

# Preliminary study on the smartphone zombie phenomenon by utilising a monitoring application

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**Abstract.** Several studies exist on the dangers of using a smartphone while walking. Unfortunately, pedestrians often disregard the warnings either intentionally or by accident as their focus is on the phone and not fully on the surrounding environment or situation. In this paper, we present our preliminary work to study the correlation between smartphone zombie behaviour and individual's psychological features, to reduce walking use. At first, in order to collect smartphone zombie behaviour from actual users, we have developed a monitoring application for smartphones. We asked seven subjects to install this application and continue living their lives normally for 15 days. For collecting the psychological features, we asked them to answer a profiling questionnaire.

**Keywords:** Smartphone zombie · Smartphone addiction · Problematic smartphone usage · Trans-Theoretical-Model

## 1 Introduction

The dangers related to being distracted while a smartphone during walking exist. This behaviour is often called smartphone zombie or sometimes shortened to smombie. The term can be understood broadly as zombie phone use can refer to a person focusing on their phone in any situation, be it during a dinner or while driving a car. In this study we focus only on the walking phone use. Walking smartphone zombie users often disregard warnings related to distracted use either by accident as their focus is concentrated on the phone, or by choice as they might feel necessary to reply a message or want to watch a video. This results in them not fully concentrating to the surrounding environment or situation at hand properly. A study from Australia found that from 4129 pedestrians observed crossing the street, on average 20% were using their phones and would also have a bigger likelihood for critical events, such as crossing at the wrong time or not checking both ways before crossing [10]. The number of users is also steadily growing as shown by the increase in smartphones prevalence numbers

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from 2010 to 2019. In Norway and Romania the prevalence rose from 31% to 86% and 2% to 86% respectively [19].

In Tokyo, from 2010 to 2014, 152 were injured for smartphone zombie [6] and between 2014 to 2018 this number rose to 201 individuals [7]. A growing number of studies are trying to understand the problematic phenomenon and create solutions that would reduce walking use. Some cities are even trying to accommodate phone users by creating separate walking lanes [9]. In Japan, a telecommunications service company created a screen blocker application<sup>3</sup> that forced users to stop using the smartphone while walking. However, as this feature completely prevented any phone use, it saw very little use in the general public. Using a smartphone is also often shown to be tied to some forms of addiction and several new applications have been introduced which let users track and reduce their own use. However, these applications are not designed especially for reducing smartphone zombie behaviour, but instead for overuse of a smartphone in general. They commonly use time limits, application blocking, self-assigned use goals and use statistics of the phone, as presented in [13]. Therefore, we think looking into additional approaches for changing the underlying behaviour of people are needed, as well as natural and effective smartphone features that assist an individual in breaking the walking phone use habits specifically.

In this paper, we present our preliminary work to study the correlation between smartphone zombie behaviour and psychological features, to achieve the above-mentioned behavioural change. At first, in order to collect smartphone zombie behaviour from actual users, we have developed a monitoring application for smartphones. We have asked seven subjects to install this application and spend their daily lives normally for 15 days. For collecting the psychological features, we have asked them to answer a questionnaire.

Our major contribution is that we propose suppressing smartphone zombie behaviour by utilizing Persuasive Technology approach. Specifically, we collected realistic data on smartphone zombie behaviour through our monitoring application and compared it with the questionnaire data. Second, we looked into the correlation between the psychological features: Stage in the Trans-Theoretical-Model, Risk/Benefit of smartphone zombie, Dickman's Impulsivity Inventory, Self-efficacy, and Big Five scores, and smartphone zombie behaviour.

## 2 Literature review

### 2.1 Study on smartphone zombie

Smartphone zombie behaviour has been recently gathered more focus but is still an understudied area of research. A study on phone use while crossing the street showed that it takes more time to cross if a phone is used and it also shows more tendency to do unsafe behaviour such as not looking or crossing at the wrong point. [22]. The slower walk gait was also a result in a study by [8] in this pilot study. The effect might be due to individuals focusing their

<sup>3</sup> <https://www.au.com/mobile/service/aruki-sumaho/>

attention on their phones. The effects on the cognitive load, gaze and general awareness has been studied and showed that general awareness is reduced when using a phone, and reading is more disruptive than texting [12]. The walking phone use also was found to be due to people having a feeling of missing out of their social interaction. This fear of missing out (FoMo) increased the likelihood of smartphone zombie behaviour and results in similar dangerous behaviour as shown in other studies. In addition, this behaviour true for both genders and older or younger age groups when the social desirability score was the same, [1] indicating that personality traits have a link in zombie behaviour. Some research try to tackle the problem by offering the smartphone zombie users with a radar-like assistance to avoid collisions with other people or obstacles[11]. However, we argue that it would be more beneficial to also focus on the phone user's behaviour, instead of trying to only alleviate the problematic behaviour be it unintentional or intended.

