	.74**	.34**	

N=168 **p>.01 (2-tailed)

18-25s

Table 7

Pearson Product Moment Correlations between questions on Perceived Usefulness for 18-25s in 2013

Measures	(1)	(2)	(3)	(4)	(5)
(1) Using a mobile phone helps me learn well.					
(2). A mobile phone helps me get things done quickly	.03				
(3). I use my mobile phone to manage my school work	.07	.01			
(4) I use my mobile to find out information.	.13	.01	.3**		
(5). I use my mobile phone to help me with my homework	.03	.05	.01	-.12	

N=218 **p>.01 (2-tailed)

Table 8

Pearson Product Moment Correlations between questions on Perceived Usefulness for 18-25s in 2015

Measures	(1)	(2)	(3)	(4)	(5)
(1) Using a mobile phone helps me learn well.					
(2). A mobile phone helps me get things done quickly	.36**				
(3). I use my mobile phone to manage my school work	.44**	.25**			
(4) I use my mobile to find out information.	.38**	.3*	.46**		
(5). I use my mobile phone to help me with my homework	.5**	.32*	.54**	.36**	

N=164**p>.01 (2-tailed) *p>.05 (2-tailed)

Appendix D

Pearsons Product Moment Correlations for all Age Groups for the Constructs of Perceived Expertise and Perceived Anxiety

Table 1

Pearson's product moment correlations for significant results for self-reported expertise, anxiety rating, technological advancement levels for the mobile phone, tablet, internet and laptop, and technological advancement and technological orientation for technology in general in 8-11s

	'r' values		
	Both	2013	2015
1.Mobile expertise x Mobile advancement	.22**	.19*	.22**
2.Mobile expertise x Laptop expertise	.25**	1**	.25**
3.Mobile expertise x Internet expertise	.19*	.13	-.13*
4.Mobile expertise x Tablet expertise	-.21*	-.28**	-.25**
5. Mobile anxiety x Laptop anxiety	.19*	.17*	-.05
6. Mobile anxiety x Internet anxiety	.13	1**	.99**
7. Mobile anxiety x Tablet anxiety	.18*	-.21**	-.04
8.Laptop expertise x Mobile advancement	.01	.19*	.14*
9.Laptop expertise x Tablet advancement	.19*	-.08	-.10
10.Laptop expertise x Internet expertise	.4**	.13	.16**
11.Laptop expertise x Tablet expertise	.35**	.28**	.23**
12.Laptop anxiety x Mobile orientation	-.16	-.05	.12*
13.Laptop anxiety x Laptop advancement	.14	.24**	.06
14.Laptop anxiety x Internet advancement	-.04	.18*	.1
15.Internet expertise x Internet anxiety	.06	.42**	.32**
16.Internet expertise x Technology advancement	.08	-.22**	.02
Internet expertise x Mobile orientation	-.01	-.01	.28**
17.Internet expertise x Laptop advancement	.03	.01	.18**
18.Internet expertise x Laptop expertise	.18**	.04	.26**
19.Internet expertise x Tablet expertise	.7**	.52**	.5**
32.Internet expertise x Internet anxiety	.37**	.20**	.37**
21.Internet expertise x Tablet anxiety	-.01	.33**	.17**
22.Internet anxiety x Laptop advancement	-.01	-.13	.12*
23.Internet anxiety x Internet advancement	.07	.32**	.22**
24.Internet anxiety x Tablet advancement	.7**	.20**	.43**
25.Internet anxiety x Tablet anxiety	.28**	.28**	.28**
26.Tablet expertise x Technology advancement	.05	.32**	.19**
27.Tablet expertise x Tablet anxiety	-.3**	.29**	.22**
28.Tablet expertise x Laptop advancement	.16*	.25**	.22**
29.Tablet expertise x Internet anxiety	.29**	.58**	.48**
30.Tablet expertise x Tablet advancement	.08	.26**	-.19**
31.Tablet anxiety x Tablet advancement	.16	.11	.12*

Correlation is significant at the 0.01 level (2 tailed) ** Correlation is significant at the 0.05 level (2 tailed) *

Table 2
Pearson's product moment correlations for significant results for self-reported expertise, anxiety rating, technological advancement levels for the mobile phone, tablet, internet and laptop, and technological advancement and technological orientation for technology in general in 11-14s

	'r' values		
	Both	2013	2015
1.Mobile expertise x Mobile advancement	.10	.27**	.19
2.Mobile expertise x Mobile orientation	.21**	.02	.38**
3.Mobile expertise x Mobile anxiety	.51**	.36**	.60**
4.Mobile anxiety x Internet anxiety	.11*	.13	.09
5.Mobile advancement x Internet advancement	.17	.15*	.11
6.Mobile advancement x Mobile orientation	.01*	.23	.18*
7.Mobile advancement x Technology advancement	.16	.15*	.11
8.Laptop expertise x Internet anxiety	.32**	.11**	.52**
9.Laptop expertise x Laptop anxiety	.01**	.11	.59**
10.Laptop expertise x Laptop advancement	.26**	.23**	.30**
11.Laptop expertise x Internet advancement	.31**	.34**	.31**
12.Laptop expertise x Tablet advancement	.17**	.18**	.20**
13.Laptop anxiety x Internet anxiety	.51**	.34**	.59**
14.Laptop anxiety x Laptop advancement	.20**	.15	.24**
15.Laptop anxiety x Internet advancement	.31	.44**	.24**
16.Laptop anxiety x Technology advancement	.08	.29**	.31**
17.Laptop advancement x Technology advancement	.34**	.23**	.41**
18.Internet expertise x Internet anxiety	.25**	.45**	.22**
19.Internet expertise x Internet advancement	.01**	.33**	.13
20.Internet expertise x Laptop advancement	.19**	.04	.25**
21.Internet expertise x Technology advancement	.03**	.20*	.17**
22.Internet anxiety x Laptop advancement	.18**	.04	.26**
23.Internet anxiety x Internet advancement	.28	.33**	.26**
24.Internet anxiety x Tablet advancement	.01**	.11	.32**
25.Internet anxiety x Technology advancement	.28**	.18*	.32**
26.Internet advancement x Technology advancement	.25**	.09	.34**
27.Tablet expertise x Laptop anxiety	.15*	.05	.16*
28.Tablet expertise x Tablet anxiety	.66**	-.35	.21
29.Tablet expertise x Laptop advancement	.16*	-.43	.20**
30.Tablet expertise x Internet advancement	.18**	-.35	.21
31.Tablet anxiety x Laptop advancement	.25	-.6	.7**
32.Tablet anxiety x Internet advancement	-.34	.19**	.18
33.Tablet x Technology advancement	.16**	.20**	.14*

Correlation is significant at the 0.01 level (2 tailed) ** Correlation is significant at the 0.05 level (2 tailed) *

Table 3
Pearson's product moment correlations for significant results for self-reported expertise, anxiety rating, technological advancement levels for the mobile phone, tablet, internet and laptop, and technological advancement and technological orientation for technology in general in 14-18s

	'r' values		
	2013	2015	Both
1.Mobile expertise x Technology advancement	.38**	.29**	.33**
2.Mobile expertise x Mobile advancement	.3**	.2**	.13
3.Mobile expertise x Mobile orientation	.38**	.29**	.33**
4.Mobile expertise x Internet advancement	-.32*	-.13*	-.01
5.Mobile expertise x Tablet advancement	-.40**	-.16**	.07
6.Mobile expertise x Laptop expertise	.99**	.99**	.98**
7.Mobile expertise x Internet expertise	-.16*	-.08	.04
9.Mobile expertise x Mobile anxiety	-.17**	.01	.32**
10.Mobile expertise x Laptop anxiety	-.17*	-.01	.29**
11. Mobile anxiety x Technology advancement	.01	-.16*	-.02
13. Mobile anxiety x Internet advancement	.13	.09	.11*
14. Mobile anxiety x Laptop expertise	.23	.18*	.01*
15. Mobile anxiety x Laptop anxiety	1**	.99**	.99**
16.Laptop expertise x Internet advancement	-.32**	-.15**	-.01
17.Laptop expertise x Tablet advancement	-.42**	-.18**	.07
18.Laptop expertise x Laptop anxiety	-.06**	.14*	.4**
19.Laptop expertise Internet anxiety	-.29**	-.04	-.04
20.Laptop anxiety x Technology advancement	-.6**	-.03	-.03
21.Laptop anxiety x Mobile orientation	-.58**	.17**	.14
22.Laptop anxiety x Internet advancement	.03	-.14*	.16*
24.Internet expertise x Internet anxiety	.45**	.22**	.25**
25.Internet expertise x Technology advancement	.12**	-.02	.03
26.Internet expertise x Laptop advancement	.31**	.06	.14
27.Internet expertise x Internet advancement	.04	.36**	.36**
28. Internet expertise x Tablet advancement	.09	.16**	.05
29.Internet expertise x Laptop expertise	.04	.26**	.18**
30.Internet expertise x Tablet expertise	-.12	.03	.21**
31.Internet expertise x Internet anxiety	.20**	.37**	.37**
32.Internet expertise x Tablet anxiety	.33**	.17**	-.01
33.Internet anxiety x Internet advancement	.04	.17**	.22
34.Internet anxiety x Tablet advancement	.23**	.13*	.04
35.Tablet expertise x Technology advancement	.32**	.19**	.05
36.Tablet expertise x Mobile orientation	.05	.16*	.15*
37.Tablet expertise x Tablet anxiety	-.35	.21	.66**
38.Tablet expertise x Laptop advancement	-.43	.20**	.16*
39.Tablet expertise x Internet advancement	-.35	.21	.18**
40.Tablet anxiety x Mobile advancement	-.26**	.07	-.04
41.Tablet anxiety x Laptop advancement	.32**	.07	.17*
42.Tablet anxiety x Tablet advancement	.11	.26**	.20**

Correlation is significant at the 0.01 level (2 tailed) ** Correlation is significant at the 0.05 level (2 tailed) *

Table 4
Pearson's product moment correlations for significant results for self-reported expertise, anxiety rating, technological advancement levels for the mobile phone, tablet, internet and laptop, and technological advancement and technological orientation for technology in general in 14-18s

	'r' values		
	2013	2015	Both
1.Technology advancement x Laptop advancement	.38**	.33**	.36**
2.Technology advancement x Internet advancement	.33**	.35**	.35**
3.Mobile advancement x Mobile orientation	.25**	.22**	.23**
4.Laptop advancement x Internet advancement	.61**	.52**	.57**
5.Laptop advancement x Tablet advancement	.04	.39**	.21**
6.Internet advancement x Tablet advancement	-.05	.36**	.21**
7.Mobile expertise x Mobile advancement	.04	.12*	.11*
2.Mobile expertise x Mobile orientation	.01	.22**	.17**
3.Mobile expertise x Tablet advancement	.19**	.01	.03
4.Mobile expertise x Tablet expertise	.15*	-.04	-.01
5.Mobile expertise x Mobile anxiety	.12	.44**	.37**
6.Mobile expertise x Laptop anxiety	-.01*	-.02	-.1*
7.Mobile anxiety x Mobile advancement	.04	.15*	.16**
8.Mobile anxiety x Mobile orientation	-.07	.35**	.16**
9. Mobile anxiety x Laptop expertise	-.09	-.04	-.09*
10.Mobile anxiety x Internet expertise	.01	.02	-.34**
11.Mobile anxiety x Laptop anxiety	-.04	-.04	.27**
12.Mobile anxiety x Internet anxiety	.01	.04	.12**
13.Laptop expertise x Technology advancement	.42**	.42**	.41**
14.Laptop expertise x Laptop advancement	.41**	.42**	.41**
15.Laptop expertise x Internet advancement	.42**	.36**	.39**
16.Laptop expertise x Tablet advancement	-.02	.37**	.15**
17.Laptop expertise x Laptop anxiety	.42**	.09	.14**
18.Laptop expertise x Internet anxiety	.03	.22**	.05
19.Laptop expertise Tablet anxiety	-.01	.22**	.11*
20.Laptop anxiety x Technology advancement	.12	.01	.11*
21.Laptop anxiety x Internet anxiety	.05	-.02	.12**
22.Laptop anxiety x Tablet anxiety	-.06	.03	.16**
25.Internet expertise x Technology advancement	.39**	.31**	.11*
26.Internet expertise x Tablet expertise	-.01	.36**	.08
27.Internet expertise x Internet anxiety	.25**	.2**	-.01
28.Internet expertise x Tablet anxiety	-.04	.17**	-.01
29.Internet anxiety x Internet advancement	.14*	.01	.04
30.Internet anxiety x Tablet advancement	.48**	.01	-.11*
31.Tablet expertise x Technology advancement	.04	.30**	.16**
32.Tablet expertise x Laptop anxiety	.02	-.04	.13**
33.Tablet expertise x Tablet anxiety	.33**	.47**	.41**
34.Tablet expertise x Laptop advancement	-.43	.20**	.16*
35.Tablet expertise x Internet advancement	-.35	.21	.18**
36.Tablet anxiety x Laptop advancement	.1	.09	.1*

Correlation is significant at the 0.01 level (2 tailed) ** Correlation is significant at the 0.05 level (2 tailed)

Appendix E
Coding of First Word Responses

1. Text	43.Curry
2.Calling	44.Portable
3.Games	45.Small
4.Contact	46.Convenient
5. Easy	47.Facebook
6.Quick	48.Social/social life/sociable
7.Apps	49.Annoying/irritating/frustrating
8.Commuication	50.n.a.
9.Friends	51.Bbm
10.Technology	52.Network
11.Internet	53.Safe/safety
12.Fun	54.Connect/connected/connecting
13.Expensive	55.Signals/signal
14.Cool	56.Screen
15.Video	57.Blackberry
16.Number	58.Work
17.Phone	59.Twitter
18.Photos	60.Awesome
19.Music	61.Reliance
20.I.C.E	62.Mum
21.Family	63.Style/stylish
22.Ring	64.Learning
23.Touch screen	65.Entertaining/entertainment
24.Money	66 Necessary/necessity
25.Lovely	67.Addictive/addiction
26.Security	68.Useful
27.Camera	69.Organiser/organisation/organise
28.Touch	70.Social networking/networking
29.Simple	71.Privacy
30.Phoning	72.Practical
31.Email	73.Snapchat
32.Credit	74.Handy
33.Battery	75.Social media
34.Talking	76Apple.
35.Chatting	77.Girlfriend
36.Messaging	78.Anti-social
37.Boredom	79.Overpriced
38.Swanky	80.Stuck to me
39.Iphone	81.Cities
40.Alarm	82.Pain
41 Smart	83.Cities
42.mobile	84. Essential

85.Teenagers
86.Contract
87.Distracting
88. Time consuming
89.Candy crush
90.Intelligent
91.Cute
92.Black
93.Share
94.Clever
95.Valuable
96.Important
97.Conversation
98.New one
99.People
100.Emergency
101.High tech
102.Noisy
103.Arrange
104.Headache
105.Life
106.Delicate
107.Colourful
108.Electric
109.Charger/charging
110.Buttons
111.Metal
112.U tube
113.Helpful
114.Harmful
115.Information
116.Passcode
118.Seconary school
119.Gadgets
120.Hard to turn on
121.Amazing
122.Advancements
120.Hard to turn on
121.Amazing
122.Advancements
122.Advancements
123.Access
124.999
125.Police
126.Global
127.OK
128.Samsung
129.Electronic
130.Electronic
131.New
132.Selfie/selfies
133.Sister
134.Dangerous
135.Responsible
136.Google
137.Violence
138.Facts
139.Strangers
140.Weird
141.Wired
142.Bell
143.Happy
144.Flappybird
145.Wireless
146.Phone number
147.Creative
148.Property
149.Good
150.Exciting
151.Telephone
152.Brilliant
153.Courageous
154.Online
155.O2
156.No comment
157.Computer
158.Android
159.Dial
160.Enjoyable
161.Ding
162.Dad
163.Wifi
164.Band
165.Need
166.Shopping
167.Nokia
168.Fantastic
169.Used
170.Brick
171.Freedom
172.Nanna
173.Questionnaire

174.Trust
175.Brand
176.Bullying
177.OK
178.Can
179.Serious
180.Keypad
181.Calendar
182.HTC
183.Amusement
184.Life
185.Liberty
186.Wrong
187.Hurtful
188.Rubbish
189.Fake
190.Personal
191.Modern
192.Surf
193.McDonalds
194.Over-consumption
195.Sim
196.Useless
197.Allow
198.Jailbreak
199.Instant/instantly
200.Long distance
201.Compact
202.Business
203.Hacking
204.Handheld
205.Calculator
206.Research
207.Unecessary
208.A waste
209.Hand
210.Instagram
211.Brands
212Safari
213.Context
214.Dependance
215.Fancy
216.Anywhere
217.Consuming
218.Common
219.Arrangements
220.Voice
221.Face
222.Aerial
223.Constant
223Upgrade
225.Contract
226.WhatsApp
227.Enabling
228.Lazy.
228.Nice
229.Device
230. Arrangement
231.Radiation
232.Lifeline
233.Fashionable
234.Procrastinator

Appendix F

Like Most/Like Least Comments

A sample of the like most/like least comments are listed:

Like most:

Communication

They are useful because I can contact someone whenever I need to. They enable me to let people know where I am, to meet people if I don't know where they are or if I'm running late. They allow communication that wouldn't be possible without a phone.

The ease at which you can communicate with others and at an extremely low cost nowadays. Through the use of apps, you can effectively get everything you need sorted with just a single device, no need to carry around multiple pieces of technology (e.g you can communicate, listen to music, browse the web etc)

Being able to text my boyfriend all the time - otherwise I might feel quite lonely, I don't really text anyone else. Useful for when I'm waiting, or even in awkward social situations.

You can text and talk to anyone anywhere, instantly.

