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보행중 스마트기기 사용에 따른 교통사고 위험성 연구

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A Study on the Risk of Traffic Accidents using Smart Devices while Walking

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Abstract : This study was conducted to test the impacts of distractions caused by smartphones on pedestrians whilst walking alongside or across vehicular traffic in a high-density urban zone in South Korea. Through this study, we propose objective evidence for a link between the risk of traffic accidents and distractions from smartphones for pedestrians because of less likely notice activities surrounding road along their walking. This means that smartphones usage may cause inattentional blindness even during a simple activity that should require few cognitive resources. We conducted an experiment comparing pedestrian behavioral patterns of walking with smartphone distractions (such as listening to music with earphones or sending text messages) and normal walking without any distractions. In the experiment, participants walked along a pedestrian path prescribed by researchers and were observed at 8 points which were as follows: two observation points through which participants were instructed to listen to music whilst walking, two points where participants were instructed to send text messages, and four points through which participants were instructed not to use a smartphone at all. According to pedestrian behavior analysis, there is a trend for attention to be distributed amongst whatever other activities pedestrians are doing whilst walking. Therefore, this study proposes that pedestrians walking with such distractions are at a higher risk of traffic accidents compared to those who walk without such distractions. Thus, we advise for the South Korean government to consider ways to traffic policy that will enhance traffic safety for pedestrians.

Key Words : impacts of distractions, smartphone distractions, pedestrians, risk of traffic accidents, cognitive psychology

1. Introduction

1.1 Outline

Rapid technological development has greatly influenced how people interact with one another. Perhaps the most common example of this are smart devices, such as smartphones, which allow humans to do multiple tasks from almost anywhere, even when walking. Smartphones allow individuals to listen to music, surf the Internet, make phone calls, and send text messages, all with decreasingly limited restrictions based on location. However, increasing dependency on smartphones in our daily lives could increase our attempts at multitasking, even during potentially dangerous activities, such as walking across busy streets. The risks of using such devices whilst driving have been proposed in innumerable previous studies. Distractions such as mobile phone use or watching TV whilst driving drastically increases the risk of traffic accidents. Similarly, the effects of distractions from smart phones for pedestrians whilst walking through or near traffic is being researched. As the recognition of high-risk activities in humans is passed through the sensory organs, smart phones act as a barrier as pedestrians unwittingly block their own vision and/or hearing with mobile phone and/or earphones.

The researchers of this study conducted an experiment to test the impact of distractions from smartphones on

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pedestrians whilst walking through or near traffic. Through this study, the researchers are proposing objective evidence that such distractions increase the risk of traffic accidents for pedestrians. The objective of this study is to reduce South Korea's pedestrian traffic accidents and for this material to be promoted for educational purposes in order to prevent future traffic accidents.

1.2 Previous research

Hyman's research[1], investigated the effects of divided attention whilst walking. Pedestrians were classified based on whether they were walking whilst talking on a mobile phone, listening to an MP3 player, walking without any electronics, or walking in pairs.

In the first study, Hyman collected observations of 317 pedestrians (148 males, 169 females; 294 classified as college-age, 18 as older than college-age, and 5 as unsure). Trained observers were positioned in pairs at the two corners of Western Washington University's (WWU) Red Square along its primary walking path. WWU's Red Square is a large open area surrounded by academic buildings and a library (total area: 59,120 square feet). Hyman's initial study found that mobile phone users walked more slowly, changed directions more frequently, and were less likely to acknowledge others than pedestrians in the other classifications.