## 2.2 Study on smartphone addiction

While smartphone zombie as a behavioural problem requires research, an understanding the underlying problem is essential. The growth in smart device use and the link to excessive and problematic use has been studied for years, but common terms, criteria and unified terminology are needed so that cross-cultural and comparative studies and be made. Phone use has steadily grown and according to a recent EU study on 19 countries, around 80% of 9-16 years old use the internet on their phones [19]. In addition, the use of various smart devices starts at an increasingly younger age, which might also develop into smartphone addiction as the adolescents are more vulnerable for mental health issues [20]. Often overuse related symptoms are anxiety, depression, stress and poor sleep. Many studies have also looked into smartphone addiction in relation to DSM-5 criteria on substance and gambling [2] perspective as similarities seem to occur for both addictions. Compared to DSM-5, addicted smartphone users often use their phones in 1) problematic or dangerous situations, 2) lose interest in other social situations like family, 3) continue use even with negative effects, 4) have difficulty in controlling or stopping use, 5) constant need to check the phone, 6)increase phone use to get satisfaction or relaxation, 7) urgency and need to be always connected, responding immediately, and 8) anxiety if the phone is not available [5]. However, as of now there is no clear consensus on the terms or on the exact definition on what amounts to a person being addicted to their smartphone and how the level of smartphone addiction can be effectively measured. It is likely that smartphone addiction and the use of a phone while walking is somewhat connected. As stated above, the need to constantly be connected, the need to check one's phone, anxiety from non-use and the need to respond to messages immediately, affects a person's ability to focus on their surroundings effectively while walking. In various studies personality and gender play a role on what type of smartphone use occurs, and which types of personalities are more vulnerable for smartphone addiction. In multiple studies [3, 18] For example, females are more likely to focus on social networking applications and a need to

maintain or create new relationships and have a higher dependency and problematic use levels than males. Phone use by males is more reflected in gaming applications, voice and texting as well as having a tendency for using phones in risky situations. The correlation between the smartphone zombie behaviour and the psychological characteristics of phone users might shed more light on how reduction in phone use can be achieved.

### 3 Method

#### 3.1 Theoretical background and policy

Since we are in the initial stage of the study, we selected two theoretical frameworks for the experiments and investigate the correlation between the smart-zombie behaviour and the frameworks through a field study.

**Trans-Theoretical-Model:** Trans-Theoretical-Model (TTM)[17] is where individuals achieve a targeted behaviour change by progressing through several stages: Pre-contemplation, Contemplation, Preparation, Action, and Maintenance. As an example, a person might be considering quitting smoking but is currently in the contemplation stage and not yet committed for the behaviour change. TTM is frequently used in clinical therapy for habitual behaviours such as quitting smoking or drinking. In this study, we assume that smartphone zombie behaviour is also similar to these habitual behaviours. TTM also shows that we need to select suitable intervention strategies for individuals in various stages of change for a better likelihood of success. As a starting point for this study, we focus on the subjects who are either in the Contemplation or in the Preparation stages, because achieving change in their behaviours should be easier as they are more willing participants.

**Pathway model of problematic mobile phone use:** Bullieux et al. proposed a framework to describe the correlation between the dysfunctional mobile phone use and specificity of the factors based on the related studies[4]. They claimed that there are four pathways as follows: the impulsive pathway, the relationship maintenance pathway, the extraversion pathway, and cyber addiction pathway, to reach dysfunctional use<sup>1</sup>. Here, we measure the correlation between smartphone zombie behaviour and psychological features based on this model.

#### 3.2 The smartphone zombie behaviour monitoring application

In order to collect realistic smartphone zombie behaviour, we developed a monitoring application for smartphones. It collects smartphone's operational data while a user is walking, including the foreground application used and whether the display is on or off. The application also collects activity recognition data for the subject such as "walking", "still" or "tilting". The collected data is then stored into cloud storage from Amazon Web Services.