That you can phone people all over the world

The fact that you can speak to anyone no matter how far away they are

Texting and the fact that if you have data you can go on any app.

Texting and selfies

Fast contact with others

Being able to contact people that aren't near you

You can talk to people instantly over long distances

Dad texts me when it’s time for tea (micro-coordination).

Easy to make plans, talk to friends

You can instantly communicate with people.

They allow you to be involved with social situations quick and easy

Quick access to friends and family, easy to talk

Physical attributes

Small, so you can carry them

The fact that they are small and have a big memory

Portable

The ability to use the internet anywhere

They are easy to use and useful to have

It’s portable and combines everything I may need in a day

Evaluative

That they are portable, and they have so many functions that can make everyday tasks much more easily. For example, they can help you to be organised, you can get different kinds of information whenever you need it and no matter where you are (microcoordiantion)

Easy to use

It’s yours and no-one else’s and you can connect with people (personal attachment)

They’re cool

Easy to use, easy to communicate, easy to communicate with people, easy to organise, easy to talk

I can use them for more than just making calls, for example, internet, shopping, etc.

Able to do lots of things on one small device, contact people, play games, listen to music

Helps with a lot, playing games, music, searching the internet, setting alarms, keeping a calendar

Being able to do a wide range of things whenever and wherever, on the go

Safety and Security

Feeling safe

They're convenient and make me feel safe when I'm alone

You can cycle really far, and your parents are like OK, You got your phone, so it's OK

You can use them for emergencies; it's magic

They are useful in emergencies- you feel less disconnected

GPS function on smartphones

You can never get lost because of google maps.

Entertainment

Being able to play on apps when I'm bored

They also provide entertainment and if I'm ever bored I can play on it! The internet means I can find something out whenever I need to.

That I can get to use Twitter on them and upload pictures on Instagram

Playing games to pass time and texting people and Snapchat. It's also fun.

You can have your own mini photo album

I can play games, socialise, talk to friends

Listening to music

Being able to take photos

Like Least

Communication

I feel obligated to reply because my friends know that I must have got their texts and I don’t want to seem rude, but I really just want to be alone

People can get addicted to them.

not being able to 'switch off' - people are always able to reach me and it's harder to get away from it all and relax

That texting can take over your life.

Parents’ can consult me whenever

They can be quite addictive

Distracting

Constant need for them in society

Too much of a distraction

Dependence

Constant use

How attached people get to them

Over dependence

People use them all the time

People depend on them and it takes away from other forms of communication

That people are reliant on them and don’t communicate face to face

When people spend too much time texting

People have become dependent on them and find it hard to pull themselves away from them, making them less sociable in face to face

How reliant I have become on it; I always have it with me

Physical Attributes

They have small buttons

If you store too much, you can crash

When you get no signal

The battery power never lasts long enough

They run out of charge

When they’re slow

When they freeze

They jam up sometimes and lose signal

Time delay in response

Evaluative

They can be tricky to understand

Unsociable with a group of people

Competition between friends as to who has the best phone

Got to keep up with the latest phone

Better ones always come out

People being really loud in public places

Some people deem them as very important

Protocol on how to behave when using them

With newer phones, it can get quite complicated

With newer phones, it can be quite complicated just to find one setting to change

Superfluous functions

Too much technology and confuses people

Radiation

I get bad headaches on them during long phone calls

Safety and Security

I can get everything (most) I want. It makes me feel safe when I'm in a strange environment.

Hacking

People are able to get your number and text you, someone you don't know

How they are mis-used

Can be traced or tracked

Sometimes people use them dangerously

They are bad for driving

They cause bullying and arguing

Going on the internet and getting a virus

People can text improper things to people

People sending horrible messages on social media sites

Cost

How much you have to pay to text and call

You have to pay to use them as well as the phone itself

Expensive to call and text

Appendix G

The Interviews

Interviews with groups of 8-11s

Interview with students on Nov 3 at Group 1 (girls)

1. Can you tell me what you think about mobile phones please.

V. It's always there.
S. Good for games.
E. Sometimes I use it to text people because I'm bored. I use it to play games when my phone is out of battery.

2. Why do you think the mobile phone has become such an important part of everyday life?

V. It helps if you something bad happens.
E. You can use them if you're bored.
S. It's good for contacting people on.

3. Would you say it is a luxury or a necessity?

Not asked.

4. What technological gadgets do you like using most?

V. I am sometimes on my phone when I'm tidying my room.
S. I play a game and speak at the same time.
E. I text and and watch TV or listen to the radio.

5. On average how many hours do you spend on technology in a day?

E. About 4 hours; 2 hours watching TV and then 2 hours on the phone or the laptop.
S. About 2 hours watching TV and about half an hour on the computer.
V. 2 and a half hours; about 1 hour watching TV and half an hour on the computer.

6. What do you use technology for?

Ansared above.

7. Do you carry out multi-tasking with technology?

Not asked.

8. What activities are you doing when you use your phone with another activity?

Not asked.

9. What technology do you think males like using most?

Not asked.

10. What technology do you think females like using most?

Not asked.

11. Do you use all the features on your phone?
What percentage of features would you say you use?

Not asked.

12. Do you prefer to call or text?
V. Text.
E. Text
S. Call.

13. What makes you decide to text rather than talk?
V. It's cheaper to text.
E. And it's quicker…and it gives you time to think…..if you're speaking on the phone, you might forget what you've said or arranged but with texting, you have it in front of you, so you have time to think about what you want to say.

14. What makes you decide to talk rather than text?
V. When you talk to someone, you can actually give someone your expression.
S. Talking is nicer than texting, it feels better, like you're not explaining everything everything like when you're texting. I don't like texting. Once my phone froze when I was texting…..because someone was ringing me when I was texting.

15. Do you ever think of the possible health risks of using a mobile phone?
Not asked.

16. How would you describe a mobile phone to an alien (or someone who knows nothing about mobile phones)?
A. It's a gadget that you can help to call, text, play games or music, have entertainment, go on the internet. You can phone, call and arrange meetings and you can text people and arrange trips.
B. You can do loads on it.

Interview with students on 3 Oct 2014 Group 2

1. Can you tell me what you think about mobile phones please.
M. I think it is quite good. I like to text, carry it around, do stuff on it.
L. I think it's good, because when you go on holiday, you can keep in touch, so you don't feel alone.
C. I think it's good because you can keep in touch with people who lives a long way home.
M. Sometimes I'm asleep and it wakes me up, it vibrates and wakes me.
L. I can live without my phone.
M. I could live without the technical stuff.
C. Actually, I don't know if I could.
M. I talk to my Mum or my Gran on the way home from school.

2. Why do you think the mobile phone has become such an important part of everyday life?
M. So people can keep in touch. It's good to be able to use reminders and store contacts, but games aren't really important.

3. Would you say it is a luxury or a necessity?
Not asked.

4. What technological gadgets do you like using most?
M. Apple stuff, IPods.
L. IMac.
C. IPhones.

5. On average how many hours do you spend on technology in a day?
M. About 3 and a half; say about half an hour of that's on an ipod.
L. Sounds bad; like about 5 hours if you add it all up.
C. About 4.

6. What do you use technology for?
L. Games.
M. Videos.
C. Programmes. Go on Apps, Instagram, viba. I like using viba, Muzy, Youtube and videostar. Videostar is where you can make a video for free.

7. Do you carry out multi-tasking with technology?
Not asked.

8. What activities are you doing when you use your phone with another activity?
Not asked.

9. What technology do you think males like using most?
Not asked.

10. What technology do you think females like using most?
Not asked.

11. Do you use all the features on your phone?
What percentage of features would you say you use?
Not asked.

12. Do you prefer to call or text?

M. Text.
L. Text.
C. Call.

13. What makes you decide to text or talk?

L. Calling wastes money because I'm on pay as you go.

14. What makes you decide to talk rather than text?

M. I've got 500 minutes talking because I'm on contract.
L. In some situations, you need a quick reply, then you call.
C. My Dad's away a lot, so I like to call him to hear his voice.
L. When you text, you can't hear the tone in someone's voice, their expression!
C. So, it there's an emergency it's important to call. You can use your expression, because it's an emergency.
C. When you text, you don't know if the text has got through.

15. Do you ever think of the possible health risks of using a mobile phone?

Not asked.

16. How would you describe a mobile phone to an alien (or someone who knows nothing about mobile phones)?

M. It's a gadget.
C. It's for entertainment and you can contact people.
M. It's like a box, a gadget that you can text with. When you text, you send a message without speaking.
L. The text goes along a wire.
M. No, through the air.
C. And you can play games on a mobile phone.
C. To make it work, you have to turn it on.

Interview with students on Oct 4 Group 3

1.Can you tell me what you think about mobile phones please.

E. They are good for keeping in contact with split up parents.
R. They are quite good to use.
D. They are good for keeping in contact with people. Because we are going off to different schools, they are important for us.
R. They are good for keeping in contact with your family. I talk to my family a lot.
D. The bad thing is; I go over my text limit in my contract because I text so much.

2. Why do you think the mobile phone has become such an important part of everyday life?

E. For work. My Mum has a phone for her work. She is the boss of 92 people, so her phone is important to her, so she has to contact people.
R. Moving up to secondary school. By using our phones, and Ipads, we can keep in contact everyday, and we can get to know our new school mates before we start school.

3. Would you say it is a luxury or a necessity?

Not asked.

4. What technological gadgets do you like using most?

E. Ipads, Macbooks, Apple products and Blackberrys.

5. On average how many hours do you spend on technology in a day?

E. 2 to 3 hours a day. I have my phone on me at all times. When I get to school, I hand it in to the office. In a non-school day, maybe half the day to … say 8 hours. I get so bored.
R. 8 hours.
D. An hour altogether on a school day, but in the school holidays and a weekend, maybe 5 hours. I talk to anybody and everybody, whoever is around. I use skype, the computer, a kindle, and the computer. We message each other.

6. What do you use technology for?

R. I listen to music before coming to school.
D. I’m addicted to games.

7. Do you carry out multi-tasking with technology?

Not asked.

8. What activities are you doing when you use your phone with another activity?

Not asked.

9. What technology do you think males like using most?

Not asked.

10. What technology do you think females like using most?

Not asked.

11. Do you use all the features on your phone? What percentage of features would you say you use?

Not asked.

12. Do you prefer to call or text?

E. Text.
R. Text.
D. Call.

13. What makes you decide to text or talk?

E. Calling is hard if you are doing something, but if you are texting, you can carry on with what you're doing.
R. Texting is like a way of getting out of an argument. You wouldn't say it as a 'real' person, but by texting, it's like, it protects you, like a bubble, so you can say it by text.
D. /if you can't say it on a text message, why say it on a text message?

14. What makes you decide to talk rather than text?

D. I like calling because you get more information and you know the answer straight away, but with texting, you don't get the answer straight away.
R. Texting can be awkward. If you have an argument, when you are texting, you can get a wrong impression from a text. You can get more meaning and expression in calling.
D. I like to call my Dad when he is on his lorry.

15. Do you ever think of the possible health risks of using a mobile phone?

Not asked.

16. How would you describe a mobile phone to an alien (or someone who knows nothing about mobile phones)?

E. A mobile phone is like an alien teleporter but different.
R. You can text someone who has another mobile, speak to them or download things.
D. Texting is like saying it in your head, but you just use words. It's like you are speaking but your fingers are saying it.

Interview with students on 7 Oct Group 4

1.Can you tell me what you think about mobile phones please.

N. Don’t use the phone that much except for phoning and texting my parents.
R. Good for keeping in touch.
D. Playing games.

2. Why do you think the mobile phone has become such an important part of everyday life?

R. For contacting people.
D. They are good in an emergency.
N. Yes. They are important in an emergency.

3. Would you say it is a luxury or a necessity?

Not asked.

4. What technological gadgets do you like using most?

R. Ipad.
D. Kindle.

5. On average how many hours do you spend on technology in a day?

R. 4 hours a day, mainly on the Ipad.
D. 5 hours a day, on the kindle and watching TV.
N. Yeah, 5 hours.

6. What do you use technology for?

R. Imessages.
D. Viba. I like using Imessage and Viba, because it is easier than texting.

7. Do you carry out multi-tasking with technology?

Not asked.

8. What activities are you doing when you use your phone with another activity?

Not asked.

9. What technology do you think males like using most?

Not asked.

10. What technology do you think females like using most?

Not asked.

11. Do you use all the features on your phone? What percentage of features would you say you use?

Not asked.

12. Do you prefer to call or text?

D. Call.
R. Text.
N. Text.

13. What makes you decide to text or talk?

D. I think it’s easier, because they would be good in an emergency because if you call, the person might not answer. If you text, you know the message has gone through.
R. If there was an emergency, say if your house was burning down, then I would call.

14. What makes you decide to talk rather than text?

D. When you call, you can get straight through or not at all but with texting you don’t know if you have got it through.

15. Do you ever think of the possible health risks of using a mobile phone?

Not asked.

16. How would you describe a mobile phone to an alien (or someone who knows nothing about mobile phones)?

Not asked.

Interview with students on Oct 8 2014 (boys) group 5

1.Can you tell me what you think about mobile phones please.
L. Quite useful sometimes, just in case of an emergency.
M. My Mum got me a phone, so I could go to the park.
C. I use it for going to the park.

2. Why do you think the mobile phone has become such an important part of everyday life?
L. You don't have to be home to phone someone.
M. The phone is the same size as a portable gaming device, so it is easy to fit in your pocket.

3. Would you say it is a luxury or a necessity?
Not asked.

4. What technological gadgets do you like using most?
L. Gaming devices.
M. Pocket held devices that I can pretty much do anything on; Ipod touch, You tube, the internet.

5. On average how many hours do you spend on technology in a day?
C. A maximum of 2 hours; I might spend half an hour on the laptop and then go outside to play; a total of 2 hours, but that time is broken up with other things.
L. About half an hour if it is sunny, but a maximum of one and a half hours.
M. About 4 hours; Ipod and computer and Iphone.

6. What do you use technology for?
L. Mindcraft on the internet on the phone and the computer. Also, games.
C. Watching Youtube on the laptop; PS3.
M. PS2, laptop, DS, Gameboy Advance.

7. Do you carry out multi-tasking with technology?
Not asked.

8. What activities are you doing when you use your phone with another activity?
Not asked.

9. What technology do you think males like using most?
Not asked.

10. What technology do you think females like using most?
Not asked.

11. Do you use all the features on your phone?
What percentage of features would you say you use?
Not asked.

12. Do you prefer to call or text?
L. Text.
M. Call.
C. Call.

13. What makes you decide to text or talk?
M. If you don't want to talk to them, you can send a text.

14. What makes you decide to talk rather than text?

M. I prefer to call because sometimes people don’t pick up their texts.
L. If you’re being sarcastic, people might misunderstand in a text.
C. You get the tone in your voice by talking.
M. Calling is easier than texting because there is less chance of accidentally sending a text you’re not ready to send.

15. Do you ever think of the possible health risks of using a mobile phone?

Not asked.

16. How would you describe a mobile phone to an alien (or someone who knows nothing about mobile phones)?

L. This (pointing to a mobile phone) is called a phone and it does stuff. You can talk to people or you can type in a message.

Interviews with 11-14s

Interview with 11-14s at March 18th, 2014, Group 1

1. Can you tell me what you think about mobile phones please.

A. I think they're quite helpful because, if you don't have, like, a watch, you can easily tell the time and you can keep in contact with relatives or, or if you go out somewhere, you can ring your parents.
B Yes.
A. If you get lost, or you don't know where you are.
C. Yes,
B. Yeah, they're really helpful.
A. This is the reason I got a phone, for safety and security, but I don't often use it for that reason. I was quite late getting a phone, I got it last year.
C. Yeah, and like, also, it's another way of communicating with like friends and family really like Jacob and like, yeah.
B. You can play games on them.
Int. You like playing games?
C. Yeah and you can have Facebook and Twitter and Facetime.
Int. Are those things you use?
B. Say, if you got taken away or somewhere by someone you can always have your mobile phone with you to call your parents as well.
Int. Are those things you use?
B. Say, if you got taken away or somewhere by someone, you can always have your mobile phone with you to call your parents, as well.
Int. You've got it with it, so you can use it.
A. Like if you have a fire or something.
B. So, basically, they're useful for, like safety reasons, as well, really, like fires and stuff, you said.
C. Yeah.
Int. That's really good.
B. I buy a lot of things on my phone.
A. I think you're the only one.
B. I buy things on Ebay.
C. I think our Mums buy things, but we don't.

2. Why do you think the mobile phone has become such an important part of everyday life?

C. Because, you can get like, Facebook, and Snapchat, and that and there's all the new games and stuff coming out, like …..
Int. So, you like it because you can communicate with people and because of the entertainment things on it.
C. Yeah, and like B said if someone took you, you could record it, so you could play it back and listen to it.
Int. Do you think you could do that without somebody noticing it?
C. Yes.
Int. That's interesting ….. So, why do you think the mobile phone has become such an everyday part of everyday life?
B. Well, like really, like say, if you went somewhere, like, if you could drive when you're older and like, if you got lost, you could always ring or text your parents to tell them where you are, and then they could guide you or something, from there over the phone or something.
Int. That's really good.
A.They, if you had, like a relative who lives across the world, you could just use, like, your phone to contact them when they're available and if they're not, you can easily just leave them a message.
Int. Is that OK to do that price wise?
A. Um, it can be, quite expensive sometimes, but if you don't talk to them too long, it shouldn't be too expensive.
B. Or you might email them or something.
Int. But sometimes it's nice to hear their voice, isn't it, and talk to them, have you any thoughts about this?
C. It makes me feel, like, feel safer.
Int. Feel safer. That's, like, really good.

3. Would you say it is a luxury or a necessity?

Not answered.

