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Factors affecting phone engagement whilst driving- are they transferable from outside the vehicle?

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Abstract: Mobile phone use whilst driving can be considered to have a negative impact on driving performance; yet mobile phones have become an integrated, useful and often important part of people's everyday lives. This study therefore investigates whether phone engagement habits and behaviours transfer from outside of the car to when behind the wheel also. It uses a semi-structured interview methodology, with Thematic Analysis, to find if there is anything unique to driving which inhibits drivers from mobile phone usage or is the car considered just another environment in which to use the phone to communicate and be entertained?

1.1 Introduction

As driving is a self-paced, safety critical task it would be reasonable to assume that drivers would prioritise driving and try and fit in secondary/tertiary activities according to driving demands. Lee (2010) said that *'there is not a strong differentiation of appropriate and inappropriate times to engage in interactive technology use...many teens described being on the phone "all the time" and felt that "the cell phone is my life." Technology use is not guided by finding the opportunity to engage in the task but rather only occasionally constrained by some exception to refrain from the task'*. This brings into question what are the factors which lead to *'refraining from the task'*?

Matthews et al. (2009), when studying phone usage, found that *'context strongly affected mobile phone use, from when users interacted with them to what they did with them and for how long'*. With driving being a safety critical activity it would be easy to assume that this would be one of the contexts which would lead phone users to refrain from use. However, many studies have found the contrary with high rates of both hand-held and hands-free phone usage while driving (Brusque et al., 2008; Young et al., 2010; White et al., 2010). As yet, few studies have looked into the factors which affect willingness to engage with mobile phones in different environments, in particular looking into whether the factors which influence phone use out of the car also transfer to influencing phone usage while driving.

Along with a paucity of studies into how context affects phone usage there is also very little knowledge on the extent to which the phone function intended to be used can affect willingness to engage with a mobile phone. Recent smartphones have a diverse range of functions and now extend mobile phone capabilities far beyond simple phoning and texting capabilities, the factors encouraging or inhibiting someone's willingness to engage with the phone may also therefore have changed.

The following study, therefore, investigated factors affecting willingness to engage with a smartphone in environments where mobile phones had been found to be frequently used before. The focus was on the driving environment, investigating if this was always considered a context to refrain from phone usage or if willingness to engage with a phone, while driving, varied between different journeys or within a journey based on specific factors.

If the car is found to not be treated differently to any other environment, in terms of refraining from phone engagement, then this may indicate a need for improved driver education and training as to why phone use in this environment can be so perilous. Furthermore, if the study identifies factors, in any environment, which are consistently said to inhibit phone usage then this knowledge could possibly be applied and adapted to help reduce phone usage behind the wheel.

1.2 Aims

The aims of the study were to gain insight into the factors which influence smart phone usage while driving and the extent to which these transfer from when outside of the car to while driving, i.e. can the driving environment be considered unique in its influence on phone engagement behaviour?

2.1 Method

Since the aims of the study were to explore the factors which affected willingness to engage in a relatively unconstrained manner an in-depth interview methodology was chosen. This was specifically designed not to seek or test any models, which would limit the scope of the interview, but instead it was more of an open discussion aimed at allowing maximum insight and gain a detailed picture of factors affecting willingness to engage to be constructed.

2.1.1 Participants

Twenty participants took part in the study, all of whom had been smartphone owners for at least 6 months and had held a full UK driver's licence for at least a year. Ten students (5 male, 5 female, 9 between ages of 18-25, 1 was aged 26-35) and 10 business professionals (5 male, 5 female, 7 aged 46-65, 3 aged 26-35) took part. Participants were recruited through convenience sampling through university notice boards and personal contacts; quota sampling was also used to ensure they met the demographic criteria described below.

Business professionals were sampled as this demographic have been found to be heavy users of phones in previous literature (Peters et al., 2005). Business users were also considered likely to

demonstrate task oriented phone usage (outlined in Leung et al. (2000)) as they try and meet their work demands using their mobile phone. This was shown by Falaki et al. (2010) finding knowledge workers were more likely to use productivity applications compared to high school students.