In the second study, a man dressed as a clown unicycled around the large sculpture next to a marked crosswalk in Red Square on an afternoon in the spring. Data collection occurred during a single 1-hour session. Observers placed pedestrians in the same four classifications as in the previous study. After the pedestrians the street, interviews approached the pedestrians and asked each two questions. First, the interviewers asked if they had seen anything unusual when crossing Red Square (individuals who answered 'yes' were asked to specify what they had seen). Second, if they did not mention seeing the clown, they were asked specifically if they had seen the unicycling clown. Hyman found that mobile phone users were less likely to notice any unusual activity along their walking route. Mobile phone usage may cause in attentional blindness even during a simple activity that should require few cognitive resources. He found that even a task as practiced as walking can be disrupted by mobile phone conversations. Although walking and talking on a mobile phone on campus seems unlikely to be particularly hazardous, it is a habit that could bear negative consequences. Those who walk while talking on a mobile phone tend to walk slower and changing directions more frequently than those who don't. While pedestrian-on-pedestrian collisions may be infrequent and minor, walking and talking on mobile phones could cause more serious accidents with bicyclists or cars and other vehicles.

In a similar study, Neider[2] and his team of researchers oversaw a street-crossing task in an immersive virtual environment to test how divided attention could affect pedestrian behavior when crossing a busy street. Thirty-six participants (17 classified as males, 19 as females) navigated through a series of crosswalks by walking on a manual treadmill in a virtual environment. While crossing, participants were either engaged in a hands-free mobile phone conversation, listening to music on an iPod, or walking while doing neither of those tasks. Pedestrians were less likely to cross the road efficiently when conversing on a cell phone than when listening to music, even though they took more time (about 1.5 seconds) to initiate their crossing when conversing on a mobile phone. This success rate difference was driven largely by failures to cross the road in the allotted trial-time period (30 seconds), suggesting that when conversing on a mobile phone, pedestrians are less likely to recognize or act on crossing opportunities. Neider concluded that the added task load associated with conversing on a mobile phone does impact a pedestrian's ability to successfully navigate across a street compared to crossing when undistracted. These findings mirror observations from field studies where pedestrians tended cross traffic less safely when conversing on a mobile phone[3,4]. Similarly, data from the researchers' data from this study suggest that there is a strong possibility that decision making processes, such as those associated with identifying and acting on safe crossing opportunities, are impaired due to the pedestrians' decreased ability to encode visual and/or audio information.

Walker's study in 2011 suggested that pedestrians listening to personal music devices (PMD) are more likely to be involved in traffic accidents than those not listening to PMDs. Though it has been demonstrated that pedestrians on mobile phones exhibit less cautionary behaviour when crossing the street, seemingly less research had been conducted with pedestrians using PMDs. In the study, cautionary behaviour (e.g., looking before crossing a road) was observed and recorded for pedestrians with and without PMDs. Male pedestrians listening to PMDs displayed more observant behaviour than those not listening to PMDs. Females showed no differences between the two conditions. Thus, unlike mobile phones, Walker's study suggested that PMDs do not decrease the cautionary behaviour of pedestrians.

Specifically, pedestrians who were listening to PMDs while crossing the street either increased or held constant their level of cautionary behaviour, but according to Walker's data, talking on a mobile phone still reduced cautionary behaviour. These findings should be taken into account when designing safety devices to prevent future accidents for pedestrians. Companies who develop such devices may wish to look into headphones that have the option of automatically adapting their volume to just under the level of environmental noise, giving pedestrians listening to PMDs better understanding of their surroundings.

Schwebel[5], also conducted a study designed to test how talking on the phone, text messaging, and listening to music may influence pedestrian safety. 138 college students (46 males, 82 females) crossed an interactive, semi-immersive, virtual pedestrian street. They were randomly assigned to one of four groups: crossing while talking on the phone, crossing while text messaging, crossing while listening to a personal music device (the distraction groups), or crossing without any of those devices (the undistracted group). Participants talking on the phone, text messaging or listening to music were more likely to be struck by a vehicle in the virtual pedestrian environment than were the undistracted participants.