4. What technological gadgets do you like using most?

Not answered.

5. On average how many hours do you spend on technology in a day?

B. It kind of depends really, done it.
A. It depends on what sort of day it is? If it's a nice sunny day, I'm most of the time outside, but, if it's quite rainy, I'm like most of the time inside.
C. Yeah.
B. It depends like.
A. Yeah.
Int. So, for entertainment then.
A. Something to do as well.
C. School stuff.
B. Yeah.
C. It depends how long I spend on it if I'm doing Sports stuff how long I? spend on it.
B. At night, you, like, have your phone to entertain you, because you can't go out or anything.
Int. Do you use it, more or less at the weekends?
B. Weekends could be different.
A. If it was a sunny day, then probably not very long because I'd be out with other people, probably about 5 or 10 minutes.
B. Yeah, um, but if it's a sunny day you might be out, but you'd still use it.
Int. So, the times you use it a lot is are when you're inside.
C. When I first got, like, this PC game, I spent like, 3 hours on the computer.
A. I spend about 2 hours on a range of technology in the evenings. During the day I don't really use it much.
A. Mine's probably the day, I only use my phone, if somebody, like, texts me or something.
C. Because it's been quite cold, I've probably spent more time on technology.
A. Maybe 3, a bit longer.
B. If it's a cold day, and it's been raining, probably about six hours.

6. What do you use technology for?

A. Xbox.
C. Um probably my phone, Xbox and TV.
B. iPad, phone.
Int. If you could have one, what would that be?
C. I'd probably say phone, so I have something with me all the time.
B. My phone.

7. Do you carry out multi-tasking with technology?

A. Yes.
C. Yes.
B. Yes.

8. What activities are you doing when you use your phone with another activity?

A. Eating and going on my phone, if that counts.
C. Eat and watch TV.
A. I'll normally drink a cup of tea while playing on my Xbox.
B. Playing Xbox and eating while I'm listening to music.
A. Eating, watching YouTube and playing.
Int. With your phones, are there particular activities you use?
A. I like to Snapchat.
C. Sometimes, I'm cycling down to the shop or McDonalds, I put music on.
B. Doing homework and listening to music.

9. What technology do you think males like using most?

B. Xbox.
C. Gaming.
A. Xbox. I'd say Xbox, games, and the TV.

10. What technology do you think females like using most?
A. iPad, phones, Snapchat,
B. Games, phones, Selfies.
C. Selfies. I think it depends what sort of girls they are. Some may have Xbox's and play stations.
Int. What, Girls that are Tomboys?
C. No, you can't really call them Tom boys,
A. I know that girls that have got PS3's.
B. They like phones.
C. They can keep in contact more. Social things are more important for girls.

11. Do you use all the features on your phone?
What percentage of features would you say you use?

12. Do you prefer to call or text?
B. Text.
A. Text.
C. Call.

13. What makes you decide to text or talk?
A. It's cheaper and it doesn't use up your money so much.
B. You can't say, because of credit, because some people are on contract.
A. But if you're on pay as you go.
Int. So, what makes you decide to text rather than call?
C. I would say, it's quicker if I've got texts to text back to. If someone texts you, I can just text them straight back.
A. For one thing, it's quicker.
B. Also, if someone texts you, you can just stop and text back when you're ready.
A. It depends what the noise is like round you because sometimes it's really noisy, you might not be able to hear them if you ring them.

14. What makes you decide to talk rather than text?
C. If I'm in an emergency.
B. If you, like, just to get hold of someone then.
A. I would, like, instead of waiting for half an hour.
B. Well, really, say, if you want to get hold of someone then.
B. Say, if you are driving. Say you're not meant to, but if you've got you're hands free, you could ring.

15. Do you ever think of the possible health risks of using a mobile phone?
16. How would you describe a mobile phone to an alien (or someone who knows nothing about mobile phones)?

Not answered**.**

Interview with 11-14s on Nov 15, Group 2

1. Can you tell me what you think about mobile phones please.
A. They are used for certain things like contacting, entertainment.
B. I use it for games.

2. Why do you think the mobile phone has become such an important part of everyday life?
A. People are quite lazy and now they rely on technology to do things for them.
B. It's not important to me.
C. I only phone my friends sometimes, but most of the time, I use it to play games.
A. I bring my phone to school if I need to contact my parents, but most of the time I use it.

3. Would you say it is a luxury or a necessity?
Not asked.

4. What technological gadgets do you like using most?
A. Xbox.
B. My phone.
C. Phone.

5. On average how many hours do you spend on technology in a day?
A. 10 hours in the holiday, and one day I went on it for 12 hours. I went on it at 6 in the morning and came off at 10 at night.
B. On a school day I go on it for like 2 hours.
C. About 3 hours.

6. What do you use technology for?
A. Calling.
B. Games.
C. Games.

7. Do you carry out multi-tasking with technology?
All. Yes.

8. What activities are you doing when you use your phone with another activity?
B. I sometimes am on my phone when I'm tidying my room.
C. I play a game and speak at the same time.
A. I text and watch TV or listen to the radio.

9. What technology do you think males like using most?
A. X Box
B. X Box.
C. X Box game consoles.

10. What technology do you think females like using most?
A. Phones, because they like texting and stuff and improving their self-image, like going on Facebook.
B. Yeah, phones.
C. Phones.

11. Do you use all the features on your phone?
What percentage of features would you say you use?

12. Do you prefer to call or text?
A. Text.

B. Text.
C. Text.

13. What makes you decide to text or talk?
A. Calling takes a bit more credit than texting
C. I don’t really mind, but texting is a bit slow.
B. If you call someone on the phone, it might cut out because the range isn’t that good.

14. What makes you decide to talk rather than text?
B. For a long chat really.

15. Do you ever think of the possible health risks of using a mobile phone?
Not asked.

16. How would you describe a mobile phone to an alien (or someone who knows nothing about mobile phones)?
C. It’s a contacting device.
B. Social, Entertainment
A. It’s the best thing in the world.
B. Yes, it is.

Interview with 11-14s Group 3

1. Can you tell me what you think about mobile phones please.
A. I think they're good because they can help you if you're lost, or need something, then it saves time, you can just call someone.
b. I think they're good, because if you are lost, then you can phone up, and you can phone up whoever you need, and they can come and get you.
C. I think they're good, because they're just good in emergencies, and just if you want to keep in touch with someone, but some people's phones they use them, for like different things, like music and games and stuff, but I only use mine for emergencies, because mine's quite an old phone.
Int. Do you like the fact that you can have music and games on a phone? Do you think you might use them in the future?
C. Well, yeah, but I don't really need them at the moment, but maybe in the future. It's good and it's small, and you can just carry it around with you wherever you go.

2. Why do you think the mobile phone has become such an important part of everyday life?
A. I think, probably, because, um, over time, they've got more advanced, and you can do more things on them, so people find them more entertaining.
B. I think, they, um, because, they could get quite, um, addictive, I would say, because, like, if you have a routine of going home of texting your friends, listening to music and playing games, um, and it's something to do when you're bored, as well, you can just, yeah, go on your phone.
Int. Do you think that is a good thing?
B. Yeah.
Int. Do you know anybody in school who is addicted to their phone?
B. No.
A. No, not really.
C. My sister, she is at university: her boyfriend, she is always texting her boyfriend. Her boyfriend is at university in Edinburgh. I think the reason they use them so much is because, I think, virtually everyone has one now, like at weekends, people like, in secondary school use them to work out when they can meet up and stuff, and people just use them all the time. They've just become part of our lives basically.

3. Would you say it is a luxury or a necessity?

4. What technological gadgets do you like using most?

5. On average how many hours do you spend on technology in a day?
A. Probably about 3.
B. 5.
C. Probably one and a half.

6. What do you use technology for?
A. My laptop, I watch videos and YouTube.
B. My iPod, and I play games on the X box, and I go on Facebook.
C. I watch videos, and I like, go on websites if I need to do homework or I watch TV. I like going on our computer in our house.

7. Do you carry out multi-tasking with technology?
A. Yes.
C. Yes
B. Sometimes.

8. What activities are you doing when you use your phone with another activity?
A. My laptop, videos and YouTube.
B. Go between iPod, games on the X box, and Facebook.

C. I alternate between watching videos, websites for homework and watching TV.

9. What technology do you think males like using most?

B. X Box.
A and C together. Yeah, X Box.

10. What technology do you think females like using most?

A. Probably phones.
B. Yeah, phones.
C. Yeah, phones or laptops.
Int. Why?
A.Boys are more obsessed with games than girls, so they usually like to go on their X box. Girls are closer with their friends than boys, so it's a good way of keeping contact.

11. Do you use all the features on your phone? What percentage of features would you say you use?

12. Do you prefer to call or text?

A. Text.
C. Probably text.
B. I would prefer to call, just because it's quite hard, not hard but, it takes quite a long time to text, but in a phone call you get everything done much quicker.
Int. Can you tell me a bit more about why you like to phone?
B. Just because you can have a conversation, like an hour's conversation. To cover that conversation, you would have to send lots of long or short texts and quite much of your money. I like using the home phone.
Int. What the landline?
B. Yeah.
Int. So, why do you prefer to text more?

13. What makes you decide to text or talk?

B. I'm not sure.
A. I think, because, um, if you call them and they don't answer, then you have to keep calling them again, but if you text them, you know they'll get it. You might forget to call them again, then you won't know.
C. Yeah, I think with texting, you know if they've got it, whereas with phone calls you don't know if they realize you've called them, and sometimes they don't pick up. If they try to call you back, and your phone's on silent, you won't know, but, if you text them, you know they've text you, and they're checking their phone regularly. You can find out what they want, instead of phoning them back, and using your credit.
B. If you forget the time you are going to meet them, then you can look back, and you would have it there in front of you, instead of ringing them back again to find out.

14. What makes you decide to talk rather than text?

B. Probably, if I need to know something really quickly, and I haven't got time, and I know they'll answer. I can ring up and say, do you know what this is? Just because you can get quite a lot said in the time of you texting, either a long message or lots of short messages.
C. I think I only really want to ring if it's like a really personal issue, or if someone's upset about something. And I want to talk to them to find out how they're feeling, because with texting, you don't really get how they're feeling. It sounds completely different. They could be making up that they are upset, or they're fine when they're not

15. Do you ever think of the possible health risks of using a mobile phone?

16. How would you describe a mobile phone to an alien (or someone who knows nothing about mobile phones)

Interview with 11-14s Group 4

1. Can you tell me what you think about mobile phones please.

A. They're helpful, and I use them a lot.
B. They're good for keeping you safe, to keep you in contact with your parents or guardians.
C. It's nice to know that you can contact someone if you need them.
B. They're useful if you want to go on, like, because you can go on like Facebook or Twitter when you're out, if you have it on contract, then you can use that.
C. You can use the internet, and it's a good way to keep in touch with your family, so if you go out with your friends, it's easy to keep in touch.
Int. So, from what you're saying there are lots of different uses for your phones.
B. Yeah.
B. Also, if you get lost you can use maps on your phone.
C. There's this App called Find your phone, and so I use it to find my parent's phone.
Int. Do you use the Maps one?
B. If I need it to. I use it because I play football and we have a match every Saturday, and we have to find out where we're going.
B. We type it on the phone, and it gives you a pointer and then you have to follow it on your pointer.
Int. Do you play football every weekend?
B. Yes, I play for Wells.

2. Why do you think the mobile phone has become such an important part of everyday life?

C. Because it's useful, and, um, people find it easier to carry round a little phone than having to use a pay phone.
A. It can do all the same abilities of a laptop.
B. You're a lot safer on your mobile phone because if you get into trouble you can just ring.
C. There is an emergency call button, so you don't have to put your passcode in.
Int. So, you can call the emergency services.
B. My sister's dance. We are in, er, Reading. There was a little boy, smacked his head on the stage and we had to get in contact with the emergency services, and we used the emergency button.
A. My Dad once. He's a builder, and he was working with my Uncle, and he got hit in the head by a chainsaw and got knocked out. We had to use the emergency call button at work.

3. Would you say it is a luxury or a necessity?

4. What technological gadgets do you like using most?

5. On average how many hours do you spend on technology in a day?

B. Wow....Is that including TV?
A. Every time I get home from school, I just need to relax, so, I sit on the sofa and watch TV for a bit, but then I help my Mum get everything ready, about 3 hours.
B. I probably spend, actually about, 4 hours on it, because when I get home from school, I go on the Xbox and I play it for about 4 hours straight.
A. Yeah, just over 2 hours I think.
C. I'll probably spend about 4 hours because I get home, I'll probably watch like, about 2 hours of TV and then I'll go on my iPod, for like, an hour and then after an hour.
A. I go on it to relax.
C. Unwind. It depends, to be like, when you're tired, and you can't be bothered to do anything.
A. Yeah you can't be bothered.
A. It depends where I am, and what I'm doing.
B. Because I come home, go on the Xbox, and then I come off, I have tea, then I do something else for a bit, and then I go on my phone, and then I Facebook message people.
C. If I am out doing something, then I won't go on it unless I need to contact someone, like, I would never go on a game in a restaurant or something.
B. No.
A. No, I wouldn't go my phone in a restaurant.
B. It's just polite manners, isn't it?
A. I wouldn't go on it, anyway, because I'd be waiting for my food, and I'd be talking with my family.
Int. Are there other public places that you think it's OK to use your phone?

C. It’s like, not that I go there, but it’s like, in pubs, all the time people watching football on the TV, on their phones texting people, all the time.
B. If you’re sat on a bench, waiting outside a shop, it’s fine then, if you’re bored, it’s fine then, to go on your phone.
Int. If you’re meeting friend and someone rings and they start talking, how does that make you feel?
C. Oh, it’s a bit embarrassing. I usually say I’m just with someone at the moment, can you make it really fast.
A. If I’m out with Eve and Chloe, and then someone else rings, but then if someone rings to come out with us, then they wouldn’t mind cos it would be like for all of us.
C. I think, like, loads of people, like, go on phones and other gadgets and stuff, because they are like travelling.
C. If you’re on the train or aeroplane, everyone will be on their phones.
C. You can use a mobile phone on aeroplane mode to play games, listen to music ....
B. I’m not sure if you’re allowed to.
A. Well, you can if it’s on aeroplane mode.
C. I used my phone on aeroplane mode when I went to Scotland. I played games, videos, listen to music, radio.
B. Music.
A. It’s quite annoying though, if you don’t have headphones and someone has head phones and you’re just sat there, and they’re listening to music, and you’re just OMG, turn it off.
C. I think that’s rude.
B. Yeah, that’s rude If the other person has music and your sitting next to them and you don’t want to hear it, I think that’s rude.
C. You see, my sister I gave her my iPod touch and she’s on it 24 7. She watches Youtube videos of stupid things. She’s only 8 though.

6. What do you use technology for?
C. The music.
A. Gaming.
B. X box, PS3.
C. Wi.
A. Ipod**.**

7. Do you carry out multi-tasking with technology?
B. Sometimes.
A. Yes.

8. What activities are you doing when you use your phone with another activity?
A.I like watching TV and texting people. My Dad says I shouldn’t use two types of technology at once.

9. What technology do you think males like using most?
A.X Box.
B. Xbox, PS2.
C. Xbox.
B. Anything you have a controller with.
C. I wouldn’t say they’re really into texting or calling.
B. Anything, they can shoot people on.
B. You can play on games with a friend with a headset, and you can play on the headsets together.

10. What technology do you think females like using most?
B. It depends if you’re a Tom Boy or not. Xbox.
C. Some people like that, but other people like to have a lot of likes on their Facebook; texting.
A. Yeah.... and Instagram.
B. I only have Facebook, because I moved from London and that’s how I keep in contact with my friends.
C. Not everyone has a phone.
B. Xbox is addictive. We like Xbox.

11. Do you use all the features on your phone?
What percentage of features would you say you use?

12. Do you prefer to call or text?

C. Text.
B. Text.
A. Text.

13. What makes you decide to text or talk?

A. I don't know.
B. It's easier if you call, you'll be on there for hours.
B. I only text because I don't like calling. because I never know what I want to say. You have much in your head and then you call someone, and you don't know what to say, so, I just find it really awkward.
C. If you want a long conversation or just a chat with someone, I'd text back & forth, and if it's a length of time, and it's probably cheaper to text.
Int. Would you do that with texting or use Facebook?
A. It depends what's nearest. If you're out and about, it'd probably be texting but if you're at home, you'd use Facebook on a laptop.
C. Or if it's your friend's birthday sleepover, and you can't go, you wouldn't want to say it to me them, so you'd text.

14. What makes you decide to talk rather than text?

B. If I'm with someone.
C. Especially if you are in a relationship
A. If you're with your family, I'd call my Mum, say if I was down the park.

15. Do you ever think of the possible health risks of using a mobile phone?

16. How would you describe a mobile phone to an alien (or someone who knows nothing about mobile phones)?

C. It's a messaging and calling device that.
A. You use it a lot and it's helpful for information and if you want to contact your family and your friends.
A. You use it for the internet.
C. Most people have one.
A. You use it to message your parents.
C. There's lots of different kinds. You can use it for games.
B. Basically a phone is a sense of security and you're going to have security if you keep your phone with you.
A. You can use it for an emergency.
C. You have buttons to press.
B. It depends what sort of phone you have what you can do with it.
A. Grandparents had an old Nokia phone, and I said, 'you need to get a new phone, so you can have it to help you in your lives'.

Interview with 11-14s Group 5.

1. Can you tell me what you think about mobile phones please.
M. They can be dangerous.
A. Some people have them for image.
J. Some people have them for Facebook and sending messages to other people.
M. Sometimes they are used inappropriately.
A. They are good for emergencies, if there is a car crash or something like that. There is an emergency facility on the phone, it's coded so you don't have to pay for it so you can use it an emergency.

