Mobile Phones

The Mobile Phones set of articles is separated into 9 sections, each of which can be individually downloaded. It is a 'work in progress' incorporating new information whenever time permits.

Section 1

Introduction

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Introduction

Mobile phones have been steadily increasing in popularity and use since their first introduction in the 1980s. We present a few statistics about usage both in the UK and across the world.

- By 2007 Ofcom said there were 122.6 mobiles for every 100 people in the UK. The UK telecommunications turnover in 2008 was £62.2 billion and Vodafone was let off paying £6 billion tax by HMRC.

- In 2008, 44.5% of all call minutes originated on mobile phones, and cost the average household £32 per month. 99 billion minutes of outbound mobile calls were made in 2007.

- According to the Daily Mail in 2011, 15% of UK households only had mobile phones and no fixed landlines; this increased to 30% for households of 15-24 year olds in 2012. In June 2010, 25% of US households had no landline phone. The Czech republic have 63% of households and Finland 61% without landline phones. In South Africa mobile phones outnumber fixed lines by eight-to-one, largely due to the lack of an extensive landline network.

- In 2012, over 40 million people, 49% of the UK adult population, were using the internet on their mobile phone. In 2010, 38% of US adults access the Internet with it, 9% have made a purchase with their phones (20% of those aged 18 to 29) and 20% have viewed a video.

- Mobile phone theft accounts for 33% of UK street crime.

- By the end of 2011, there were over 5 billion mobile connections across the world for approximately 7 billion people (Markov & Grigoriev 2013) and it is predicted that this will double by 2020 (Michael O'Hara, Learning without Frontiers Jan 2012).

- The average USA mobile phone user between April 2009 and March 2010 spent 25 minutes per day on voice calls (737 minutes per month). This information has been extracted from their bills which is probably more accurate than recall. Many claim to use their phone much more extensively than this. In 2002, the internet was used for 6 minutes a day, in 2008, this had gone up to 24 minutes. And mobile phone use doubled. Although people aged 18-34 account for only 23% of the population, they use 36% of all internet use.

- 15% of Americans have interrupted sex to answer a mobile phone call; 32% of men and 23% of women say they can't live without their mobile; 30% of teenagers have received pornographic texts or videos of one of their friends; one phone available in China has a stun gun attachment that packs a 800,000 volt punch.

- 28% of teenagers admit to texting whilst driving which makes them 23 times more prone to accidents; 2 years after North Carolina passed a law banning teenage drivers from using a mobile phone whilst driving, awareness of the law stands at 78% of licensed teenagers, though there has been no long-term effect (Goodwin 2012), other than drivers changing from talking to texting!

- French mobile users send 20.4 text messages a month; Germans average 22.8 and British people send 67!

- In 2009, 62% of homeless youth in the US owned a mobile phone (Rice 2011).

- 300 million fewer women than men in developing countries own a mobile. An initiative, championed by Cherie Blair, called mWomen proposes to halve this 'gender gap' within 3 years, with special female-specific handsets and tariffs.

- Mobile phones account for 88% of all telecommunication users in India (Kapdi 2008). The rural sector accounts for more than 25% of all wireless phone users and this proportion will grow as affordability of mobile phones increases.

- Vodafone considered its investments in India when they demanded capital gains tax of over $11 bn on the purchase of a local operator. George Osborne lobbied against the tax bill on Vodafone's behalf.

As the number of mobile phone users increases, the way they are used is changing. There has been a downward trend in the proportion of pre-pay subscriptions, as operators have attempted to lure pre-pay customers onto monthly contracts against a background of slowing overall subscriber growth. On average, contract subscribers spend around four times more per month on mobile services than pre-pay customers. A lot of the "pay as you go" phones are left unused when their owners get a new phone on a monthly contract.

4G technology (LTE, Long-Term Evolution), which is about 100 times faster than 3G, including full-motion videos, home entertainment systems, advanced location systems, etc. is currently being rolled out. This will mean a new generation of phones (and their accompanying mast infrastructure). The UK regulator, Ofcom, has given phone operators permission to trade spectrum to increase mobile network capacity, as available bandwidth has become an issue as smartphones put increasing demand on networks.

BT reported in July 2008 that almost 60% of their payphones were unprofitable, with almost 6,000 phones making less than one call a month, and more than 50% making less than one call a week. Payphone usage had halved in the last 2 years and calls were still declining at 20% year on year. This system now seems to be completely non-viable. It is difficult to see how anybody in the future, including young people, are going to be able to make phone calls from a public box in an emergency.