Participants in all three distracted groups were more likely to look away from the street environment (and look toward other places, such as their telephone or music device) than the participants in the undistracted group. Findings were maintained after controlling for demographics, walking frequency, and media use frequency. Distraction from multimedia devices has a small but meaningful impact on college students' pedestrian safety. Listening to music involves somewhat less cognitive complexity than engaging in conversation. It may be that more self-aware pedestrians are able to multi-task street-crossing with other activities to some extent, although their attempts to multi-task might break down on occasion, leading to the increased rate of vehicular collisions in Schwebel's music and text messaging groups. It may also be that the participants' instructions to "continue crossing the street even when distracted" led them to cross whenever possible and to not hesitate at any opportunities. Future studies might reconsider such instructions.

Thompson's[6] research tested the impact of technological and social distractions on cautionary behaviours and street-crossing times for pedestrians. Observers recorded demographic and behavioural information, including frequency of mobile phone usage for various tasks (sending text messages, listening to music, etc.). Thompson's team examined the effects of mobile usage for pedestrians crossing the street, grouping participants by age and gender. All multivariate analyses were conducted with random effect logistic regression (binary outcomes) and random effect linear regression (continuous outcomes), accounting for clustering by site. Observers recorded crossing behaviours for 1102 pedestrians. Nearly one-third (29.8%) of all pedestrians performed some other task with a smart device while whilst crossing the street. Distractions included listening to music (11.2%), text messaging (7.3%) and talking on the phone (6.2%).

Pedestrians who were text messaging, talking on the phone, or talking with a companion took more time crossing the street. Pedestrians sending text messages took 1.87 additional seconds (18.0%) to cross the average intersection (3.4 lanes), compared to undistracted pedestrians. Texting pedestrians were 3.9 times more likely than undistracted pedestrians to display at least 1 unsafe crossing behaviour (disobeying the lights, crossing mid-intersection, or failing to look both ways). Pedestrians listening to music walked more than half a second (0.54) faster across the average intersection than undistracted pedestrians.

Distracting activities are common among pedestrians, even while crossing intersections. Technological and social distractions increase crossing times, with text messaging associated with the highest risk. Our findings suggest the need for intervention studies to reduce the risk of pedestrian injuries. Researchers for the Korea Transportation Safety Authority[7] conducted a survey investigating the potential traffic dangers for pedestrians using sound equipment such as earphones[8] (Korea transportation safety authority, 2014). There were 297 participants; 166 (55.9%) classified as male, 128 (43.1%) as female, all between 10 and 30 years of age. The results showed that 236 (79.5%) of the participants had experience with smart devices whilst walking. The most common reported purposes of using sound devices were listening to music (221 [53.9%] participants), making phone calls (52 [12.7%] participants), watching videos (35 [8.5%] participants) and playing games (32 [7.8%] participants). 80% of participants were engaged in activities that the researchers deemed distracting whilst walking, therefore it was suggested that there was an increased risk of traffic accidents for pedestrians using sound devices due to reduced auditory reception[8].

Though studied sparsely in previous literature, early research suggests aural cues are important in judging the safety of pedestrian environments[9,10].

According to the survey results of the Hyundai Maritime Climate and Environment Research Institute, 77.2% women drivers, 69.8% of elderly drivers, and 68.6% of smartphone users are walking while walking.

While driving Smartphone / DMB users accounted for 67.5%. As a result, we have analyzed the share of women and elderly drivers in Korea, which shows that the number of female drivers (4.3%) and aged drivers (2.6%) have increased since 2011[11].

In terms of smartphone usage, 2.4% (862,000) of smartphone users aged between 3 and 59 years were at high risk and 13.8% (4,946,000) were at risk[12].

Literature regarding automobile driving in particular has examined this issue and discovered that both telephone conversations[13-15] and texting[16,17] reduce drivers' attention to the road environment and substantially increase risk of motor vehicle crashes, injuries, and fatalities.