2. Why do think the mobile phone has become such an important part of everyday life?
A. They can be good if you are lonely & you want a friend, you can text them.
M. You can use them for music & some phones have games that are free.
J. Phones are often used for advertising.
A. You can use your phone to text or receive a boy's photo and not tell your Mum.

3. Would you say it is a luxury or a necessity?

4. What technological gadgets do you like using most?

5. On average how many hours do you spend on technology in a day?
A. 5 hours on the ipod, probably more at the weekend.
M. I've got a new dog so maybe 3 hours a day.
J. At weekend, 4 hours. I use an ipod, laptop or my iPhone or I watch TV.

6. What do you use technology for?
A. Ipod.
M. MP3.
J. All you can do on an MP3 is on an ipod, you can text, play music, games, use facetime.
A. Phones are better because you can call & text as well.

7. Do you carry out multi-tasking with technology?

8. What activities are you doing when you use your phone with another activity?
9. What technology do you think males like using most?
M. I think boys like game boys, murder mystery games & nasty games too.

10. What technology do you think females like using most?
J. Phones.

11. Do you use all the features on your phone?
What percentage of features would you say you use?
Not asked.

12. Do you prefer to call or text?

13. What makes you decide to text or talk?

14. What makes you decide to talk rather than text?

15. Do you ever think of the possible health risks of using a mobile phone?
Not asked.

Interviews with 14-18s in 2014

Group 1: Interview with 14-18s on October 10^{th}, 2014

1. Can you tell me what you think about mobile phones please.

E. I think they're really handy.
S. They're just really quick and simple to communicate with people.
M. You can do so many things on it.

2. Why do you think the mobile phone has become such an important part of everyday life?

E. Take pictures.
S. Loads of different apps for different forms of texting.
M. Social networks.
The ordering cards are introduced to interviewees at this point and they are asked which usage spaces they felt are important.
E. This is the reason I got a phone, Safety & Security but I don't often use it for that reason.
S. I was quite late getting a phone, got it last year.
M. Mine is probably relationships with friends & family.
S. (Pointing at Expansion). What does this mean?
The interviewer explained what expansion was.
M. Personal history is about taking photos.
E. Self-image is important to some people. It was one of the reasons for getting it in the first place.

3. Would you say it is a luxury or a necessity?

Not asked.

4. What technological gadgets do you like using most?

E. I like iPad.
M. Ipod.
S. At home we've got a family tablet – it's really useful, its small & portable.

5. On average how many hours do you spend on technology in a day?

E. About 4 hours.
M. About 4 hours for me too.
S. Probably 1, maybe 2.

6. What do you use technology for?

E. Phones for texting my friends.
S. Tablet for homework
M. Phones.

7. Do you carry out multi-tasking with technology?

Not asked.

8. What activities are you doing when you use your phone with another activity?

Not asked.

9. What technology do you think males like using most?

E. Games & consoles.

10. What technology do you think females like using most?

M. Phones.

11. Do you use all the features on your phone?
What percentage of features would you say you use?

12. Do you prefer to call or text?
E. Call.
S. Text.
M. Text.

13. What makes you decide to text or talk?
E. They all text back, pretty quick anyway.

14. What makes you decide to talk rather than text?
E. I like to hear their voice.

15. Do you ever think of the possible health risks of using a mobile phone?

16. How would you describe a mobile phone to an alien (or someone who knows nothing about mobile phones)?
A device that you can get in contact with other people and you can also listen to music. You can also give them some information that is written out. They fit in your pocket and you have a case to stop it breaking.

Group 2: Interview with 14-18s on November 14th, 2014

1. Can you tell me what you think about mobile phones please.

A. I think they're are good aspects like everyone uses them, so they are obviously a significant aspect of daily life. I think they're really useful because you can use them for so many different things like contacts and games and also like you've got your applications, calculator & stuff......
B. I think they're useful just for contacting, but I don't think you need them for all the other things like games & stuff. I don't think that's really useful.

2. Why do you think the mobile phone has become such an important part of everyday life?

A. You can use it for so many different things in everyday life like you don't really need the internet You don't really need so many technologies as you did before because it's all in one; it's more convenient; you can get them all on your phone.
B. I think it's because people are really busy maybe and like you use it quite a lot to contact people and also texting all the time, I don't know........... texting just because you can. It's just so easy.

3. Would you say it is a luxury or a necessity?

4. What technological gadgets do you like using most?

5. On average how many hours do you spend on technology in a day?

A. Does that include TV?
Int. Yes.
A. Probably 3 to 4 hours. I might watch a bit of tele when I get home and then go on the laptop and do my homework, listen to music.
B. Yeah, it's the same for me. I do my homework on my laptop, watch a bit of tele. About 4 hours for me. I don't know.
A. Does this include when you used it at school during lessons?
Int. Yes.
A. Well, maybe about 3 or 4 hours actually, thinking about it.
Int. In the holidays, it might be different.
A. In the holidays, I use it a lot more.
Int. Would you use different things in the holidays?
A. No, I just use it more.
B. Yeah, it's the same for me.

6. What do you use technology for?

A.I text people on my phone, I use Facebook and the internet on it.
Int. Do you use the internet on your phone or your laptop?
A. I normally use it on my laptop but if can't get the internet or I'm out of the house, I use it on my phone and I listen to music on it. I kind of use it instead of an Ipod.
B. Most......It can be a computer or ....I think a phone or an ipod. You can use the internet and it's just loads easier than using the computer. You can just turn it on and use it.
A. My favourite phone is probably my laptop followed by my iPhone.
B. Yeah, I quite like my laptop ...... but, it's really slow, on the laptop you can ..... The internet is much clearer.
A. So, that's a bit annoying. The internet is much clearer though on a bigger screen and it's a better connection.

7. Do you carry out multi-tasking with technology?

A. Yes.
B. No.

8. What activities are you doing when you use your phone with another activity?

A. Maybe if I'm doing a bit of homework or something like that and I need a bit of help, I might text my friends to get help or someone texts might text me... No, not normally...
B. No, no, I don't.

9. What technology do you think males like using most?

A. X Box.
B. Games, actually.
A. Laptops...... or computers.
B. Yeah...Laptops.

10. What technology do you think females like using most?

B. I think phones.
A. Either a phone.
C. Or a laptop actually.

11. Do you use all the features on your phone? What percentage of features would you say you use?

12. Do you prefer to call or text?

A. Text.
C. Text.
B. Text.

13. What makes you decide to text or talk?

B. It's cheaper.
A. Yeah, I don't know why (*really questioning why with animation in her voice*) .... Yeah, its's probably the same reason.
Int. Have a little think why you decide to text rather than ring.
B. It's like if you are just asking someone for like homework. Like, do we have homework that needs to be in tomorrow? It's just like quicker and easier to text; like you don't have to call and ask about stuff. It's just like ....gets to the point....
A. Yeah.
A. And, like if it's not very urgent, it's just like easier for the person you're texting to do, it's like if they're busy or something and they can't answer you're call. Oh, look someone's texted me and they can answer it then.
Int. It like, gives you some sort of control...
A. Yeah.
B. Yeah

14. What makes you decide to talk rather than text?

15. Do you ever think of the possible health risks of using a mobile phone?

16. How would you describe a mobile phone to an alien (or someone who knows nothing about mobile phones)?

C. Something that you can use for.......
A. That other people have that you can use to talk to them.
B. For contact, its multifunctional for technology that you can use for entertainment...... you can get the news, you can get the internet, contact..............

Group 3: Interview 11-14-18s on November 14th, 2014

1. Can you tell me what you think about mobile phones please.

J. I'd say in general they're really useful because, obviously you can chat to your friends when you might want to have a normal conversation, but you can use it for more serious things, if you need to get hold of someone you can just call them up.
S. With smart phones these days you can do so many things on them. You can do general things on them mostly people.
K. They're useful for when you're out & about and your parents can ring you back & check how you're doing, messaging your friends, asking people about homework.

2. Why do you think the mobile phone has become such an important part of everyday life?

A. I think it's because we are all starting to rely more and more on technology, communicating, especially this school with twelve hundred people, so they don't all live in one area, so we can communicate with each other. It's a lot easier to communicate with everyone.
B. We're a social race. We feel like we want to communicate, we have the need to communicate.
Int. Do you have a phone at school?
B. Yeah but It's switched off & I just turn it on to use it to call my Mum. We're allowed phones in school as long as they don't see it in class, then they're fine with it. I use it when I need to ring my Mum to pick me up earlier. I have it in school, but I don't use it.

3. Would you say it is a luxury or a necessity?

Not asked.

4. What technological gadgets do you like using most?

A. My kindle E reader I've got a tablet which you can do more things on it.
Int. So, the kindle's your favourite?
C. Mine's probably an ipod, so you can listen to music wherever you go.

5. On average how many hours do you spend on technology in a day?

A. Quite a lot, because obviously homework relies more and more on technology, as well; probably 4 hours each day I'd say. In the holidays, I probably spend more time because you need to occupy yourself with – in the holidays, it's for more social aspects.
B. I probably spend about an hour; that's mainly for homework anyway but in the holidays, not a lot.
C. About an hour.

6. What do you use technology for?

7. Do you carry out multi-tasking with technology?

C. Yes.
A. I do.
B. Often.

8. What activities are you doing when you use your phone with another activity?

C. I sometimes listen to music when I'm doing my homework & I'll be on the internet researching things on my Ipod. So, I use my Ipod for music, and my phone for researching.
A. I'd say it depends what you're doing. If you're doing homework you are going to be more focused.
B. Listening to a bit of music. You switch back and forth.

9. What technology do you think males like using most?

A. I'd say, probably, You Tube, social internet websites, have access to such a vast range of things you can do.
B. I'd say the same thing, anything you can play about with, have a look at, work out what it does, anything you can do a lot of things
Int. What sort of things?

B. Like gaming, music, internet.

10. What technology do you think females like using most?

A. I'd say generally more social media because they like to you see a lot use a lot more activity mainly on phones, sometimes tablets.

11. Do you use all the features on your phone? What percentage of features would you say you use?

12. Do you prefer to call or text?

A. I'd say generally text because you don't have the pressure of people constantly talking. If you send a text, you don't know what to say so you have time to think. With a text, you've got a little bit of time to think about it.
B. I'd say probably texting because it's slower. The phone's over really quickly. If you text, you don't have to memorize anything. With texting, if you send a text you have a written memory.
C. Yeah, texting for me.
I. That's interesting.

13. What makes you decide to text rather than talk?

B. If you want a long conversation or just a chat with someone I'd text back & forth, and if it's a length of time probably cheaper to text.
C. Would you do that with texting or use Facebook?
A. It depends what's nearest. If you're out and about, it'd probably be texting but if you're at home, you'd use Facebook on a laptop.

14. What makes you decide to talk rather than text?

A. If it was urgent or something or if I was trying to meet up with someone maybe..... to arrange something or if I was in town or something.
B. Yeah.

15. Do you ever think of the possible health risks of using a mobile phone?

16. How would you describe a mobile phone to an alien (or someone who knows nothing about mobile phones)?

A. I'd say the first thing would be to explain that you can talk to people through it with people in your area, so it connects to telephone lines & you can just talk to people. I'd say with more modern phones, you can do a lot more things .... more things. A phone is a device that you can use primarily to talk to people with but with more modern phones, they allow you to do other things like, take pictures and photographs.
B. That's pretty much what my answer would be as well.

Group 4: Interview 14-18s at Further Education College, 2014

1. Can you tell me what you think about mobile phones please.

A. I think that …. They are good when you want to, like, contact someone.
Int. Yeah.
A. But sometimes if you're like sat in your group and everyone's on their phones, there's no point. You use it to meet up with people, and then when you're there, you're still on it, so.
B. Sometimes it's good and sometimes it's not. Yeah, like, I think they're really, really useful for, like organisation and they're really good for, like, changing if something happens, then, you can just ring someone so they're really good from, like, a safety point of view but on the other hand, they can be bad for that if you're not careful.
B. Yeah, they can be quite a big waste of time. They're really good for, like, if you use them, like usefully, but otherwise not great.
C. Oh, yeah, like, um, if you have a good phone and then you're in a country, or something, or all your friends are from another country, you have like a way to connect them together. If you like, er, sometimes I'm like quite shy to talk, so I use my phone to actually talk to them, people through chat first, then I go and talk to the person after I feel comfortable.
Int. So, if you've built up a built of a relationship and…
C. Yeah, I've done that, like because if there's people who I meet, and I talk to them, and I never meet with them in my whole life, then someone else says this to me, or gives me their number, I go and talk to them.
Int. You mentioned something about the drawbacks of having a mobile phone.
B. Yeah, well, they can be a big waste of time. So, they are really useful for meeting up with people, but if your family is abroad or whatever; my sister is at uni or something, then I can Facetime her, and something like that, but if you are by yourself and you should be doing work, you can find them really distracting. It's just like you're bored, and if you didn't have phones and technology, you'd probably like go out for a walk or you'd do like something else, but you don't because they are just there. They are so easy to access and if you're doing work, it's just like really distracting because you're like, Oh, I wanna know what it says, but I'm doing my work so, you're not really concentrating.
Int Could you do anything different? Like put it in another room.
B. You kinda, I kinda, like end up doing 10 minutes,
then checking it, then go back and doing work.
A. It's like, I'll think I'm going to go to bed early because I'm really tired, but then you'll sit there, like on your phone, for an extra hour or something, like looking at, just, random stuff. (Others laugh in agreement) You might not be even talking to someone… You are just like, at Instagram, or something or like, just things that amuse you and then, by the time you look at the clock, you are going to be like 8 and it's like half past 12.
B. It happens.
C. Like you start one thing and then you get distracted by things, and then you like click on it, and from there, by the time you look at the time, it's like 5 hours and ….

2. Why do you think the mobile phone has become such an important part of everyday life?

B. I think cos, like, we said before, we need it to communicate with people.
A. Yeah, like, if I'm going to be home late from school or college, I'll just ring my Dad and be like, can you come and pick me up or I'm going to be a bit late and stuff like that. And like the school, the college, they send us texts as well, like to say, oh, your psychology class has been cancelled cos the teacher is not in and without that, you wouldn't really know.
C. It's quite handy like it's right there in front of you. You don't have to worry about carrying it all around it's like, you can just put it in your pocket and you have everything in it.

3. Would you say it is a luxury or a necessity?

A. I'd say both, like because like you can get like, really old phones like a brick, where you just call and text on. I would say like right now, that is a necessity. Then you can text or call your parents and tell them where you are, and stuff, but then all these phones you have now, like iPhone, and you can take photos, go on Facebook, Instagram and Snapchat and all of that I think that is a bit of an accessory kind of thing ….
Int. So, it is an accessory rather than a luxury?
A. It's like, a bit like a luxury being able to do everything (emphasize the word everything) on it because phones are first invented to just text and call.

Int. So, like iPhone would be a luxury?
A. I think iPhone are a bit of a luxury because they can do a bit of everything (agreeing).
Int. Yeah.
A. Whereas they're not like one of the old phones that can only do what they are originally invented for, that's like a necessity.
B. On the other hand like my Dad, my Dad, he will like, when we go away, cos we can get internet, if he can, he will check the news and something on his phone which will like influence what we do for the day whether we go that kind of thing that's kind of a necessity like to figure out how you are going to get home type of thing.
Int. Yeah.
B. But you can't get that on the, like the brick (laughs and another Ps laughs).
B. I think it depends what you need your phone for because like, if you do need it for stuff like that you need a phone that is more capable of it, like something that is a bit better is a necessity not a luxury, but if you only need it for texting and calling, anything more than that is a luxury.
Int. Yeah.

4. What technological gadgets do you like using most?

C. I like, only use my phone and sometimes my laptop and that's it.
A. I use my laptop and my phone.
B. I use an iPad because I don't have a laptop. I like that. I think it's really good.
Int. Do you have smartphones?
All. Yeah.

5. On average how many hours do you spend on technology in a day?

A. I wouldn't say I like, use solid hours. Like maybe a couple of minutes just to see if anyone's text me, or if I've got any missed calls because that's how work gets hold of you. That sort of thing. You always want to know but I wouldn't say like I don't know.
B. I don't really know because you don't really think, Oh, I'm going to watch an hour of tele, or like I'm going to go on my phone for an hour. Your kinda' like, like you might text your friend at lunch to find them or you might like, ring your parents to say, like, I'm coming home now. You might get home and you might like, text other people, but it's like really short kind of things.
Int. So, when you are doing your college work, what are you using?
B. I use the computer in the library. Maybe like 4 hours, 5 hours maybe including, like computers at college. I don't really watch much TV at home. I don't really have time for it, because I'm working, and college work, and everything.
C. Yeah, like, I have lots of work, so I use the computer at college. 3 hours. When I get back home, I will be …, I check my mobile and look at how many messages there are, look at, like an advert if the conversation is like going then probably two hours, for me I'd say. The rest of the time, I'm on the laptop or something. So, 3 hours.

6. What do you use technology for?

Answered in Question 5.

7. Do you carry out multi-tasking with technology?

B. Yeah, I'll like, read, and then like, carry on like a conversation, through like Facebook messenger or something. I don't use multi gadgets at work cos you can like ….
A. Don't you, I do?
C. I do.

8. What activities are you doing when you use your phone with another activity?

C. It sounds so weird, but I can like be on my phone, and I'll be watching a film on the phone, and I'll be texting at the same time, then at the same time talking to someone else, and then doing like work tasks at the same time. It sounds weird, but I actually do it.
Int. So, do you like have one tab open for… and one tab?
C. No, I have, like my laptop in front of me, and then I'll be doing something, watching something on that, and then at the same time, I'll have like, my phone texting someone, and then, at the same time, my sister might be talking to me. I'll be able to have a conversation with her at the same time, as I have a conversation on my phone, and then at the same time, like, I'll have my homework in front of me, but I won't be really concentrating on my homework but, you can't ring me, I'm doing my homework, but then I'll be looking at texts.