Students were also sampled as this demographic have been found to be early adopters of technology and so may display patterns of phone usage that the rest of the population may later also demonstrate. This was proposed by Nelson et al. (2009) who suggested undergraduate students make an excellent sample for phone use studies as they tend to be the first demographic to adopt a new technology. Lee (2010) describes '*a generation raised on augmented reality, handheld videoconferencing, and immediate access to all of the world's information*'. Furthermore, students are also likely to be driving for purely personal reasons, opposed to business reasons, which may influence their phone usage habits to be more socially oriented (outlined in Leung et al. (2000)).

It should be noted that the intention of the study was not to compare or contrast the phone habits of student and business professional drivers, both groups were included to ensure a more complete picture of factors affecting phone usage could be gained.

2.1.2 Photo Elicitation Interview

In order to get participants to think deeply and recall as much information as possible on their previous phone use, a methodology involving the use of photographic prompts was used. This involved presenting the interviewees with images which could be used to help immerse them into the described environment and aid in recall of past experiences

The photo elicitation methodology involved participants being presented with a mood board (Figure 1), consisting of three A1 cardboard sheets. The two outer sheets presented pictures depicting two environments (e.g. in a meeting and while shopping) whilst the middle board only depicted driving. The five environments represented on the boards acted as prompts to talk around and to remind the participants of possible variations in the environment. For example, photos of people eating in a restaurant alone, with friends, with work colleagues, looking bored or looking busy etc. were intended to help remind participants that in each environment there can be many different situations and factors affecting their behaviour. It was hoped this would aid memory recall and therefore give more insight into factors affecting willingness to engage with their phone in different environments. It was made clear that for the driving scenario participants should consider their phone usage to be based on using the phone in hands-free calling, where appropriate, and to imagine their phone is set up in a cradle within easy reach from their driving position.

Participants selected an environment and then considered scenarios which might be relevant to their phone use behaviour before then describing the scenario and talking about their phoning behaviour.



Figure 1: Mood board for photo elicitation interviews

2.1.3 *Rationale Behind Environments Chosen*

The main environment of interest in the current study was usage whilst driving. However, other environments were also investigated to try and gain more informed (and possibly more honest) answers about participants' in car use (by not focusing solely on their, possibly illegal, phone behaviour whilst driving). This made the intentions of the study less explicit to the participants. Investigating environments outside of the car also provided insight into how factors affecting phone usage transfer from out of the car to while driving.

For the out of car environments it was decided that places with varied characteristics but also wide spread usage (so environments every driver could identify with) were required to allow maximum insight into what factors may affect phone engagement and why. It was decided the environments to be studied were while:

- Using public transport
- In a restaurant
- Shopping
- In a meeting
- Driving

These environments have diverse but contrasting characteristics which enable the identification of factors influencing willingness to engage.

2.1.4 *Rationale for Scenarios*

Three pilot studies were initially conducted with participants left to suggest their own scenarios which affected phone interaction in an environment. However, participants experienced difficulty in recalling scenarios which affected their phone use behaviour and often used the same or similar scenarios for each environment. Based on feedback from the pilot studies prompt cards for the scenarios affecting phone usage were created.

These prompt cards were used to help structure the interviews and give participants reminders of factors which may affect their phone use to talk around. The scenarios were based on reasons which frequently featured in the pilots for use or non-use of the phone and were supported as reasons for use or non-use by the literature. The scenarios chosen were times when participants:

- Had a perceived high workload
- Were bored
- Had other people present
- Needed information
- Expected an incoming call/ email/ text
- Had a time pressure
- Other

If the participants didn't feel the factor influenced their phone use they were not required to discuss that factor. The 'other' card allowed them to suggest and talk about any other factors not suggested which may have influenced their willingness to engage.

Participants also talked about their likelihood of using different phone functions based on the environment and scenario they were imagining themselves in.