2. Methods

2.1. Participants

For this study, there were a total of 20 participants (9 males, 12 females) with a mean age of 27.7 years of age. The researchers believed that participants in their twenties were most ideal due to their seemingly more frequent use of smart devices. The average reported walking time of the participants was about 1 hour 20 minutes per day. Participants also claimed to be exposed to a pedestrian environment for more than 1 hour per day.

In order to preserve the natural behavior of the participants, the researchers did not inform the participants about what they would be observed on until after the initial experiment had concluded. After the experiment, the personal and pedestrian habits of the participants were investigated in a closing interview.

2.2 Experimental conditions

In this study, the participants were given no information about the objectives of the experiment in order to preserve their normal behavior. One limitation of this study is that the researchers did not have participants walk down the same road with different, other distractions at different parts of the path. Follow-up research may be conducted in the future exploring whether that was a potential factor in such studies.

This study was performed along a path of pedestrian sidewalks and crosswalks through a resort area in Gangwon Province in South Korea. The researchers divided the pathway into "distraction zones" and "non-distraction zones". The participants were instructed to perform certain tasks on a smart device whilst walking through each distraction zone and not to use the smart device whilst walking through each non-distraction zone. There were 2 different distraction zones: one zone was for listening to music (2 songs selected by the researcher) with the smartphone, the second one was for sending text messages to the researchers.

The first zone (0.5 Km) was the distraction zone for listening to music. The second zone (0.1 km) was a non-distraction zone for walking without using the smart device. The third zone (0.3 km) was the distraction zone for sending text messages to researchers whilst walking and the last section was another non-distraction zone for walking without using the smart device. The total length of the participants' path was about 1.2 km.

Each point where the participants' prescribed paths might have intersected with traffic vehicles was an observation point for researchers to observe the participants' behaviours before crossing the street. There were 2 crossing spots each in both the music-listening distraction zone and the text messaging distraction zone and 4 crossing spots in the non-distraction zones. The width of the pedestrian path which the researchers prescribed was between 1.1 m and 8.6 m. None of the participants strayed from their prescribed paths throughout the study.

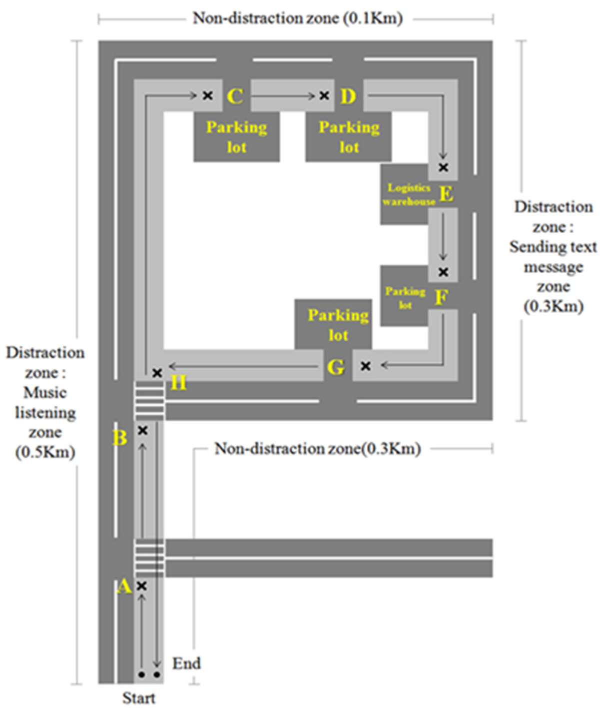

Fig. 1. Experiment pathway.

Each participant walked along their instructed pathway only once, while trained observers secretly recorded the participants behaviour from a distance. The research operator explained to each participant what they were required to do when passing through each respective zone. Seven operators investigated the behavioral patterns for each participant; one for closing interviews and surveys, one for providing instructions to participants at the starting point, 3 for tracking and observing the participants, 1 for asking participants about their behavior in the experimental zone (their prescribed walking path) after the experiment, and 1 operator to keep watch for any safety hazards to the participants.