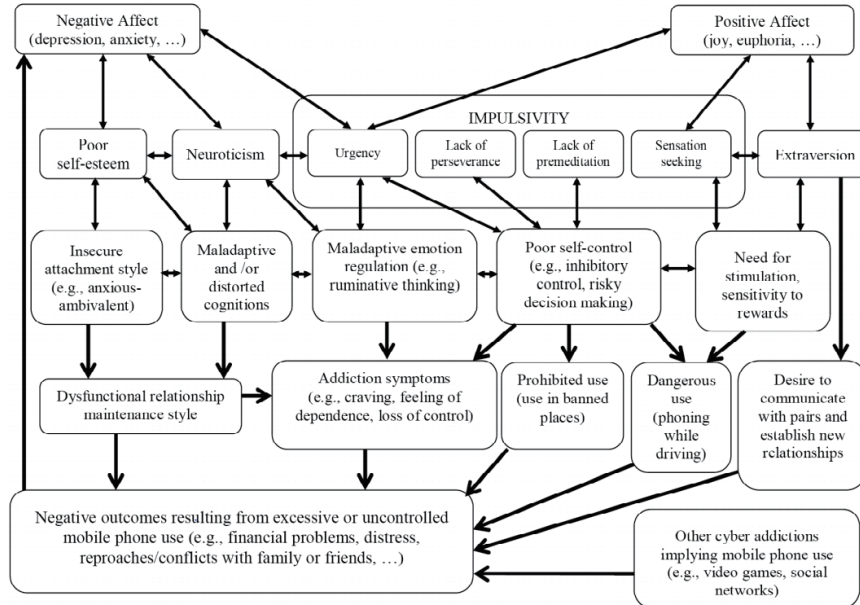


Fig. 1. Pathway model of problematic mobile phone use

### 3.3 Questionnaire

In order to collect the psychological features of the subjects, we distributed a questionnaire.

In the smartphone use part, we collected data on which smartphones functions did the subjects use in their daily lives, such as calling, web browsing, messaging applications.

In the TTM part, we inquired where in the TTM model stage would the subject consider themselves to be in and excluded everyone who was not in either the Contemplation or Preparation stages.

The smartphone zombie behaviour part focused on collecting data on the phone functions the subjects used while walking and the reasons why they used those functions.

In “Risk/Benefit of being a smartphone zombie” part, we collected subjects’ opinions towards smartphone zombie behaviour with 14 questions. Seven questions were about the risks related to smartphone zombie, which corresponded to “Negative Affect” in the “Problematic mobile phone use” model. The other seven questions are about the benefits, which corresponded to the “Positive Affect” in the same model.



Fig. 2. Intervention methods

In the intervention part, we collected the subjects' preferences for smartphone applications which could encourage users to stop smartphone zombie behaviour. We asked subject to choose three of their favourite and one least-favourite intervention applications they would be willing to install on their own smartphone. Figure 2 shows the intervention applications shown in the questionnaire. Table 1 shows the description of each App. We have created the intervention applications by a behaviour change support systems (BCSS) and persuasive systems design (PSD) model with guides on how to change people's attitudes or behaviour [15].

In the psychological measurement part, we collected the subject's psychological features with the following: Dickman's Impulsivity Inventory, Self-efficacy, and Big five scores. Dickman's Impulsivity corresponds to "IMPULSIVITY" in Fig. 1. Self-efficacy corresponds to "Poor self-esteem". Big five scores correspond to "Neuroticism" and "Extraversion".