2.1.5 Analysis

Conducting a Thematic Analysis was chosen as the method for analysing results as this allowed insights from the interviews to be collated but did not rely on a pre-existing theory or framework to be applied to the open discussions. The Thematic Analysis adopted a realist/ essentialist epistemology where a *'largely unidirectional relationship is assumed between meaning and experience and language (language reflects and allows us to articulate meaning and experience)'* (Braun et al. 2006), allowing motivations, experience and meaning behind codes and themes to be theorised in a straight forward way. Similarly, themes were identified at a semantic/ explicit level whereby the analysis was not looking for any meaning when coding beyond what the participant had said. This ensured data was taken at face value and no meaning was added or implied to the individual codes, only at the analysis stage were patterns in the data and their broader meanings and implications explored.

The Thematic Analysis was carried out using the procedure recommended in Braun et al. (2006). Familiarity with the data was first achieved through both transcribing the interviews verbatim and then through 'active reading' of the transcripts allowing for patterns in the data to be observed.

Codes were next identified within the transcripts using an 'inductive' or 'bottom up' approach, whereby the data was coded without using any pre-existing coding framework from themes found in previous literature. Instead the themes were strongly linked to the data themselves, where the data was read and re-read for any themes related to willingness to engage and once identified were highlighted on a print out of the raw data and an occurrence of that code recorded in an Excel document. An example of quotes and how they were then coded is shown in Table 1 below.

Table 1: An example of how quotes from the interview were coded

Quote	Code
'If it was work related I would do anything with the phone because it doesn't matter if it's discreet or indiscreet because it's to do with work'	Discretion not needed Context of function same as environment so will use
'If functions can help me get information I'm likely to use them to do that'	Use functions if helpful
'Most functions wouldn't be used as it would be rude to play games in a meeting'	Social rules/ etiquette inhibit usage

The analysis then focused on collating the specific codes into broader themes, by analysing which codes were frequently mentioned in conjunction with one another or appear to be related to one another and thus could be considered to cover the same topic or reason for use or disuse. This process allowed for larger and more general themes to be formed, as opposed to lots of specific themes which may only apply to this study.

These initial themes were then reviewed and those that were no longer believed to be themes (were too specific or did not have enough data to support them) were removed or collapsed into each other where possible (two previously very specific separate themes combined into one more general theme which depicts the same reason for use or disuse but in a more general way). These were then reviewed against the initial coded data extracts to ensure the themes captured the meaning behind each extracts coherently. Next the same process was conducted but referring to the entire data set and ensuring the themes reflect the meaning of the data set as a whole until more refined and better defined themes were achieved. The resulting refined thematic map is shown in Figure 2.

3.1 Results

3.1.1 Coding

The tables on the following pages show the frequency counts for the number of times each item was coded in the transcripts for an environment during the initial stages of the Thematic Analysis.

Table 2: Showing the number of times each theme was coded in each scenario as reasons for using or not using their phone

Themes	Number of times coded in each scenario				
	Driving	Meeting	Shopping	Public Transport	Restaurant
Rude	1	37	6	6	28
Ineffective medium	10	7	4	6	4
No reason for use	4	7	13	7	10

Attention needed	31	5	14	0	7
More capable device	14	2	0	5	1
Noise	0	0	3	2	0
Legality	4	0	0	0	0
Reasons for using the phone					
Discreet	1	14	3	4	8
Expectancy/importance	13	15	14	0	15
Entertainment	7	6	20	18	10
Helpful to situation	12	17	15	13	5
Informal environment	4	7	19	13	7
Low attention needed	12	0	15	10	3
Save face/look busy	0	0	1	4	4
Connect with people	3	0	3	8	8
Productivity	0	0	0	4	0
Create a comfort zone	0	0	0	2	2
Habit	0	0	0	0	3

The resulting refined Thematic Map, once the Thematic Analysis on the codes above had taken place, is shown in Figure 2. This displays themes and sub themes (which help give structure to particularly large themes).