Australian researchers have devised a way to make mobile phones talk to each other without using mobile phone base stations. Flinders University's Serval project involves fitting phones with open-source software called Distributed Numbering Architecture (DNA) that turns phones' WiFi capability into a mini mast and lets them connect with other phones to form their own network. They will be able to provide telephone access to millions of people who currently lack affordable telephone coverage.

Children and safety

The average age at which a child gets their first mobile phone is 8 (Daily Telegraph February 2009), and more than 35% own a phone by this age. According to Populus, which did a survey reported in the Daily Telegraph in February 2009, 75% of children aged between 7 and 15 own 'at least' one mobile phone.

Apparently, 26% of UK mobile phone users would give a child a mobile phone for safety reasons. It is unclear why this should be, as some of the children we hear about who have been kidnapped, then murdered, have had a mobile phone. It is the first item an abducter would dispose of. According to the police there is a dramatic increase in mobile phone theft on the street, in violent incidents when the phone is the only thing taken. Through their mobiles children can, for instance, be exposed to bullying, disturbing and explicit images, gambling, predators and rip-

off schemes. In a survey reported in the Daily Express only 36% of parents stopped their children from accessing the internet on their mobile phone. Rod Barnes, head of mobile phones at moneysupermarket.com said *"Take heed of warnings regarding internet access and look into whether filters can be placed on your child's mobile to bar access to specific sites."* Far from a mobile offering you peace of mind about your child's safety, it may be exposing them to pornographic sites and paedophiles 'grooming' them for dubious contacts.

Mobile phone addiction

There have been suggestions that mobile phone use is addictive. Professor Lai and his team at the University of Washington have found that radio frequency radiation activated endogenous opioids, compounds generated by the brain which behave like morphine. An increase in endogenous opioid activity in the brain caused by microwave radiation is known to increase alcohol-drinking behaviour. People with panic disorder and agoraphobia showed significantly more emotional alterations as well as intense physical and psychological symptoms when they were apart from or unable to use a mobile phone (King 2014).

In 2000, Charlton & Bates suggested that addiction to mobile phone use has been replacing cigarette smoking in young people. 75% of British teenagers say they literally could not bear to be without their phone.

The following quotations show what effect this addiction can have on families -

'We give our daughter a reasonable amount of pocket money with extra for her school dinners. We learnt that all this money is being spent on texting her friends. She hasn't had a meal in school for the past 2 months and worst of all considers no other activity or hobby worthy of her pocket money.'

'My daughter no longer communicates with the family, her phone has to be beside her day and night, we often hear her texting or talking in the early hours of the morning, her homework is suffering, her hobbies no longer take priority …she is not the daughter we once had'

'I discovered our daughter had been using my credit card without my permission to buy more call minutes for her phone.'

Others have stolen money from the parental purse to obtain money to 'feed' their habit. The children, especially girls it seems, are as much prey to danger (of many sorts) by having a mobile phone, as the ones their caring parents were trying to save them from.

Many young people watch TV on their phone. In Norway, adverts from 20 different companies are targeted to viewers, depending on the information given to broadcaster NRK when they signed up for the two month trial of the system. According to Gunnar Garfors of NRK, *"We know lots about the viewers; we have their phone numbers, their name, sex and where they live. We can also determine their presumed interests when we see what they watch or listen to and what times they do it. And we know where they are geographically because of positioning technology."*

Many mobile population subsets, such as students, do not have ready access to wired phones, and can be heavy users of mobiles. A study of medical students in Yazd, Iran, showed that students spent an average of 40 minutes talking and 65 minutes listening to music per day. They also received or sent about 28 text messages per day. They reported using their phones in the following places – 87% at home, 80% in the street, 37% in the classroom, 19% when driving and 18% in the library. Mobile phone use by medical students in a college in South India appeared to be problematic (Subba 2013) as over 34% suffered from 'ringxiety' or phantom ringing, getting very upset. They used their phones at restricted times and in places where it was prohibited. A significantly larger proportion of ringxiety sufferers also complained of hampered studies.