**Table 1.** Description on the Interventions

#	Intervention Name	PSD's Category	description
(a)	Screen blocker	Primary Task Support	App. blocks any user's operation if they try to use their smartphone.
(b)	Notification silencer	Primary Task Support	App. blocks notifications while walking.
(c)	Zombie impression	System Credibility Support	App. occasionally shows news on the impressions of smartphone zombie behaviour from others.
(d)	Risk news	System Credibility Support	App. occasionally shows news on the risks of smartphone zombie.
(e)	Feedback	Primary Task Support	App. shows the total time of smartphone zombie per week. It also provides advice on how to stop zombie.
(f)	Gaming	Primary Task Support	App. gives exp. points for a game character, if the user does not use smartphone while walking.
(g)	Reward	Dialogue Support	App. gives some coupons: drink tickets, if a user does not use a smartphone while walking.
(h)	Praise SNS	Social Support	App. reports a user's smartphone zombie time to others. The user receives "Like!" praise, if the user does not use a smartphone while walking.
(i)	Competition SNS	Social Support	App. reports a user's smartphone zombie time in a ranking SNS. Users compete with each other.
(j)	Self-monitoring	Primary Task Support	The user sets a goal score in the App. Users can monitor how much of the goal they have achieved.

### 3.4 Data collection

We conducted the data collection between 25.12.2019 – 24.01.2020. First, we recruited subjects from Lancers<sup>4</sup>, which is a crowd sourcing service in Japan, willing to install the smartphone monitoring application. Through the service, we recruited seven subjects who used an Android smartphone. They were requested to install the monitoring application and spend their daily lives normally. This monitoring period lasted between 06.01.2020 – 17.01.2020. Starting from 17.01.2020, we asked subjects to answer the questionnaire and the reply deadline was 24.01.2020.

**Table 2.** Monitoring application and Questionnaire results

#		1	2	3	4	5	
Age		20 – 29	30 – 39	30 – 39	40 – 49	40 – 49	
Gender		Female	Male	Female	Male	Female	
App.	Zombie frequency a day	16	3	6	10	3	
	Zombie second a day	433	48	190	1316	432	
Questionnaire	Frequency of zombie		once a week	once a week	over three times a day	over three times a day	less than a month
	When considering quitting zombie behaviour?		In six months	Tomorrow	In a month	No	In a month
	Functions while walking	Mail/Message	✓		✓		✓
		Internet	✓	✓	✓	✓	
		Take photo	✓				
		SNS	✓		✓	✓	
		Games			✓		
		Movies	✓				
		Map	✓		✓		✓
		Healthcare News apps	✓			✓	
	Risk score		2	7	3	3	4
	Benefit score		0	1	3	12	-1
	Impulsivity	Dysfunctional	4	-3	-10	4	-14
		Functional	-8	-6	-5	-14	5
	Self-esteem		33	23	37	16	42
	Big Five	Openness	26	24	25	21	33
		Conscientious	-21	-12	-4	-22	6
Extraversion		11	7	16	-3	13	
Agreeableness		3	9	2	-1	16	
Neuroticism		28	23	22	33	6	
Preferred App.		(b)(f)(g)	(b)(e)(g)	(f)(g)(i)	(b)(e)(g)	(b)(e)(g)	
Not-pref. App.		(a)	(h)	(a)	(f)	(c)	

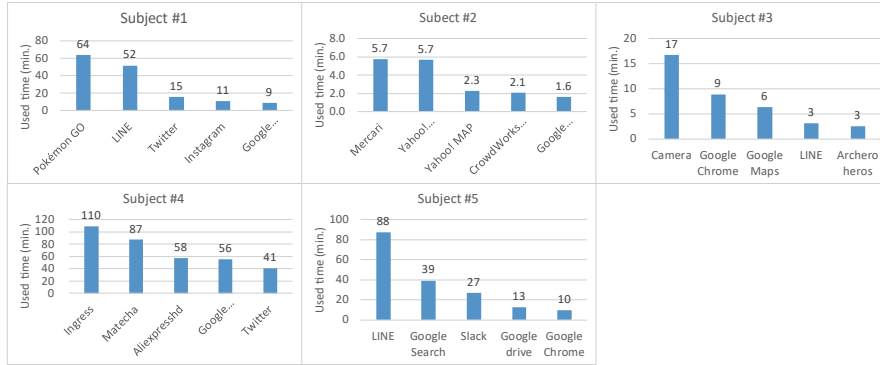
## 4 Results

Table 2 shows the App. and questionnaire results for the five subjects. We did not collect questionnaire data from two participants, because they answered that they do not use smartphones while walking. However, we did analyse the monitoring application data to verify the accuracy of their statements. The five subjects were in their 20s, 30s, and 40s with a female and male in each group except for the 20s.