The three large circles ('function context matches the environment', 'attention required' and 'importance') all show the major themes which were identified as having an impact on engagement or not with a phone in an environment.

The two smaller circles coming off the 'function context' theme represent sub-themes which could also influence phone behaviour but depended on the state of the main theme i.e. rudeness associated with using a phone in an environment would be dissipated if using the phone function was relevant to the environment e.g. using the web browser to help answer a question in a meeting, the rudeness was no longer an issue as 'context of function matched context of environment'. Similarly discreteness of the phone function could dictate phone engagement, if it wasn't discreet it might not be used, unless the function matched the context e.g. text messaging in a meeting would be more likely than calling due to the discreteness of texting.

The rectangular boxes coming off 'attention required' theme represent the two different ways that the attention required could influence behaviour, they are rectangular to show they affect the theme as opposed to the theme affecting them. I.e. it could be the environment required too much attention so

the phone wouldn't be used, or the environment required little attention so there was spare capacity to use the phone. Similarly the attention required by the phone function could dictate use or non-use, whereby if the function required a lot of attention it would be unlikely to be used or required little attention it may be engaged with.

Importance was considered a standalone factor or theme which could affect phone engagement behaviour.

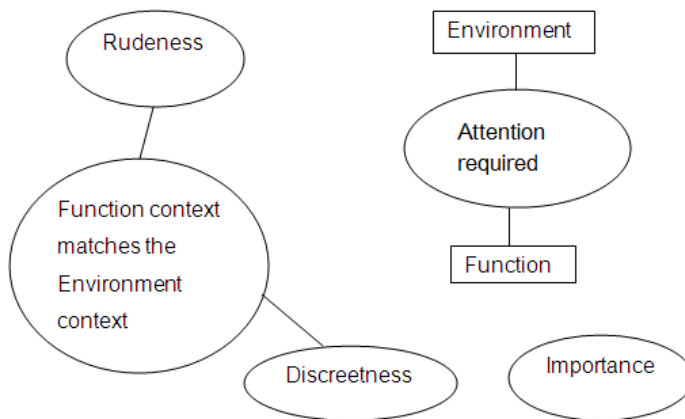


Figure 2: Developed themes mind map

4.1 Discussion

4.1.1 Themes

As can be seen in Figure 2 all the themes which were coded in the transcripts and identified as having an effect on phone usage were then analysed and their relationship with one another considered and represented in diagram form. The proposed relationships between these themes are discussed below.

One theme which was developed from this further analysis was the attention required. This refers to both the attention required for the phone function and the environment and the interaction between the two. It appeared if there was a low amount of attention required in the environment then functions which were said to require a high attention (such as playing games or sending a text and email) were used. However, if there was a high degree of attention required by the environment (such as when driving and in the high workload/ time pressured scenarios) then only those functions which were said to be quick and easy to interact with (therefore requiring low attention) would be interacted with.

The next theme was whether the 'function context matched the environmental context'. This related firstly to having a usage for the phone. If the function context matches the environment context then it would have a reason to be used so may be engaged with (e.g. using the internet to help price check when shopping or playing games for pleasure when in an informal, pleasurable environment such as shopping). If the function did not match the environment (e.g. business email when shopping out of pleasure) then it was far less likely to be engaged with. This theme also related to rudeness whereby

if the function used related to the environment (e.g. business call in a business meeting) it may be engaged with because using the phone wouldn't be considered rude, the noise and discreetness would not then matter. However, if the function did not match the context (e.g. private call in a business meeting) then the function would likely not be engaged with.

The final theme developed was the expected importance of the phone function. It seemed this could influence peoples' decisions on whether or not to engage with the phone task. When functions were expected, and therefore considered important (such as expecting an incoming call, email or text) it often lead to people being more willing to engage with the phone. This seemed to be influenced by both the importance placed on the function, for example it was a common perception that a call was more important than an email, based on the belief that if someone really wanted to get in touch with them they would call, whereas if it could wait an email would suffice. Also an expectancy placed on the incoming phone medium could influence importance with expected calls, emails or texts generally having a perceived higher importance and therefore higher willingness to engage with them than if they were not expected.