In Turkish university students, the addiction level was determined to be higher in the second-year students, those with poor family income, those with type A personality, those whose age for first mobile phone is 13 and below and those whose duration of daily mobile phone use is above 5 hours. The sleep quality worsens with increasing mobile phone addiction level (Sahin 2013).

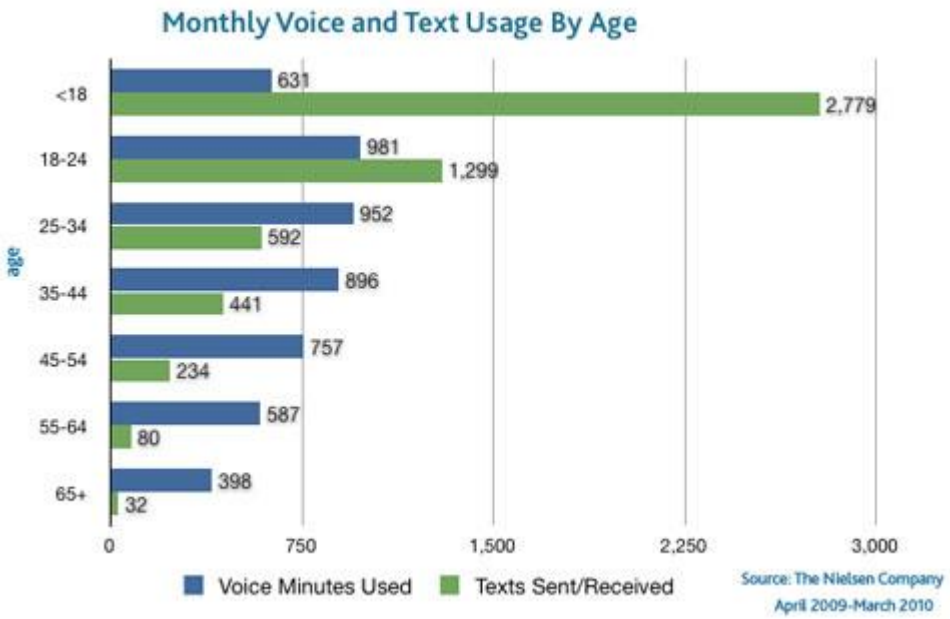
In April 2014, India opened its first centre dealing with 'technology addiction' in Bangalore (Travasso 2014). It has so far catered primarily to adolescents aged 14 to 18. In an unpublished study 3.5% of respondents aged 18-65 admitted to being addicted to social networking sites, 1.3% to the internet and 4.1% to their mobile phones, leading in some cases to physical or psychological distress.

Dysfunctional use of the mobile phone has often been conceptualized as a 'behavioural addiction' that shares most features with drug addictions (Billieux 2015). Problematic mobile phone use is a function of gender, extraversion, neuroticism and openness-to-experience. The Mobile Phone Problem Usage Scale has been developed to measure the characteristics that would enable the screening of and intervening in the potentially problematic behaviours of mobile phone users (Takao 2014).

Roberts (2014) reported mobile phone activities that are associated significantly with cell-phone addiction (CPA) (e.g., Instagram, Pinterest), as well as activities that one might logically assume would be associated with this form of addiction but are not (e.g., Internet use and Gaming). CPA amongst a total sample of college undergraduates is largely driven by a desire to connect socially. Future research must identify the activities that push cell-phone use beyond its 'tipping point' where it crosses the line from a helpful tool to one that undermines personal well-being and that of others.

Dossey (2014) describes the phenomenon as FOMO (fear of missing out). Jon Grohol, a psychologist sums up the syndrome well *"Teens and adults text while driving, because the possibility of a social connection is more important than their own lives (and the lives of others). They interrupt one call to take another, even when they don't know who's on the other line…They check their Twitter stream while on a date, because something more interesting or entertaining just might be happening. It's not 'interruption,' it's connection. But wait a minute…it's not really 'connection' either. It's the potential for simply a different connection. It may be better, it may be worse – we don't know until we check. We are so connected with one another through our Twitter streams and Foursquare check-ins, through our Facebook and LinkedIn updates, that we can't just be alone anymore. The fear of missing out (FOMO) – on something more fun, on a social date that might just happen on the spur of the moment – is so intense, even when we've decided to disconnect, we still connect just once more, just to make sure."*

A report in the US in 2010 showed the following information about the number of voice calls and text communications by month and by age.