There is a significant difference on the frequency of using smartphones while walking between App-measured times and questionnaire-answered ones except for subjects #3 and #4. Among this small sample we cannot make definitive statements, but the subjects who were in 20s and 30s group tended to use more functions while walking compared with subjects in their 40s except for subject #2. The subjects who had higher scores in “Risk score” used less functions while walking. There was no significant correlation between the number of “functions while walking” and “Frequency of zombie / When will quit zombie”, “Impulsiv-

<sup>4</sup> Lancers: <https://www.lancers.jp/>





**Fig. 3.** Functions and time while walking

ity”, “Self-esteem” or “Bigfive”. For the intervention methods, (b) Notification silencer is mostly selected as preferred app., while (a) Screen blocker is selected as the most unpopular intervention app.

Figure 3 shows the top five functions and time while walking for each subject. We extracted the functions and time while walking from the monitoring application. In order to calculate the time, we first used walking time from Google Activity Recognition and Screen On/Off recordings. Then, we calculated the time of Google Activity Recognition output if “walk” and Screen On/Off recording was “On”. Surprisingly, among most subjects there was a significant difference between the self-reported answers in the questionnaire and “Functions and time while walking” measurements. For instance, Subject#1 answered that she does not use Game applications while walking. However, the monitoring application data showed that she used Pokémon Go<sup>5</sup>, a location-based game, the most while walking.

## 5 Discussion

### 5.1 Comparison between the app’s data and questionnaire

The comparison between the app’s data and questionnaire results demonstrates that there is a cognitive difference between the two for some subjects.

First difference was the frequency of using smartphone while walking. The all subjects use smartphones while walking more than three times a day. However, the only Subject #3,4 answer correctly. From this difference, we consider that it is difficult to ask subjects to recall the frequency accurately with the current questionnaire. For our preliminary nature of this field study, we would study the correlation with more subjects.

<sup>5</sup> <https://www.pokemongo.com/en-gb/>

The other one is the difference between the realistic app use while walking under the monitored data and those which subjects answered in the questionnaire. This difference illustrates that it is difficult for the subjects to recall the exact app they use while walking, since they mistakenly recall using other apps. Similar discrepancy between recorded and self-reported use times for subjects has been shown to be problematic in other self-reported research results [14, 21, 16]. Users often over- or underestimate their own use, so caution in self-reporting questionnaires is advised.

From another point of view, this might give some hints towards suitable behaviour change. Seeing the actual smartphone zombie time and related applications name might effectively reduce zombie behaviour. Specifically, subjects #1,2,5 might recognize that they are using their phones more while walking than they had conceived.

## 5.2 Correlation between psychological features and zombie behaviour

We discuss each subject for their psychological features with mapping them to (i) Impulsivity, (ii) Relation maintenance, (iii) Extraversion, and (iv) Cyber addiction in “Pathway model of problematic mobile phone use”.

Subject #4 is considered to be an (i) Impulsivity user, since he has higher dysfunctional impulsivity score and Poor self-esteem score. Subject #1 is considered to be a (ii) Relation maintenance user, since she has a higher Neuroticism score. In addition, she answered that she uses SNS functions to communicate with others, so that she would not make them feel uncomfortable. Subject #5 is considered to be an (iii) Extraversion user, since she has the highest score in Big Five’s Extraversion score.

Subject #2 and #3 are difficult to clearly categorize to (i)–(iv), since they do not have any significant scores. Subject #2 is considered to be a light smartphone zombie user, since their “zombie seconds a day” is significantly smaller than others. In addition, he stated willingness to quit zombie behaviour by answering “Tomorrow” in the TTM question on “When quitting zombie?”. Therefore, his behaviour fits for a person that is in the preparation stage of change. Subject #3 might be considered to be a (iv) Cyber addiction user, since she answered using game application while walking. However, the monitoring data indicated that she only plays games just for three minutes while walking. If anything, she utilizes the camera application more while walking, which is not her answer in the questionnaire.

For the intervention methods, we could not find any significant difference between the subjects. However, the questionnaire implies that the subjects who play games while walking prefer to select (f) Gaming and (i) Competition SNS intervention methods, so that they can stop smartphone zombie while playing with others.

On the other hand, the amount of data we have collected is not enough to find further implications toward the target behaviour change. Therefore, we plan to conduct an experiment with more subjects. In parallel, we plan to collect more

than 500 participants for an updated questionnaire study based on the current study.

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