A. I can’t carry on two conversations at once.
B. If I’m speaking to my sister and I’m trying to text, I’ll either say to my sister what I’m texting, or I’ll write down what she’s saying to me. It’s so bad like my texting is so bad.
B. I go running sometimes, and I always have my music on. I never usually text because I will probably go face plant into the ground. I have my phone on me because if you like fall over or something. It’s like, please ambulance; I’ve made a bad decision or something.
A. It’s quite useful to have but I only need it for work. You can’t really go to the gym and text at the same time.
B. Yeah.
A. It depends what equipment you’re on because.
B. Yeah.
A. Because if you have it like right in front of you, that’s kind of OK, but like, you might roll over and die.
B. Say if you’re on the cross trainer … you’ve got to be able to have your hands free (to use the phone) or to like, do some stuff, you can’t just use It doesn’t really work.
C. Watching movies, texting, and my homework but then I won’t be really concentrating. If I have like a deadline, I’ll put everything away. If I don’t have a deadline, I’ll have everything in front of me.

9. What technology do you think males like using most?

B. I want to say computers. I don’t think they’re any different from how we are.
A. To be honest with you, I don’t think they’re that different. Yeah, cos my brother, he’s always using his laptop, and he always uses the same ……
B. I’d say laptop and phone probably.
A. My brother’s always on his Xbox.
B. Yeah, they use that more than girls.

10. What technology do you think females like using most?

All. Phone.

11. Do you use all the features on your phone?

What percentage of features would you say you use?

A. No, I think I use…. Your phone comes with all these. It comes with loads of stuff that you’re never going to use, and you download the ones you use the most. So, I think I use about 4%. Literally nothing, it’s like texting, calling and Instagram.
B. That’s what I use.
C. I download some things. I download something and then I delete it and do another one. I get bored and then delete that one. One more thing, I keep is just like chat and things.
Int. What sort of thing do you download and delete?
C. Probably, like games and stuff, I have like apps in psychology and like apps in biology.
Int. What do you use?
B. I don’t really know. I’d say I use I use messenger on my phone. It’s all messages because my storage is limited. I don’t have any games or anything. I literally just have messenger. They’re pretty much what I use my phone for, .. and photos
Int. What percentage?
B. Well the phone comes with messenger, but I download messenger, so I’d say 80% messenger and other stuff like looking up something on the Internet or something.
C. I probably use 80% and I download 2 or 3 apps.
12. Do you prefer to call or text?
A. Text.
B. I think it depends because if it’s like a friend that you haven’t (seen for a while) like my friend who lived in Somerset, now she’s moved to Torquay in Devon. Whenever I talk to her we don’t really bother texting, so we just call each other, because it’s so much easier to catch up and everything. It’s so much easier to have a fluent conversation by call.
C. I like to call. If you want to have a long conversation, I just tell that person please call me.
B. Yeah.
C If you’re having a conversation or text.
B. If it’s like a really casual conversation, it’s really easy to have it by text, but if it‘s like a big catch up, like, Mum I’m getting the bus home at 3, I’ll just text them. But if it’s like an emergency or a long conversation, it’s so much easier to ring.

12. Do you prefer to call or text?

13. What makes you decide to text or talk?

14. What makes you decide to talk rather than text?

15. Do you ever think of the possible health risks of using a mobile phone?

C. Yeah, like when you use a phone next to your ear, you have the radiation, and like, I also heard that at night time, if you don't have a background light, and you are concentrating on your phone, it puts more strain on your eyes, that kind of thing.
A. I never really think about it though, because I only use it for a couple of minutes at a time. I'm not really thinking ….
A. Yeah, to be honest, you're talking about the strain on our eyes. I never do that because when I go to sleep, I am going to sleep right now. I don't really care. I am just like I am going to bed right now. And, I put it on, 'Do not disturb', so if I do get a message it won't show me, so, I'm like not tempted or anything. I'm literally just I'm going to sleep. I do think that's important because you can, like spend so long on your phone, so if you did see something, you'd be on your phone for hours.

16. How would you describe a mobile phone to an alien (or someone who knows nothing about mobile phones)?

C. Everything you need to know, is like, it's right there.
A. I think the only thing it doesn't do is feed you (All laugh).
B. Yeah, pretty much.
A. An electronical box.
C. It tells you what you need to do but it provides you with information it gives you that information.
B. It's like a device that helps you to communicate with people that you are not necessarily next to. It send signal to someone else from what you say to where they are.

Group 5: Interview 14-18s at Further Education College, 2014

1.Can you tell me what you think about mobile phones please.

A. I think they're necessary.
B. I think they're more than just a phone now. You sort of keep all your appointments on them now and you can go on lots of different social media rather than just using it to call people now.
C. I think they're pretty useful, yeah. I don't really use it for social media or anything but I use it as an MP3 player.
Int. Do you have smart phones?
A & C. Yeah
B. No, but I don't.

2. Why do you think the mobile phone has become such an important part of everyday life?

B. Because everybody has one.
A. That's how it's become for arranging to meet up with everyone and stay in contact with everyone, that's sort of what everyone does now. Sort of text each other, call each other all the time.
Int. Yeah.
B. You just use it for everything like a clock.
Int. Yeah.
A. Exactly.
B. You use it as clock a camera.

3. Would you say it is a luxury or a necessity?

A. A necessity but a smart phone is a luxury. You need a mobile phone just to stay in contact, but you don't really need everything that comes with it like all the apps and the camera phone. But you need a mobile phone for emergencies that sort of thing.
B. Especially, to get hold of your parents and that kind of thing to let them know where you are and things. Yeah, like when I lost my phone, my Mum was stressed out so much because she didn't know where I was, and stuff like that, so I think it is a necessity for everyday life.

4. What technological gadgets do you like using most?

B. My Xbox and music on my phone.
A phone. I'm always on it. Like in the evenings and things like that.
B. My phone and my laptop. Those two.

5. On average how many hours do you spend on technology in a day?

B. About 4.
C. Yeah, 4
A. I agree, about 4.

6. What do you use technology for?

7. Do you carry out multi-tasking with technology?

C. Yeah, a lot.
B. Yeah.
A. Yeah.
.

8. What activities are you doing when you use your phone with another activity?

B. I spend time on my laptop. I use my phone and go on Snapchat while I'm waiting for it to load. Yeah and I'll text people and say, what are you actually doing? while I'm doing chores or something, to make it less boring.
Int. Yeah.
C. I listen to music when I'm doing chores and exercising but if I'm doing stuff like revision, I try not to multi-task.
A. I'm always using my laptop when I revise so I guess that's still on technology. I guess I'm always on it.

A. I use my laptop and my phone and then in the evening and then if I’m just chilling I’ll probably watch TV whilst on my phone.

9. What technology do you think males like using most?

B. Xbox.
A & C. Yeah, yeah.

10. What technology do you think females like using most?

All. Phones. You never see girls like put their phones down.
Int. Why do you think girls like using phones so much?
B. It’s more like social and they just want to be in contact, usually more, they use a different like Snapchat, texting, different things.
A. Yeah.
Int. So, if you had to choose between your Xbox and your phone, what would you choose?
B. Yeah, I’d choose my Xbox. I lost my phone for quite a long time and I got used to not having one. Um, yeah, so I’d probably choose the Xbox. The thing is with the phone, it’s just because everybody else has a phone but I don’t really have to have one, it’s not such a necessity but because everybody else has a phone and I know their numbers I need it.
Int So you’re not so bothered about it.
B. No.

11. Do you use all the features on your phone?
What percentage of features would you say you use?

C. I don’t use them all.
A. 80/85% but not all the time, like some I only use occasionally like with GPS, to find where you’re going. I don’t use that very often, but I do sometimes.
C. Mine’s probably the same.
B. I probably use about 30% of them. The alarm clock, music and the calendar. I don’t use the Internet or anything like that.
Int. Do you all use calendar?
A, B & C. Yeah.
C. I put everything on my calendar.
B. I put a reminder to come here.
Int. Do you get lecture information on your calendar?
B. Well, we’re supposed to. Sometimes we get texts, or the teacher doesn’t say.
Int. What? They forget.
C. Yeah. It does help when they do text out. And re-arrange it.

12. Do you prefer to call or text?

C. Text.
B. Text because it’s cheaper.
A. I prefer to call.

13. What makes you decide to text or talk?

C. I’m quite awkward on the phone I think. So, in a text, you can think about what you’re gonna say and you can revise it.
B. If I’m at work and I can’t really talk on the phone, it’s easier to text then.
A. Right. I don’t like calling people say if I’m sat with my Mum. When it’s not convenient to talk. I don’t know, if I’m in a social situation with my friends, it’s quite rude so I’d rather just text and then come back to the conversation with them.

14. What makes you decide to talk rather than text?

B. I think it’s way easier over the phone, like rather than on text where you’re like, where shall we meet? And the friend says like ok, do you want to meet? Oh, like, here I just find it easier, and they respond quicker as well, and, like, you don’t have to wait for them to text you back.
C. In an emergency obviously because they are on the other end of the phone, you don’t have to wait for them to reply.
A. When you need to know something, you don’t want to text all the time to say.

B. You can sort of communicate easier. You can get emotions and stuff across and like voices and jokes and stuff you can get across.

15. Do you ever think of the possible health risks of using a mobile phone?

C. I've sort of hear stories but I'm not sure how much to believe.
Int. What sort of stories?
C. There's one about brain cancer and about putting it under your pillow, something like that and it's by your head when you are asleep so it's really bad for you, something like that.
A. I'm never quite sure what to believe about health things like that I don't really know what to pay attention to.
B. I try to avoid putting my phone near my head and stuff. I know it's not really good because of the frequencies and stuff like even though you can't see them, they're still there and they do stuff to people.
Int. So, how do you know that?
B. Um, I've just researched into it a little bit. I just did it myself.

16. How would you describe a mobile phone to an alien (or someone who knows nothing about mobile phones)?

A. To keep in contact with someone who is to far away to hear you.
C. Um, I'm not sure.
Int. There is no rush. You can think about it a little. There's not a wrong answer.
C. Yeah, ok. A way to keep in contact but also most of them have other features so you can use it to basically plan your life.
B. Um, you can keep all the information you need in it.
A. Entertainment. It's got games and things you can play on and music, all different things like the Internet that you can go onto to access lots of different things.

Interviews with University students

Group 1: Interview with university students on Friday Nov 12th, 2014

1. Can you tell me what you think about mobile phones please.

K. In general?
A. I think mobile phones have evolved quite a lot, so, I think in that sense it's become …… No-one thought a mobile phone would be just a mobile phone. Now, a mobile phone is just an app on a phone.
L. Yeah, that's true.
A. Along with other apps.
K. My mobile phone is completely essential to me, but I barely ever text or call people on it. I use it for mail and all my university stuff because….
A. Exactly.
K. It's like, because it's like automatic, like my computer and stuff, it's an excellent back up if I can't bring my laptop and that kind of thing. I don't think mobile phones are just mobile phones anymore. I think they are palm top computers or a back step for old fashioned palm tops if anyone remembers those.

2. Why do you think the mobile phone has become such an important part of everyday life?

A. Yeah well, as she said, I think, because of emails, all the apps you have, Twitter, link up to social networks and these are quite important things to be people now.
K. Yeah, like, I think that, on that note, it's like a balance between convenience and actual useful like functionality. And then all those things like, you talk about the apps and social networks. I think people have become so embedded in constantly needing to be, like given information and updated about stuff. And like the games are so addicting, people can't put them down.
L Yeah exactly.
K. To the point that anybody who doesn't have a mobile phone on them anymore like all the time that kind of thing.
A Yeah.
K. And I find myself looking at Facebook if I have 5 minutes, and I'm trying to load something on my phone. Yeah, it's pretty dreadful really.
A. I agree.

3. Would you say it is a luxury or a necessity?

A. I think it is now a necessity especially now you have emails on your phone. Everyone, especially if you are in a university environment, they're always expecting you to look at your calendar because you have your calendar.
K. Mm.
A. Go on your phone, because things are always changing, so I feel the need to be always on my phone to check and update myself about these things.
K. I think so, I think it depends on how you view it though, because I think there is a certain necessity for a mobile phone for physically having a phone on you, which actually in today's society, in reality, it is the way people contact each other. The only reason I got a mobile phone in the first place when I was a kid was to be safe and my parents wanted me to have a phone on me.
A. Yeah.
K. So I was able to contact them in an emergency, anything like that, but then also again for the calendars and stuff, for example, our timetables for our lectures are not put down on paper anywhere.
A. (laughs) No, you cannot.
K. You have to have access to the internet, which you can have through your phone and it's the most portable and convenient way of doing it.
L. And…
K. Certainly if the lecture's move or anything like that, the only way to find out is through your mobile phone and you have to find out so you have to have your phone on you.
A. Yeah.
K. I had that the other day and I didn't have it, so I didn't know where the lecture was!
A. Yeah.
L. Yeah.

K. It sucked, but then at the same time, there is a luxury component to it, in that you don't necessarily need an iphone or the latest smart phone.
A. Yeah, yeah I agree.
K. Because those are the phones that come up with all the luxuries, like the games and social networks.
A. But the updated models though. I think, for example, that they are constantly updated, but is there really a need? I mean what's the difference between an iphone 4 and an iphone6?
K. Yeah.
A. You can still make calls.
K. Yeah, it's just a ….
A. One is a necessity and one is going a bit too far.
Jo talks about how the other group thought that an old phone like a Nokia that you could just call on was a necessity, whereas an iphone type phone was a luxury
A. I do agree with that, because a phone is there, for if you need to get in communication with someone but I think that it is, as I said before, phones have evolved so the use of the internet is dominating society. Everyone is on the internet doing something or other. It's become so important where we have to constantly use it. I think the iphone can facilitate that whereas the Nokia can't.
K. You are aware of what you need what you do because I have friends who are say graphic design students or art students who constantly need to have the capacity to have a camera with them, and that kind of thing, but the old Nokias have it, but it wasn't nearly to the level of which they need to know and I think, yeah, I mean, for example, you know, if I had a kid who was primary school age coming into secondary school age, I'd expect them to be able to have a Nokia or something so they can ……
L. Yeah, yeah.
K. Make calls easily so they can get the bus to school that kind of thing on their own but then, I think when it comes to the point where you are at university or going into your professional career, you need a certain level of functionality these days, in order to stay ahead in your own field in what you do. I think different phones, different updates and different levels of technology cater to you depending on what you actually do.
A. Yeah. I would agree with that as well.

4. What technological gadgets do you like using most?

A. I think the ipad. I think that's the most useful thing that has come out, as in a tablet because it is your computer in a table, in a portable form. You can see in a lecture that everyone has their ipad, or a netbook because of how useful they are because they can do similar functions or the same functions as a normal laptop or a computer, so I think that is the most useful one.
K. I completely disagree.
A. OK.
K. I have an ipad, and I don't use it. And the reason I don't use, it is because I have an iphone which I got just afterwards, and I mean my iphone can do everything that my ipad can do.
L. I think the ipad and tablets of that kind still lack a certain level that laptops can provide. I bring my laptop all the time because the storage capacity on my laptop is better. The graphical capability of my laptop is better. And, actually if you think of the ipad, as the most up to date tablet, if you have the most up to date laptop which the majority of people don't, um, because they don't want to invest that much money in an item. I think computers still outstrip tablets and that kind of technology, so I think having a laptop for me is much more essential, and I use my phone for all the things that my ipad would do.
A. I think I would disagree with that as well because, in my opinion, if you know how to use the ipad, like I use my ipad for a lot of things, and I think if you know how to use it, the most effective way, for example, is, downloading apps, Word, Excel, and they still work and you can carry on …. So, I think, in that sense, you would have to have a lot of knowledge about ipads, in order for it to be fully functional and to be on the same level as a laptop, and I guess not a lot of people would have that understanding of how to use an ipad, so I think I would agree and disagree.
K. I don't know. I think I am biased just because my boyfriend's a PC gamer.
A. OK.
K. Which means I'm a computer gamer.
A. Yeah, yeah.
K. But, like, I play games on my laptop that there is no way an ipad could match.
A. Oh yeah Oh yeah.
K. But maybe that's the only difference.
A. In terms of games a PC is on top.
K. Yeah.

5. On average how many hours do you spend on technology in a day?

K. Oh my god! Far too many. 8 to 9 hours.
A. Yeah, I think it would be most of my day apart from when I'm sleeping. I think it would be from the start of the day….
K. Probably 8 to 9 hours a day.
A. Yeah, solid hours.
K. Yeah, I'd agree. I mean I use it from varying degrees.
A. I mean you start the day, because your iphone has woken you up. It's the first thing you check and then you get your messages, and it starts from there Then you get ready and then you start checking your timetable on your phone. So, I think, in that respect, you are constantly surrounded by …
K When you say technology what do you specifically refer to?
Int. That includes the TV.
K. OK, so everything like TV, laptops, that kind of thing.
Int. It doesn't include hairdryers.
L. 8 to 9 hours.

6. What do you use technology for?

Ansared in previous question, so not asked.

7. Do you carry out multi-tasking with technology?

A. Yes, all the time.

8. What activities are you doing when you use your phone with another activity?

A. I'll be using my laptop and I'll probably have the TV on as well, so I guess that's multitasking. When I'm on the laptop, I'm doing all sorts of multitasking as well. So, I'll have one tab here and one tab …. So, I'll be looking at this page while I type the age (on another tab). Or watching a video on this side of the computer while I work on this side.
K. Yeah, I do that.
L. Yeah, so I do that sort of multitasking. I can be multitasking on the same computer as well.
K. Yeah, so last night, I'll give you a really prime example. I was sat watching the TV. I had the laptop on my lap, I had one tab open where I was watching snippets of videos on You tube and stuff, and then I had another tab open where I was doing my wedding planning and then I had my phone. So, it was the ultimate multitasking but that's a typical evening for me. Although, that's only if my partners not there. If he's there, I'll generally like just watch the TV.