Tracking and tapping phones

It is relatively simple to follow a person via their mobile phone. Plenty of companies offer the technology to do so, legally and with the phone user's knowledge. The same process can be employed to locate the user without alerting them. Qualified services may achieve a precision of down to 50 meters in urban areas where mobile traffic and density of base stations is sufficiently high. Rural and desolate areas may see miles between base stations and therefore determine locations less precisely.

The SIM card has its unique International Mobile Subscriber Identity (IMSI) number. The second number is the International Mobile Equipment Identity (IMEI) and is specific to the handset and remains constant even if the SIM card is changed. Mobile phones transmit these numbers each time they make a call, or log on to the nearest base station when the phone is on standby. Once the tracker knows which mobile they are looking for, it is not hard to locate, if you have the right information.

Tapping a mobile phone uses a device called an IMSI-catcher. This pretends to be a legitimate base station of the mobile phone network and tricks the phone into routing its call via the IMSI-catcher where it can be passed on for decryption. Once received, the IMSI-catcher passes the call on to the network, so the suspect is none the wiser that he or she is being monitored.

Officially, authorities like the police can obtain permission to find the position of phones in emergency cases where people (including criminals) are missing. In some instances law enforcement may even access a mobile phone's internal microphone to eavesdrop on local conversations while the phone is switched off (CNET News 2006). US District Judge Lewis Kaplan said that the eavesdropping technique "functioned whether the phone was powered on or off." Some handsets can't be fully powered down without removing the battery; for instance, some Nokia models will wake up when turned off if an alarm is set." Newsweek, in June 2009, reported that wiretapping programmes can easily be transferred to any mobile phone. The latest programmes can silently turn on handset microphones even when no call is being made, allowing the covert listener to hear voices in a room halfway around the world.

Private investigators and consultants in counter-wiretapping, computer-security software and telecommunications market research, claim that a surprising number of people carry a mobile that has been compromised, usually by a spouse, lover, parent or co-worker. Private investigation companies believe that up to 5% of mobiles are tapped. This figure does not include government wiretapping. Some "free" tracking services allow the mobile phone number being tracked to be added to telemarketers' lists.

A combination of tapping and tracking has been usefully used by the police to identify and catch terrorists (BBC news August 2005). However, tracking systems can work both ways. A mobile phone application worth less than two pounds precisely tracks aircraft in flight and it has caused concern that it could make them terror targets (Daily Mail October 2010). The Plane Finder AR application allows users to point their phone at the sky and detect the position, height and speed of nearby aircraft. It also shows the airline, flight number, departure point, destination and even the likely course. British and European air traffic control systems have not yet adopted the technology but it is being fitted in all new aircraft, which now constantly broadcast their positions.

Users are being urged to enter a number in their phone's memory under the heading ICE - In Case of Emergency. This is intended to facilitate identification of people who have been injured in such a way that they cannot communicate. It does have security implications, though, possibly making identity theft easier.

Tens of thousands of people in Britain are being covertly tracked. Scanners, which were first installed in 2005, capture Bluetooth radio signals transmitted from devices such as mobile phones, laptops and digital cameras. The data is being used in a project called Cityware to study how people move around cities, providing a permanent record of their journeys, which is then stored on a central database. Those with access to the database admitted in 2008 that they did not know precisely how many scanners had been created, but there were known then to be scanners in Bath, San Diego, Hong Kong, Australia, Singapore, Toronto and Berlin. Bluetooth tracking technology is already being used to aim advertisements at people, for example as they walk past shops or billboards. Bluetoothtracking.org allows people to search the whereabouts of friends and associates without them knowing about it. This is available from Google.

Customers in shopping centres are having their moves tracked by a surveillance system that listens in on the whisperings of their mobile phones; when they go in, what shops they visit; how long they remain there, and what route they take. The surveillance works by monitoring the signals produced by mobile handsets and then locating the phone by triangulation. Even when the owner is not using it, a mobile phone makes contact with the network every couple of minutes, which is enough for the receivers to get a reading on its position.

Apple iPhones and 3G iPads are recording and storing details of all their owners' movements, without giving any visual indication that such data is being recorded (BBC April 2011). Location data is kept in an unencrypted file say security experts Allen & Warden. According to Apple "*We may collect information such as occupation, language, postcode, unique device identifier, location where an Apple product is used so we can better understand customer behaviour and improve our products, services and advertising*."