4.1.2 *Can the Driving Environment be Considered Unique*

It was found participants' reports on what affected their phone engagement when driving shared many commonalities with phone engagement outside of the car. The expected importance of the phone use was a frequently mentioned reason for engaging or not when both in and out of the car. Another influencing factor was the attention needed with people reporting judging the demand of the environment at the time and the demand the function required (such as being more likely to answer a call on an empty motorway, than send a text on a busy A road) before engaging with the phone.

The 'function matching the context' was mentioned far less as a factor influencing the decision to engage in the driving environment than in all the outside the car environments. This seemed to be because the driving environment was often quite a private, solitary environment and therefore there were less social rules to consider (for example placing a call wouldn't disturb another driver's conversation). However, some factors, such as if friends or family were present in the driving environment affected willingness to use the phone, this was found to be less to do with social rules though and instead a result of the participants reporting they were more aware of the risks they were taking when driving and someone else was present. They reported feeling more responsible for their passengers' wellbeing and therefore the reduced willingness to engage was considered to be related more to the 'attention required' theme. Another reason for having a lower willingness to engage when passengers were present was that they thought the passenger may be judging, assessing and possibly pass comment on their driving. A misjudged decision, such as using the phone at an inappropriate time (a misjudgement of the attention needed) would have more severe consequences than if they misjudged it when alone. The participants seemed aware they would receive a repercussion (in terms of being judged or getting verbal feedback) on their misjudgement as opposed to when driving alone when their misjudgement would only receive repercussions if they actually crashed.

Other environments, similar to driving, such as shopping and public transport were also perceived by many participants to have few social etiquette rules affecting their usage, however, based on comments in the interviews conducted it appears the 'attention required' theme had a far larger impact on willingness to engage when driving than in the shopping and public transport environments, possibly due to the safety critical nature of the task.

The driving environment does not, therefore, appear to be unique in terms of what influences willingness to engage with all environments seemingly influenced by the perceived importance (expected importance) of phone use. Similarly it was influenced very little by the social rules and rudeness of using the phone (similar to shopping and public transport environments). Although phone engagement while driving was found to be influenced heavily by the attention needed in the environment this was also observed in meetings and (less frequently) in other environments when there was a time pressure.

People generally reported refraining from using their phone while driving, with the level of attention required by both the road environment and phone function having the largest effect on reported phone engagement. This reassuringly suggests the level of demand that would be placed on their cognitive resources in the event of phone engagement is understood and considered. Although, as the driving environment is dynamic and ever changing, answering a call in a low demand environment could soon find the driver distracted by a conversation while a high demand scenario develops in front of them, limiting their capacity with which to recognise the change in demand and react safely to it. Furthermore it was found that the level of perceived importance that the phone use has, i.e. expecting an important call when the phone rings while driving, could lead to an increased willingness to engage. This could suggest a necessity to educate drivers that they may be susceptible to phone engagement in such scenarios. Guidance to counteract this such as: refraining from driving or putting their phones on silent if they are expecting to be contacted about something important, could be offered to help remove this temptation until their journey is over. Education should highlight that no phone interaction is important enough for drivers to put their own and others' lives at risk.

5.1 Conclusions

There were a number of factors which influenced phone use out of the car which did not transfer to the driving environment. However, no factors were found that were unique to driving and not mentioned as inhibiting phone use when outside of the car. This suggests the phone can be brought from the outside world to inside the car and factors encouraging or inhibiting phone use follow the device into the vehicle also. The finding that the importance of the phone function, such as expecting an important call, influenced willingness to engage led to the suggestion that drivers should be educated that they may make less appropriate engagement decisions in this circumstance. Drivers should put measures in place to help combat this temptation, such as ensuring the phone is on silent or refrain from driving if an important call is expected, to help alleviate this temptation.

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