9. What technology do you think males like using most?

K. Console, obviously.
A. I would say consoles and PC.
K. Probably consoles rather than PC's. Probably both.
A. Yeah. Just gaming in general; anything that can facilitate gaming.
K. Yeah.
A. Why do you think that is?
K. I think it's a culture.
L. Yeah, I think it's a culture too.
K. Gaming is geared towards male. You can see it the media. The PS4 convention was aimed at boy gamers and the hardcore boy gamers. But that's the way I saw it.
L. Yeah, that's definitely right for boy gaming. In fact, there has been a lot of prejudice. A small amount of make gamers… there's been a lot of stalking and cyber bullying to high profile female gamers like Felicia Day who are out there trying to show girls can play games too and it's fine.
K. Star craft and Twitch TV is aimed at …, towards blokes, and Twitch TV itself is a streaming site where you can watch people play games, and they have a little window of themselves playing the games and they make money through it. So, the girls do it to make money.

10. What technology do you think females like using most?

K. Phones.
A. I would say phones but …

K. It’s hard to know but a lot of the girls I know are girlfriends of guy gamers who would therefore probably use slightly better technology because they have more of an awareness of it, but most girls I know hobby-wise are around Instagram. My sister, for example, spends her entire life on Tumblr and she’s always on her phone with it. It’s probably phones.
A Yeah, phones.

11. Do you use all the features on your phone?
What percentage of features would you say you use?

A. I think for my phone I use all of its features and then add ons.
K. I agree. I was going to say it depends how you define the features on an iphone. Yes, because I use all the basic features that I have on it. When you get an iphone and you take it out the box, it comes with preset, I think its maps, notes, calendar, email capacity, tax and phone but everything else that you want to use it for, say for example, I have a PDF reader on there, I have games on there, that’s all, stuff I’ve had to buy or install but then …….
L. There are things in the accessibility menu. You can turn on touch sensitive features, actually pressing buttons so there are things like that so that’s another thing on the phone so I use that. I don’t have to keep clicking my home phone or pressing the buttons.
K. But then… yeah …. If you wan tto cal afeature anything you can have or use your phone for There is so much now that you can install or do on the phone it would be physically impossible to have everything on the phone.
A. It would run out of memory before you could get them on.

12. Do you prefer to call or text?
K. Text.
A. Text, but I think it depends on the situation as well. If I need to speak to someone after a very long time, I wouldn’t text them, I would just call them and then there’d be a more fluid conversation than a text.
L. Text.

13. What makes you decide to text rather than talk?
K. I just don’t particularly like phones. The times where I make a call are times when I’m doing something professional or formal, things like ringing up people for NHS or services, that kind of thing so at this point it’s kind of formal type things. I hate ringing people because sometimes they are so awkward on the phone. It’s like, when you come to hang up, people are like, er …. er …
A. Yeah.
K. Bye. It’s like I don’t know what to say to you now.
Certain individuals it’s better just to text. You get an instant response, a little bit less like waffley, and awkward. I don’t know. Yeah, I guess it’s quicker to text. You can just send a text and forget about it.
Int. Would you rather text than email?
K. Oh yes definitely.
A. I would rather text than email.
K. I never email now. If I have to email someone, I do it on Facebook, and then I instant message them. It’s quicker and they get notifications, so they are more likely to reply.
Int. I prefer to email because I find tapping out a message on the phone takes me longer.
K. Given the scenario where I had my laptop open, I would probably instant message them. I have two separate email accounts. I have one that I use for all the rubbish I signed up to when I was about 14, and I have my university one which I use for all my professional contacts. With all my emails at university, I get so much rubbish, spam and information about studies.
A. I think text is more personal than email.

14. What makes you decide to talk rather than text?
A. When I want to speak to my family. I wouldn’t text my Mum or Dad. I mean if I wanted to have contact with anyone over the day, I might text them but if I wanted to have a chat I’d call, or if I hadn’t spoken to my friends for a long time I’d call. A text message contact that would have taken two days, I can just have in one call.
K. I think a sense of urgency. I mean, yeah, I ring family and friends generally. But I think a sense of urgency prompts me into calling. I know when I leave at the end of the day, I want to call my partner to tell him that I’m on the way home.

15. Do you ever think of the possible health risks of using a mobile phone?

A. Sometimes, my phone heats up after I've been on the phone for a long time, and I wander what that did to me, in terms of the radio waves and stuff. I wander what happened there.
K. Mm, I do but not in that sense. I know there was a big scare about having your mobile phone next to your ear ruining your brain. That was a while ago and was vastly publicised and mostly rubbish. There was a whole thing about having mobile phones next to your bed, and the idea that your phone gave out radio waves, some kind of wave, that was genuinely deteriorating your brain. It came from no basis of science whatsoever. It was all public scare tactics I think really.
L. Yeah.
K. However, from a psychology perspective, I would worry more about the associated social and health risks of continually being on your phone. It's the general culture I think. I'll mention two things; one is, for example, last week I went away to Paris and I was stood in the Louvre looking at the Venus of Milo and about eighty per cent of people around me are looking at it through a camera or phone. That is not, to me, viewing a piece of art. That's viewing a photo of a piece of art which you could do at home from a computer and it's not the same. I think it' just not the same thing. You're not there experiencing it, if you have to look at it through a camera. I can't bear it. I feel like, put down your phone and experience it.
Int So, what is that about?
K. There is this association now of having things, like photographic or video images of something, being memories of something.
A. Yeah.
K. And this fear that if you don't have a record of what you've done you'll forget it. That's it. It won't exist anymore. Those are your memories.
Int. They define your existence?
K. Yeah. Yeah. And verifying the experiences you are having.
Int. Your identity?
K. But it's just not true really. I don't think you remember things from the photos. Yeah, the photos are nice to have, but how often do you really go back and look over and over them. Or do you just remember the experiences you have when you see the photos?
K. There's also the thing where people don't talk to people much properly. For example, there's this horrible thing, my parents will sit in a living room, each on a laptop and message each other from the other side of the room.
A. Yeah.
K. And I've been known to do it with my partner when he's playing a game and he's got his headset on and he's very much involved. I message him through his computer. That's terrible that people do that. People live like that.

16. How would you describe a mobile phone to an alien (or someone who does not know what a mobile phone is)?

L. It's a device to communicate via several mediums symbolic and/or vocal or auditory I guess.
A. Oh yeah.
K. Portable, clearly. I guess it's how you define a basic mobile phone but then if you wanted to start describing individual phones I think, if they didn't have the technological capacity themselves, you'd lose them.

Group 2: Interview with university students on Friday Nov 14th, 2014

1.Can you tell me what you think about mobile phones please.

G. I think they're good. They keep you connected to a lot of things.
A. They help you to communicate with a lot of people and keep up to date with birthdays and arrangements especially if they change. It's a really good way to keep in contact with someone if you change things like your family especially when you are at uni.
G. Social Media.
M. They have the potential for streamlining everything you do. It's like…, a mobile phone is, like…., having a hub for the majority of things you interact with. So, at some point, I'm pretty sure your mobile phone might be your credit card.
G. Some banks……., you can actually just pay into someone else's account through using your mobile now.

2. Why do you think the mobile phone has become such an important part of everyday life?

A. It helps us with a lot of really important things in our lives. Nowadays, it's social media.
M. Keeping contact with all our friends, calling our family. Everyone has a mobile phone and that's why.
G. Like university stuff everything is online.

3. Would you say it is a luxury or a necessity?

A. I think it's a luxury if you have an iphone, but I think it's a necessity if you have one of those cheap Nokia phones.
G. What about lecture notes?
M. I just use it for my timetable. But I think it's really important to have a phone.
G. I feel safer when I have my phone. If something happened to me I could call someone. If I'm in the middle of nowhere and I break down …………………
A. I think it's important to carry it around at all times.
M. I think necessity could be quite a strong word because we are capable of functioning without our phones, I think. It just makes our lives a lot easier which is why we choose to use them.
G. It depends what your definition of luxury is? I mean, like, if your definition of luxury is just something you enjoy, in general, then your phone is a luxury, but it can also be a necessity, in the fact that the amount of information we need, like in order to function in life, like now, society, like, if we don't have that information you can't function in society, or with people, like in terms of relevant stuff, news, conversation.
M. It would be a much slower process.
G. Yeah. You would almost feel out of the loop, because you don't have the necessity, like you need to feel in the loop. You don't know what your friends are talking about. Certain things could be happening, and you would have no idea what's going on.
A. Yeah, it's like when you are on holiday, and you can't use your phone…….
G You come back, and you have about seven notifications. You feel so popular.

4. What technological gadgets do you like using most?

M. Laptop.
A. Yeah.
M. I'd say
A. TV.
M. I only use my laptop as my TV, to be honest. I watch TV on my laptop. But I'd say definitely my laptop.
G. Perhaps my phone, maybe my laptop.

5. On average how many hours do you spend on technology in a day?

A. A lot.
G. A lot Yeah. Say 6.
M. (sighs) aaaaah……
A. It's a big part of your whole life; being on computers.
M. It's difficult, thinking about it now, maybe 5.

M. I wouldn't be surprised to be honest. I'm thinking maybe 3, 4. But it's very arbitrary. It's a fair amount. There's a lot of time when you are just sitting, fiddling about on your phone, or sitting at your desk I use my laptop to listen to music while I work. Does that count as using technology?
M. It's difficult thinking about it now.
A. If you add it all up it would probably be about 6, 7 hours, probably.
Yes designs

6. What do you use technology for?

7. Do you carry out multi-tasking with technology?

G. Yes,
M. Especially with Apple products because Apple products are designed so the more you buy, the more they work well together, which is quite good as a business strategy, but it helps you streamline, especially with Apple products. It helps me stream line anything.

8. What activities are you doing when you use your phone with another activity?

A. Watch TV, and I'll be on my phone at the same time, on my laptop, and sometimes I will skype.
A. Listen to music on the phone and then I'll go onto some sort of website read a bit and then when my laptop's stopped loading, I'll go on my phone.
M. Sort of browsing.

9. What technology do you think males like using most?

A. Play Station.
M. I'd say that could be true sometimes, not for me. I like using my phone and my laptop. Say if music is playing, MP3 player, If I didn't have my phone, my music, I'd go crazy quite quickly. Netflix that's one of the worst things, and the best things in my life at the moment. You can get that on your phone or your laptop. It's like never ending TV, you can get that online on your phone.
Interviewer. Would you say that's a stereotype or do you think that is real?
M. I wouldn't say it's a stereotype. Guys definitely do like gaming. I definitely did loads in my earlier teenage years. I just decided to grow up.
G. I think guys do a lot of gaming. I think just because it wasn't always accessible to females at the time. It was like yeah, girls don't do that. That's why it is a stereotype that guys play with play stations.
G. They're quite manly games. Girls It's like a massive masculinity complex.
M. I do know girls who have play stations but on the whole, guys do have them a lot more.

10. What technology do you think females like using most?

A. Phones.
G. Phones…… and laptops.
A. Nintendo DS
M. (Laughs) Old school. Phones. I try my best not to stereotype but, if I had to, I would say phones.
A. You can just do anything on your phone.

11. Do you use all the features on your phone?
What percentage of features would you say you use?

G. Everything except stocks.
M. I use maps a lot. I think maps is the saving grace for a lot of countries. I would have got hopelessly lost so many times.
A. The clock, I use the alarm.
M. But it's more with phones, now because there are apps. There is such a huge number of things you can get on your phone.
G. I probably use 90% features on my phone.

M. The ones I have put on my phone I use a lot, but there is such a scope for additional apps I streamline my phone. I've made my phone the most efficient way it can be for all the things I use. I could tailor my phone to suit the need if I'm interested in.
A. I probably use 90%
G. Yeah, same for me
G. Every month or so I go to my apps and delete them.

12. Do you prefer to call or text?

A. Call.
G. Call.
M. Call.

13. What makes you decide to text rather than talk?

A. I find calling is quite long but texting you can do whenever you want and wherever you are. With calling, you have to sit down, and you have to talk to them.
G. Texting is much more convenient.
M. I find the most frustrating thing about texts is that it is difficult to convey my emotions when I text. There is a lot of scope for interpretation.
G. Like a lot of my humour is quite sarcastic and people would think you are being really horrible if it was in a text. I do love you really, and it's more immediate if you call whereas you can't convey that over a text. It's just texting takes too long. If you have a call of about 20 minutes, you've got rid of about 4 hours texting.
M. I try to call more than text. Texting is useful when you want to quickly get a conversation out the way that is more out of necessity
M. There's also times when you can't have a conversation. If you are in a lecture and you want to talk to somebody but you can message, then I will text. It's a very subtle way I guess. Depends what environment you are in.

14. What makes you decide to talk rather than text?

M. I would say it's definitely about being able to convey my emotions.
G. It's a more immediate response.
M. Also, I'd rather hear someone than reading what they are trying to get across in a whole text message.
A. Sometimes with texting you can get a really long message, but with my Mum I prefer to shout at her.
M. Reading a long text message is kind of annoying.
G. Sometimes you think aw, they spent all this time texting me, but you could have just told this to me. Just call me.
G. What I really like about phones is that when you do talk to someone, like you know the word um, you can't use that, express that in a text, it sounds like so sarcastic
M. Also writing. Ha! Ha! On a text doesn't work on a text. You are trying to convey the fact that you are laughing, but it just seems so irrelevant when you write it on a message like, it has no real meaning in it. One of the best things is Facetime or Skype, like when you have a conversation, but you can see the other person's face
G. I don't like that.
M. I think that is the best form of technological communication.
G. I don't like Facetime or Skype. I don't like the idea of the fact that I'll be sitting there, and I like, have to put trousers on, but if you want to call someone, they don't know what you look if you just call them, like (Participant A talks)
A But skype can be quite slow if your internet is not good.
M. It depends.
A. It's so annoying.
Interviewer. Yeah.
A. It makes me angry when it's slow.
M. Yeah when the resolution isn't good. But when it is in its best form, it is really good.
A. Yeah.
G. What I don't like is skype interviews, they never work. You get jerky responses.

15. Do you ever think of the possible health risks of using a mobile phone?

G. I read something. There was a study, wasn't there saying apparently you can get, like brain cancer but it was disproved.
M. You're talking rubbish.
A. When I was studying science GCSE, we are talking about radiation masts and the radiation from them being bad for you, but then my science teacher said most things are bad for us.
M. People told me that keeping a phone in your pocket increases the chance of getting prostate cancer. But I mean…. I sort of think now that I should probably do some research into the possible risks. I don't want to say the risks (pauses) The positives outweigh the risks. Yeah?

16. How would you describe a mobile phone to an alien (or someone who does not know what a mobile phone is)?

G. It's a fundamental communication device that you can use to talk to other people over long distances. It could be someone who is in the same room with you, or it could be someone in Australia. More than that, information hub I guess. Allows us to access information from the internet at any moment. If someone asks me a question I can just type it into my phone and google it.
A. You can use the camera.
M. Find out about entertainment.
A. You can put your arrangements on there, your calendar, your friends, all your contacts.
M. You can use Siri. You can talk to your phone. You can ask your phone to find out, for example, who Genghis Khan was, and you can get information straight away.
A. Does Siri work for you?
M. Yeah. It can also be a gaming device at the same time. You can get apps.
G. You can send emails.
M. It's like an omni tool. I suppose that's the best way of describing it.

Group 3: Interview with university students on Friday November 18th, 2014

1.Can you tell me what you think about mobile phones please?

A. I think they're very good I use them a lot. They're a very useful part of life.
B. Yeah. They're very useful and I rely on them a lot. I always want to have it on me.
A. I have an iphone, so I use it for a lot of things. Texting and calling obviously, the internet, Facebook.

2. Why do you think the mobile phone has become such an important part of everyday life?

A. Cos they are easy to use, and they can do so much. We rely on them so much. Being out and about a lot; if I want to know something I just google it. So, they can do so much for us. I first got a phone when I was about 13 or something like that because when I wanted to go out say when I went to the park with my friend my Mum would want me to be able to ring her. If I was meeting people or needed picking up. Also, if I was in trouble. Yeah, the safety thing as well. Maybe that's why girls use them more than boys because girls get more scared. That could be why girls are more attached to their phones.

3. Would you say it is a luxury or a necessity?

A. I think both.
B. Both. I think the phone part is a necessity and safety but everything else you can now do on a mobile phone is a luxury.
C. Yeah. Both.

4. What technological gadgets do you like using most?
A. Phone.
C. Laptop.
B. Phone.

5. On average how many hours do you spend on technology in a day?
A. 3 to 4
B. 3 to 4.
C. Yeah, 3 to 4 I'd say.

6. What do you use technology for?
A. Everything.
B. Yes.
C. Yes.

7. Do you carry out multi-tasking with technology?
C. Phone and laptop
A. Yeah, I sometimes listen to the radio when I am on my laptop.
C. If I'm watching a TV programme on my laptop, I might text at the same time. It's bad really because I'm being entertained by the TV but then I'm checking Facebook.
B. Yeah, Yeah, I'm the same. Watch TV and use my phone.

9. What technology do you think males like using most?
B. Probably phone.
A. Yeah, phone but then they use play station more than girls do.
C. And they probably spend longer on those.