The impact of adverse weather patterns on phone calls

Longer calls were found to increase during periods of colder weather. During periods of weather that were generally considered to be uncomfortable, people were found to be more likely to communicate with fewer people, and these tended to be the ones with stronger ties (Phithakkitnukoon 2012).

The environmental impact of the technology

Manufacturing phones or cases is not energy-efficient and disposal is becoming an ever-increasing problem. According to the Express in December 2009, 1,700 unwanted mobile phones are discarded in the UK alone, every hour. It is estimated that the life of a mobile phone is approximately 18 months before it is replaced with a newer model.

In 2008, the United Nations, with 1,000 delegates from 170 countries met in Indonesia to debate the problem of mobile phone disposal, which they then believed would prove to be a major environmental hazard. At the time there were 3 billion mobile phones in use worldwide. 2011 figures show this number has increased to over 6 billion phones.

Phones contain some elements that are hazardous in disposal. All batteries usually contain mercury, cadmium, lithium and other toxic, non-biodegradable metals that can affect water supplies from landfill. Jha (2013) suggests a method of extracting lithium and cobalt from disposed-of phone batteries. The cadmium from one phone battery leaking into the water table could contaminate 600,000 litres of water. Environmentally safe disposal of discarded mobile phones is a serious problem on account of their ever increasing number and toxic metals contents. The cumulative amount of lead leached from plastics exceeded the regulatory limits used in characterizing a waste as hazardous. The average cumulative amount of nickel leached from printed wire boards (PWBs) exceeded the regulatory limit. Both plastics and PWBs should be treated as hazardous waste and should not be disposed in open landfills (Yadav 2014).

The increase in electronic waste, including mobile phones worldwide is of concern. Urgent action on the management of these wastes is necessary within a framework that respects the environment and human health. More than 50 compounds, including carbon oxides, light hydrocarbons, polycyclic aromatic hydrocarbons (PAHs), polychlorodibenzo-p-dioxin, polychlorobenzofurans (PCDD/Fs) and dioxin-like PCBs, especially naphthalene, have been identified and quantified. The main semivolatile compounds detected were phenol and styrene (Font 2011). Combustion of the printed circuit board produced the highest emission factor of PCDD/Fs (Moltó 2011).

WEEE (waste electrical and electronic equipment) regulations theoretically cover the disposal of mobile phones. However, they are the most sold piece of equipment with the lowest collection rate (Polák & Drápalová 2012). In the year 2010 only about 3-6% of Czech EoL (end of life) mobile phones were collected for recovery and recycling. In a study in Finland (Ylä-Mella 2015) 55% of respondents have two or more unused mobile phones at homes. The more phones stored at homes, the more often reasons 'I don't know where to return' and/or 'have not got to do it yet' were mentioned. This indicates that proximity and the convenience of current waste management system are inadequate in promoting the return of small waste electrical and electronic equipment (WEEE).

When the European Commission unveiled proposals to deal with electronic waste, the main association for American companies operating in Europe criticized the draft laws. If the E.C. succeeds in regulating electroscrap in Europe, then pressure will rise to do the same in the United States. US manufacturers are complaining that regulations with teeth in them would "*inhibit free trade*".

Tantalum, used in mobile phone technology, is made from the radioactive mineral ore Coltan. In parts of Africa and Thailand, the extraction of Coltan has caused problems by removing valuable resources without compensation to the groups of local inhabitants. Because of its value and the likelihood of theft, this mineral ore is being kept in living quarters and there has been an increase in children born with deformities. Tantalum minerals are also mined in Australia, Brazil, Canada, China and Mozambique. However, we have to keep the issue in perspective. Although Coltan is

mined and made into tantalum for mobile phones, computers, DVD players and video games systems also use tantalum.

Many charities raise funds by recycling mobile phones. If you are concerned about whether they are recycling the materials or merely redistributing the phones, contact the charity of your choice to find out.

One of the principal recycling schemes is Fonebak, www.fonebak.com. They also say they give donations to the Children in Need appeal. Fonebak extract and reuse the valuable or toxic metals, remake some phones for resale in less industrially developed countries, and burn the casings to make more energy.

Some of the telecommunications companies have a recycling policy. We suggest that you bear this in mind before purchasing a phone with the ability to pollute, and buy accordingly. We do not know what their recycling methods are, but trust that they respect the environmental impact that thoughtless disposal of such material could have.