10. What technology do you think females like using most?
A and B together. Phones.

C. Yes, phones.

11. Do you use all the features on your phone?
What percentage of features would you say you use?
C. Pretty much.

12. Do you prefer to call or text?
A. I prefer to text
B. Text.
C. Text.

13. What makes you decide to text rather than talk?
A. It’s more private
B. Yeah, more private. People can hear your conversations.
A. Texting you can do all the time You can be, like, watching a programme and texting or you can be walking down the road and texting.
B Yeah, it’s just like easier and quicker, but if you have a lot more to say you call.

14. What makes you decide to talk rather than text?
A. Depends how much I’ve got to say. If I’ve got lots to say I call or a complicated thing I want to talk about say, I would ring. If you are making plans, sometimes it’s easier to ring.
B. Yeah
A. Or sometimes if I want an immediate response I’ll ring. Like if I’m outside someone’s house waiting to pick them up, I’ll ring
B. Yeah
A. Because I’m like here, like now. If you text, they may not check it. So, if you want an immediate response
B. Yeah If I’m calling my parents, then I’d ring cos they’ll hear the phone and answer whereas if I send a ext, they might not look at it for a while, co calling is just quicker.

15. Do you ever think of the possible health risks of using a mobile phone?
A. Yes, the microwaves or whatever that damage your brain. My Dad tells us because of his job, like you can damage your brain if you are on the phone too long, they, like heat up your brain. You can actually feel it sometimes …
B. Yeah
A. I feel hotter when I’m on the phone … um … so, I guess there is that health risk if I’m on the phone for a long time. I don’t like getting really hot.
B. Yeah, and with head phones you can just have your phone in your pocket
A. Hands free
B. Yeah, also I wouldn’t want to keep my phone in my pocket. Is there a risk of cancer?
A. Isn’t it about your ovaries or something like that?
Int I think the risk is more for males
A. Yeah, boys always have their wallet and mobile phone in their pocket. It’s really bad.
B. Because their pockets are so much bigger than ours.
A. Initially it’s so much more-risky.
Int. Also where do charge your phone?
B. By my bed
C. By my bed
Int. Recommendations say not to.
A. Why’s that?
Int Because of the radioactive potential
A. What whilst it’s charging it?
Int. Well, any time
A. Oh, so while your sleeping your phone should be away from you?
Int. Yes.
B. When I was younger, I used to sleep with my phone under my pillow and my Dad said not to because there might be so much radiation.
A. It’s like there’s a magnetism constantly going round your phone. I didn’t realise it.
Int. Mm.

A. Especially modern one, the NFC, they have constant magnetic field round them. It's always there no matter where you are. It's like on your body.
B. Sometimes if I'm on a night out and I don't want to bring a bag, I put it in a pocket.
C. Really.

16. How would you describe a mobile phone to an alien (or someone who does not know what a mobile phone is)?

A. A small machine that you can use to communicate with other people far away from you.
C. and also them you. So, it is a communication device, but hand held and each one has a specific number and you have to know the number to be able to make it ring.

Group 4: Interview with university students on Friday November 26th, 2014

1. Can you tell me what you think about mobile phones please?

A. I think they are really useful for being able to arrange meetings with other people and, actually, so you can communicate and meet up with friends through your mobile phone. Yeah, just to be able to quickly communicate with someone, ask a question like, when you are shopping, you can straight away ask do you need me to buy milk for you?
C. I really rely on my mobile phone a lot for practical things. I find it really important for communication and, also, at university, it's really important to be able to keep in touch with people really easily, and people from home and keep that link. It's quite nice, because you don't have to invest a lot of time to, but, I'm also a bit of a technophobe. I've got a smart phone now. I had a brick phone for years and years, and then that broke down completely, and then I used my Dad's fairly smartphone for a few months, but now I've got an Iphone, I'm starting to get a bit more into it, using email and stuff. I want to start using the internet functions, because I have a contract with not very high data, but I don't really understand how much data is in any one thing. With calls, I kind of understand how much a pound's worth of calling time is. I'm not sure how to check but…
B. I have data limits on my phone, but I don't really understand how it works either. I try to stick to wifi rather than ….. and use the internet, when I can I do use it a lot. I was in France before, so used it to keep in touch with my family and friends.

2. Why do you think the mobile phone has become such an important part of everyday life?

B. I think it's because it's so small, well it was so small to carry around at one point. You could just have it in your pocket.
C. Phones are getting bigger and bigger now; they're turning into ipad size now.
Int. Do you think that's a good idea or not?
B. No, I like it being able to fit in a pocket. I like to be able to carry it around with me.
A. You have a calendar on your phone now. You can have a, To-do list, obviously you can still call and communicate with people, but it all just fits in your pocket. You can take photos…
Int. Is that how you carry it in your pocket
B Yeah but if I want to sit down I put it in my bag
Int. Is that a back pocket or a front pocket?
B. Mostly back pocket actually
A. They're so practical and it's very easy to become so reliant on them because just before getting this new phone, I didn't have a phone for a week, and I found it so difficult, because, I think just the way we make plans have completely changed. For example, when I'm meeting my Grandma, when I make plans with her, we will arrange to meet at the station at quarter past seven at Exit Number 3, sort of like that, and we make that plan the week before, but when I make plans with my friends now, it's more like we'll go shopping on Saturday, and people don't expect to have to say a place, stick to it, not to be able to say I'm ten minutes late on the bus. So, I think part of why they are so important is because they have changed our social organisation.
B. Now, like 230, doesn't really mean 230 anymore. It's like it could 225, or 235 or 240
Int. Is that annoying?
B. Well, No, because you can just text and say I'm running a bit late. So, the other person will know instead of 230 it's going to be slightly later.
A. But, some people do take the mick with it. I think if you know it's genuine so, for example, I have some very flakey friends, and I get frustrated when they regularly say like, 'Oh, by the way, can we shift it back an hour or something' but because the person does this every time, and this isn't just one circumstance, it makes me feel that, Is this how you view my time? But when someone genuinely has to be 10 minutes late …. I have the two worst ones, with them I know in advance, so I'd be like, meet at mine.

3. Would you say it is a luxury or a necessity?

A. I think for lots of jobs, it's a necessity now. I think lots of companies, they buy you phones or they wouldn't be happy with you not having a phone, because they want you to be able to use multi-media communication, contact you by email, and I guess have access to you all the time. I think in that way it's quite essential for a lot

of careers, but then I guess it's not so essential for other things, and I guess computers and ipads are doing more and more of the same things.
B From a more social point of view, I think, sometimes not having a phone can be more isolating,
a lot of people will be able to send out a message or call just to say friends are meeting up, and if you're not in the right place at the right time, you won't be contactable.
C. Apart from possibly jobwise … essential. I would say it's not necessarily a necessity but it's possibly difficult living without it.

4. What technological gadgets do you like using most?

A For me, I think like using is really the wrong word
Because it's not really something I enjoy it's something that is more really a means to an end. I use my Dictaphone for lectures. I'd probably be annoyed if lost my laptop.
B Ipod My laptop.

5. On average how many hours do you spend on technology in a day?
B. Probably from when I wake up to when I go to bed Maybe 15 hours.
A. For me yesterday I spent 3 hours studying in the library. I think I watched TV for like half an hour I spoke to my Dad on the phone for half an hour so that's four hours.
Int. Is that a normal day?
B. Yeah, that is pretty much.
C. Maybe somewhere in the middle. 8 hours.
B. I suppose it depends if checking my phone counts. I check my phone every ten minutes.

6. What do you use technology for?
A.TV.
B. Phone.
C. Use my laptop for university work.

7. Do you carry out multi-tasking with technology?
C. Phone and laptop
A. Yeah, I sometimes listen to the radio when I am on my laptop.
C. If I'm watching a TV programme on my laptop, I might text at the same time. It's bad really because I'm being entertained by the TV but then I'm checking Facebook.
B. Yeah, Yeah, I'm the same Watch TV and use my phone.

8. What activities are you doing when you use your phone with another activity?
B. If I'm on my laptop, then I'm on my phone at the same time. I have a long-distance relationship, so I use social media a lot to communicate with my boyfriend, because it's quite difficult sometimes to find time when we are both free to talk, so I'll multitask when I'm on line if I'm cooking. It's really bad. I use my laptop to work, so I don't get distracted by anything and then I'll use my phone to talk on. I'll mentally have a break if we are talking from work and walking, I'll listen to music.
C. Watching TV.
A. Yeah, I do a lot of things on the phone especially cooking, being round the kitchen, sometimes if I'm watching a film at my flat. If I'm using my laptop I might also be texting someone.

9. What technology do you think males like using most?
B. Laptops.
A. Yeah, I think guys like using their mobile phones as well. Yeah, I think laptops. Maybe guys are more into ipads and stuff.

10. What technology do you think females like using most?
A. Mobile phones.
B. Or laptops.

C. I think now, the functions of mobile phones and laptops overlap a bit more, so it’s kind of more about what different functions genders use, rather than different items of technology. Now. say you could be skyping on your laptop and then you could be gaming on your phone … it’s a bit more blurred.

11. Do you use all the features on your phone? What percentage of features would you say you use?

B. No.
A. No, I don’t think I know what half of them are. I don’t know how many features there are on my phone. I would say ten per cent I want to start using the calendar and reading maps. I feel I want to start using all these things like maps, import my calendar or get my emails to ping but then whenever I need those things, I’m not going to start learning a new way then.

12. Do you prefer to call or text?

B. It depends …… Mmm … I like texting, because I don’t feel like I’m imposing myself on the other person. Like I can text them and then when they’re free, they can answer me back, whereas if you ring they have to answer now, because you want their attention now. So, I tend to ring when it’s urgent and text if it’s for information or nothing very important.
A. I never even thought of it like that. If I want a piece of information, I’ll text. If I want to talk, I’ll ring and if I want to talk but maybe not to such a close friend I’ll normally text, and then if I get a chatty response then I might ring. Text maybe.
C. Call.

13. What makes you decide to text rather than talk?

A. I might text when it’s short and chatty sort of thing because it can take a long time to type.

14. What makes you decide to talk rather than text?

B. Yeah, if it’s something urgent or you’d like to have a proper conversation with that person. Generally I’ll be calling up to say can you go on Skype? It’s nice to see them without necessarily having to travel all the way over to see them.
A. Yeah, I used to Skype quite a lot but now I’m living in a house with 8 people and my internet connection is really bad. Actually, one thing that is bad about Skype is that you can’t multitask whilst you do it. I used to get quite annoyed when my Dad would ask me to Skype because you can’t go around tidying your room. If you are on Skype, you have to be on Skype.

15. Do you ever think of the possible health risks of using a mobile phone?

B. I do I think about keeping it in my pocket and then I do sometime think, hang on a minute if it’s been in my pocket for a while, I’ll put it in my bag instead. I try and not sleep next to it at night which also helps for my alarm ringing in the morning to get me out of bed. Yeah, I know about the health risks but I’m not very good at…
Int. What health risks do you know about?
B. Well, it’s the waves, isn’t it? I should probably know more scientific terms for it. And when I’m calling as well.
A. It can hurt your thumbs from too much texting.
Interviewer gives a little explanation
A. I think about it being in my pocket. People say don’t put it in your front pocket, because of ovarian cancer and stuff. We read a few articles in school and as far as I understand they haven’t found any evidence.

16. How would you describe a mobile phone to an alien (or someone who does not know what a mobile phone is)?

A. A small box that has different functions and different thing you can do on it, and you can call people, and you can hear them speaking from far away. You can talk, and part of it is you can write messages or send messages to wherever they are and there are other things you can do on it. You can find information.
B You can talk to someone who is not physically there. You can do it from anywhere, be anywhere and actually talk to someone who is anywhere else.

Group 5: Interview with university students on Friday Nov 28th, 2014

1. Can you tell me what you think about mobile phones please?

A. Well, I like them, but they do get to a point that you use them so much, and like, you don't even kind of realise it, that your missing things that are happening around you but, at the same time, I was thinking about this as I was walking over here, because with skype or iphones or even with skype, I can see my friends and family at home. I can use my iphone.
C. I can just speak to friends and family on Facetime and I can see their face, for example, yesterday for Thanksgiving. It was really nice, makes me a little bit less homesick.
B. Yeah, I think they are really useful like, if I didn't have my mobile phone I would feel unsafe I would feel a bit uncomfortable especially if I'm feeling a bit weird when going home at night or something but then again they can be quite anti-social, like, if there is a group of people that you don't know that well and everyone's just using their phone, I think it's really bad.
A. It's like, I know I do it. I get stuck in a sort of social media loop. I'll be like on my phone on Facebook, go to Instagram, go to Twitter, then to Tumblr, and then go back to Facebook, and before I realise it, it's like 30 minutes and it's like, OMG, I haven't got any work done.
B. Yeah.
A. And then like, I've done nothing.

2. Why do you think the mobile phone has become such an important part of everyday life?

A. It is really useful just like by the fact that you are staring in to a little box, the point of you staring into it is probably for you to send a message to someone important or get them on the phone, check an email to find if we have any psychology studies, if I couldn't access email or my text messages on my phone, or I couldn't check on my phone, I know I would probably have been lost, or not having access to find things out,
C. Like, I would have been lost in London so many times. So, it's like that, because it's so convenient for people.
B. It's like now, because pretty much everyone has a mobile phone. It's pretty normal now to be using it and checking it all the time.

3. Would you say it is a luxury or a necessity?

A. On the scale of the entire world I would say it is a luxury but anybody living in like somewhere in a Western country or a first world country generally I would say it is a necessity.
B. Yes.
A. Because it's become so ingrained in our lives now it is way more required but now it's a necessity kind of like having a car like it's not an absolute necessity but if you can have one you are going to. It's definitely something that is at the top of their priority list. Like you buy a car, a cell phone, a house, obviously clothes too.
B. I think like certain brands are like a luxury like iphones, but like mobile phones in general everyone should have some form of phone.

4. What technological gadgets do you like using most?

A. My macrapro. I got it when I was a senior in high school and it's kind of heavy, but it's been one of the most useful things I have. I have almost my entire life on there, all my photos. Also. my ipod, and then just a cell phone.
B. Mine is virtually the same.
C. Phone

5. On average how many hours do you spend on technology in a day?
B. A lot; 7 hours.
A. Lately, a lot more because I am working on term papers. 5 or 6 hours a day.
C. Maybe 3 or 4.

6. What do you use technology for?

B. Revision, school work, academic stuff and entertainment.

7. Do you carry out multi-tasking with technology?
B. Yes.
A. Yes.
B. Usually have music playing on one tab and typing an essay or if it's just like on the cell phone I would be on like a call with somebody and I would say, oh, let me google something on the phone, or google maps.

8. What activities are you doing when you use your phone with another activity?
B. Yes.
A. Yes.
B. Usually have music playing on one tab and typing an essay or if it's just like on the cell phone I would be on like a call with somebody and I would say, oh, let me google something on the phone, or google maps.

9. What technology do you think males like using most?
A. I wouldn't say that much difference. Less and lees people now just have an ipod now they'd just have a cell phone.

10. What technology do you think females like using most?

B. A lot of my girlfriends like using ipads.
A. Oh yeas, if I had the luxury to have an ipad as well, I'd have an ipad.
B. I would say phones are what girls like best for Intsagram, Twitter.
B. All the photo apps for taking pictures.

11. Do you use all the features on your phone?
What percentage of features would you say you use?

B. I don't use many.
A. I'm sure I don't use it to it's full ability. I don't use the stock market one or all the utility ones.
B. Yeah.
A. I use a lot of the social media ones like Twitter, Yikyak, Facetime, all that kind of stuff and then maps I use all the time.
B. Yeah.

12. Do you prefer to call or text?

A. I prefer to text if I'm on the move, or something like, I'll see you in 5 mins, I'll meet you there but if it's a friend that I actually want to talk to I'll call.
B. Call.
C. Text.

13. What makes you decide to text rather than talk?

B. If I want to say something quick or short.
A. If it's kind of like the first time you are friends with somebody you'd probably send them a text.
B. Or if you are in a place where you can't really talk like in a library.

14. What makes you decide to talk rather than text?

A. If it's a conversation where I am going to be on the phone for longer than like 30 seconds.

B. Yeah, yeah, and if I can't be bothered to text. I find it easier to call.

15. Do you ever think of the possible health risks of using a mobile phone?

B. Now I am.
A. No, the only one, like the health risk is being on your phone while you're driving, but not as far as damaging your credit cards or your brain.
B. Actually, when I charge my phone I put it on the floor not on my bed, because, it's like near your head when you're sleeping and the waves. Also, I heard a rumour or maybe it's a truth about damage to your head.

16. How would you describe a mobile phone to an alien (or someone who does not know what a mobile phone is)?

B. A portable device that you can communicate with, small …..
A. Box. A small device, a small rectangular box that is used for communication, interactive, (pause) entertainment, like instead of having a personal assistant that follows you around you have a little robot router with al the information you have collected in your life.

Appendix H

What Make of Phone do you Own?

8-11

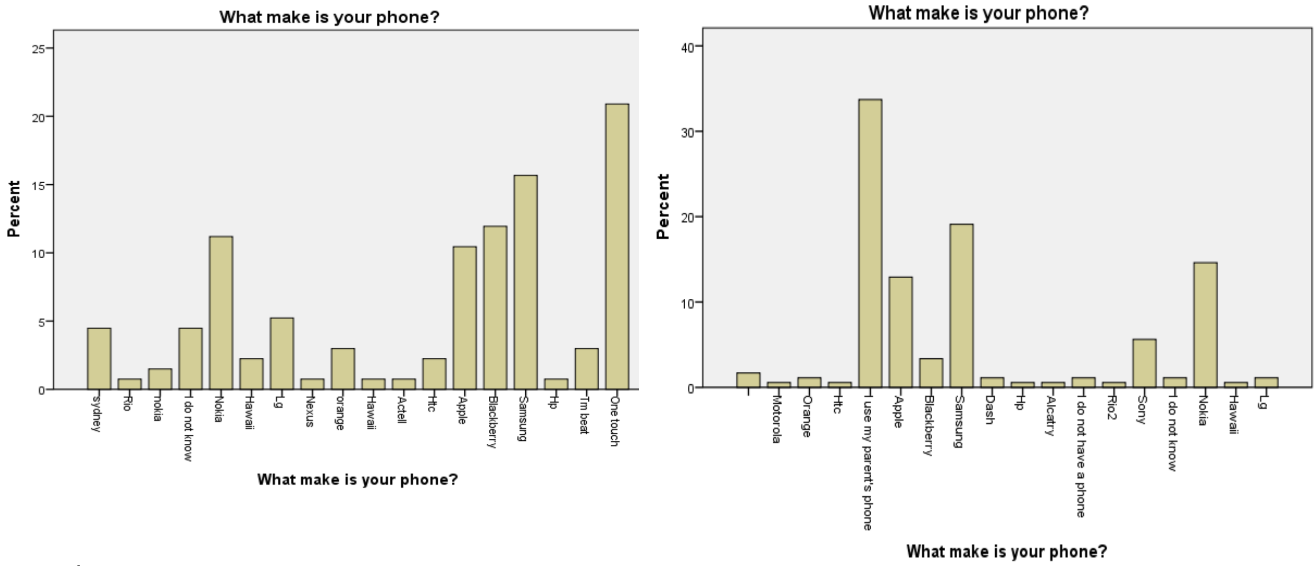


Figure 1
Make of phone for 8-11s (2013 and 2015) respectively)

11-14

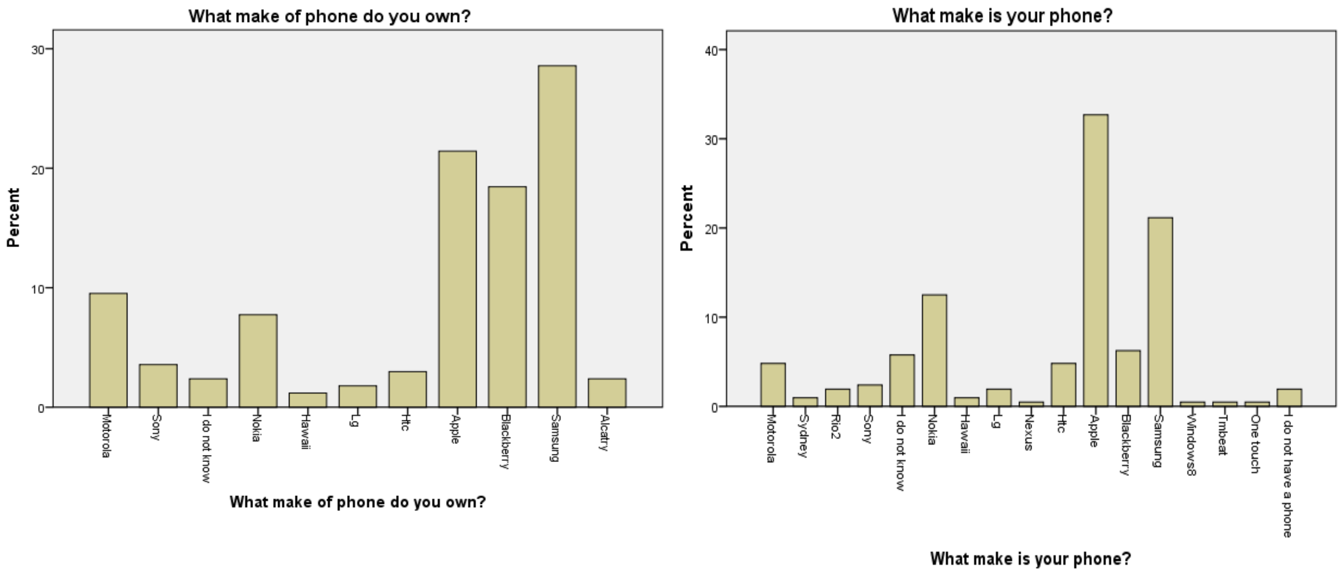


Figure 2
Make of phone for11-14s (2013 and 2015) respectively

14-18s

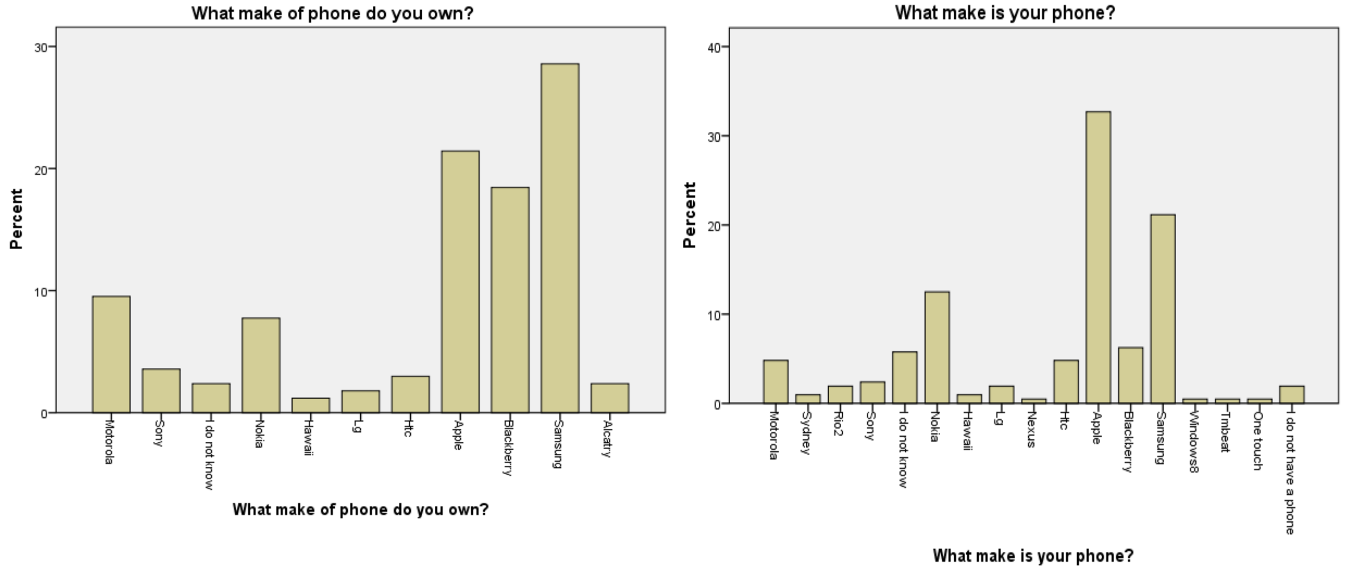


Figure 3
Make of phone for 8-14-18s (2013 and 2015) respectively

18-25s

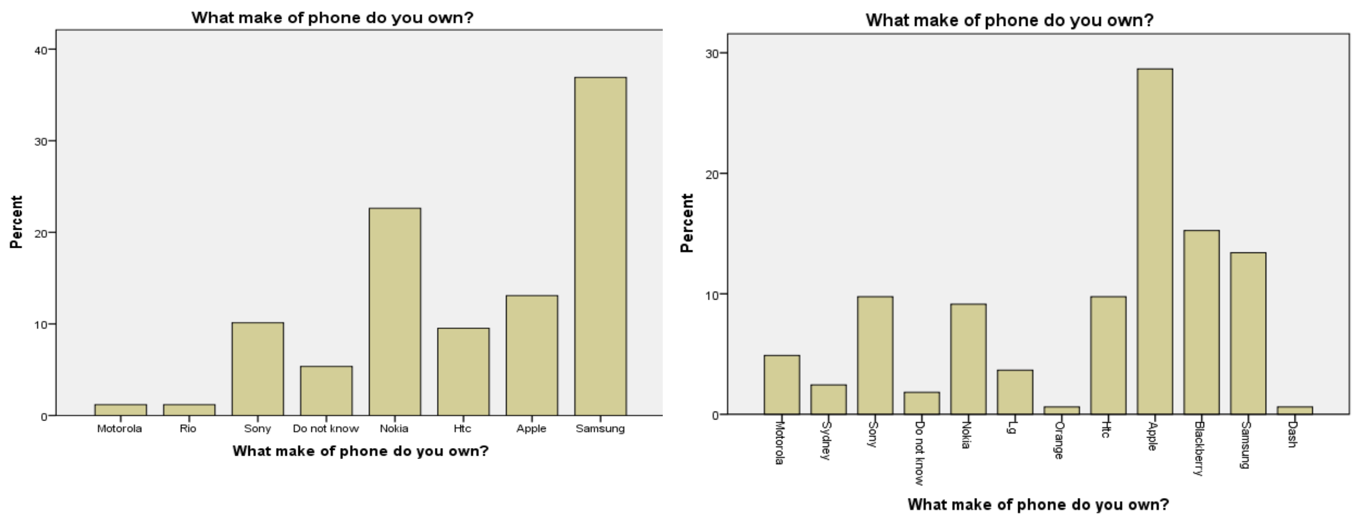


Figure 4
Make of phone for 18-25s (2013 and 2015) respectively

Appendix I

How is Your Phone Paid For?

8-11s

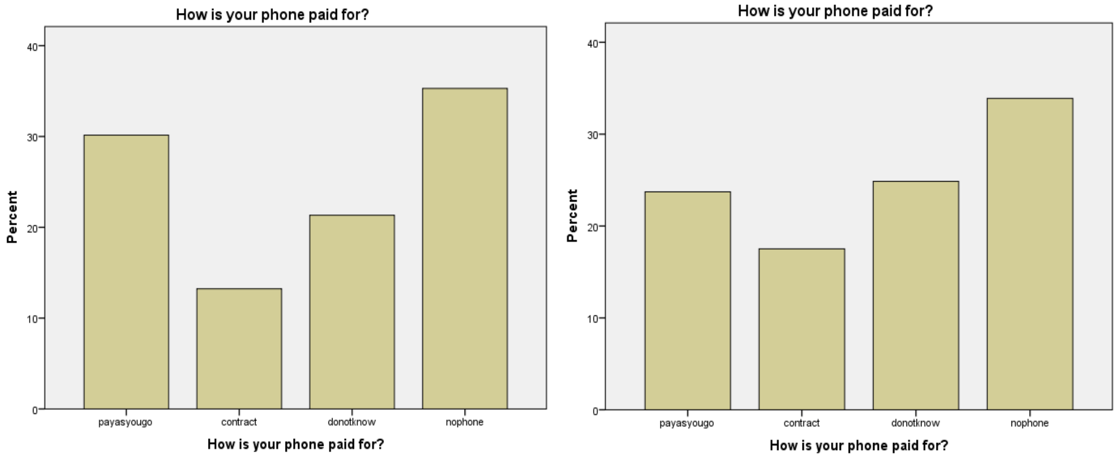


Figure 1

Payment method for mobile phone for 8-11s (2013 and 2015) respectively

11-14s

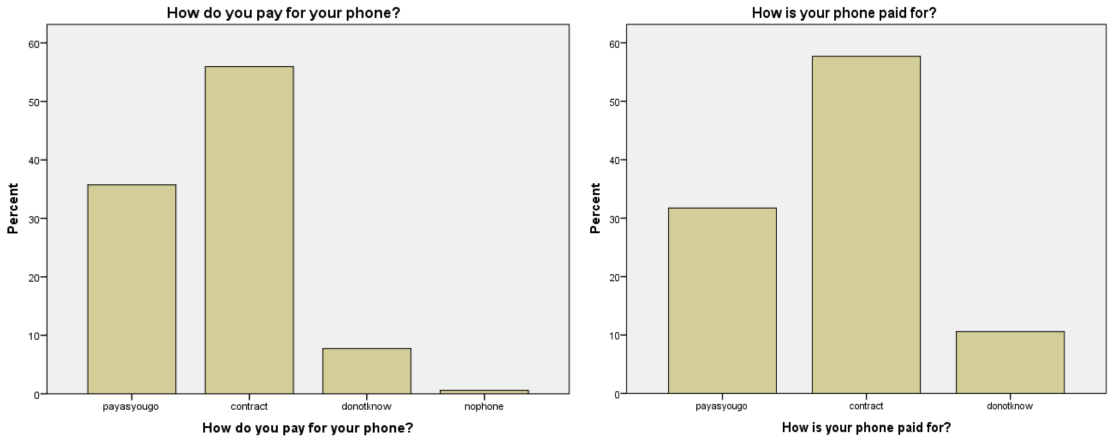


Figure 2

Payment method for mobile phone for 11-14s (2013 and 2015) respectively

14-18s

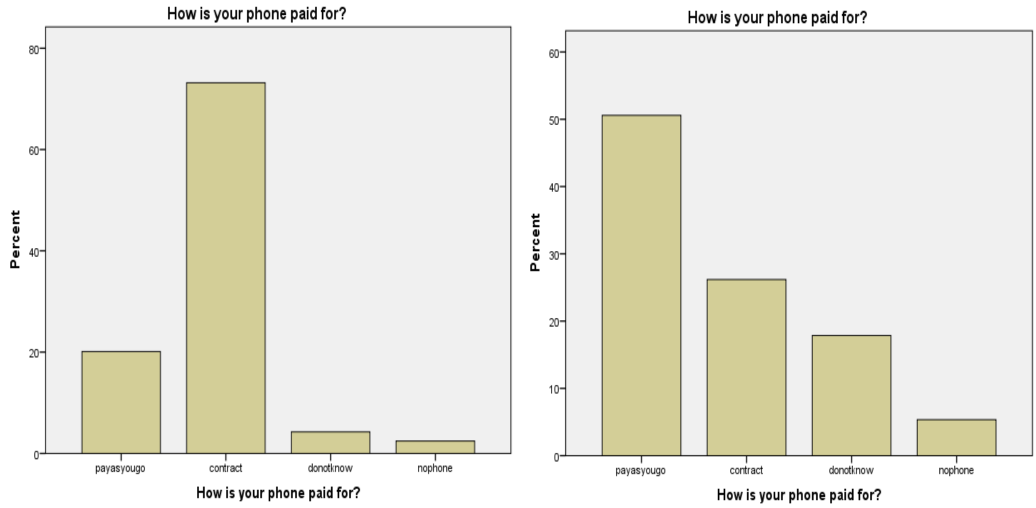


Figure 3
Payment method for mobile phone for 11-14-18s (2013 and 2015) respectively

18-25s

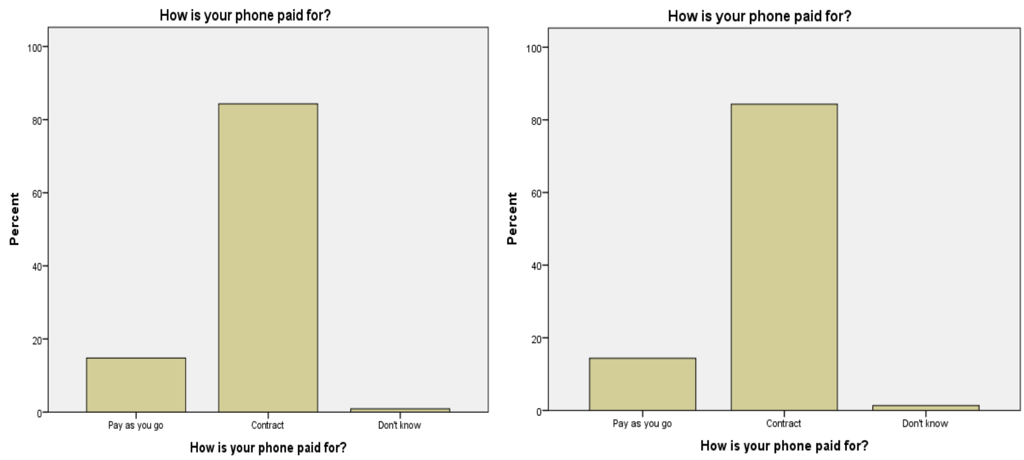


Figure 4
Payment method for mobile phone for 18-25s (2013 and 2015) respectively

Appendix J.

Demographics Questionnaire for Experiment 5

Are you male or female?
How old are you?
What age are you when you first started using a mobile phone?
How many years have you used a mobile phone?
How many calls do you make in a day?
How many texts do you make in a day?
What three functions do you do most on your phone?
Do you consider yourself to be a heavy or light user?
Do you use hands free equipment?
What percentage of time when you use your mobile phone, do you use hands free?
Which side of the head do you use your mobile phone if you make a call?
Do you experience any effects from using a mobile phone?
Do you consider yourself to be a 'novelty seeker' or a 'harm avoider'?
Do you believe in 'paranormal' phenomenon?
Are you sceptical about 'paranormal' phenomenon?
Have you consumed a meal in the last 3 hours?
Have you consumed alcohol in the last 24 hours?
Have you had a caffeine drink in the last 3 hours?
Do you smoke cigarettes?
Do you consider yourself to be an extrovert or an introvert?
Do you consider yourself to be sensitive to products?
If female, please say whether you are menstruating or not?
Do you consider yourself to have a hedonistic attitude to life?
Have you taken any prescription medication in the last 24 hours?
Are you allergic to anything?

Appendix K.

State Well-being Scale (Bristol Well Being Group) for Experiment 5

How anxious do you feel right now?
How calm do you feel right now?
How excited do you feel right now?
How frustrated do you feel right now?
How happy do you feel right now?
How interested do you feel right now?
How invigorated do you feel right now?
How mentally alert do you feel right now?
How mentally fatigued do you feel right now?
How motivated do you feel right now?
How optimistic do you feel right now?
How physically relaxed do you feel right now?
How relaxed do you feel right now?
How restless do you feel right now?
How sad do you feel right now?
How satisfied do you feel right now?
How stressed do you feel right now?
How tired do you feel right now?