After the participants finished, surveys about their natural walking behaviours were conducted and participants were interviewed about their recognition of the crosswalks and other behaviours they exhibited during the study.

2.2.1 The first distraction zone (listening to music)

There were 2 points (A and B) from which researchers observed the participants' behaviour whilst walking and listening to music. Point A was a 5.7 meter-long marked crosswalk across an entrance/exit to a parking lot for vehicles from a main road. Relative to the participants' walking path, vehicles could have approached from the left or right. Point B was across a one-way vehicle entrance to a parking lot with crosswalk markings along the surface with a length of 19.1 m. Point B would also serve as point H when participants returned from the other direction.

Each participant started walking from the point of departure while listening to two songs (selected by the researcher) back-to-back on a smartphone through earphones. Each participant was given the same two songs. Researchers checked whether or not participants observed their surroundings as they walked through points A and B.

2.2.2 The non-distraction zones

There were 4 points (C, D, G and H) from which researchers observed the participants' behaviour whilst walking through the non-distraction zones.

Point C was across a one-way parking lot entrance and approaching vehicles could only have entered from the left of the participants' walking path. Point C had no crosswalk markings on the road surface and had a length of about 9.4m. Because the road was the same color as the pedestrian path, the participants may have been less likely to notice oncoming traffic at point C.

Point D was another entrance and exit into another parking lot. Based on the participants walking direction, vehicles could have approached point D from both the left or right sides. There were no crosswalk markings on the road surface and the length of the crossing area was about 9.7 m.

Point G was an entrance/exit into yet another parking lot. Based on the participants' walking directions, vehicles could have approached from the left or right. There were no crosswalk markings and the length of the crossing area was 6.8 m.

Point H was the same crosswalk as Point B but with participants returning from the opposite direction, and was thus a marked crosswalk with a length of 19.1 m.

2.2.3 The second distraction zone (sending text messages)

There were 2 spots, points E and F, to observe participants' behaviour whilst walking and sending text messages. Point E was an entrance/exit for logistics vehicles to a warehouse. Point E had no crosswalk markings and had a crossing length of about 9.0 m.

Point F is an entrance/exit for a parking lot from a main road. Based on the the participants' walking path, vehicles could have approached from the left or right. Point F did not have any crosswalk markings on its surface and was 3.5 m long.

2.3 Measures

The focus of this study was whether or not distractions from mobile phones influence traffic safety practises according to how pedestrians use smartphones whilst walking. The pedestrian activities the researchers hypothesized to be distractions were listening to music and sending text messages with smartphones whilst walking. Participants' behaviours were measured by observing whether or not they looked left and right before crossing the road and whether or not they recognized crossing areas. The primary measurements were made by observing the natural behaviors of the participants. The second measurement was made in a closing interview analyzing the participants' actions and whether or not they noticed the road conditions.

3. Results

After the participants were observed walking along their prescribed paths, their walking habits were analyzed through closing interviews and surveys with multiple-choice questions on a 5-point rating scale (1- strongly disagree, 2- disagree, 3- neutral, 4- agree, 5- strongly agree)(see Table 2). Surveys showed an average score of 3.38 on the 5-point rating scale. Based on the closing survey, it was concluded by the researchers that the participants normally exhibited safe behaviors whilst walking.

Researchers compared the behaviors of the participants walking through points A and B (the music-listening

Table 1. Observation points in the experiment

Point	Road conditions and observations	Point	Road conditions and observations
A	○ Crosswalk section ○ Vehicle access areas on left and right sides ○ Crosswalk length : 5.7m ○ Looking left or right before to cross 	E	○ Crosswalk section ○ Vehicle access areas on the left and right sides ○ Crosswalk length : 9.0m (No crosswalk marks) ○ Looking left or right before to cross 
B	○ Crosswalk section, ○ Vehicle access on the right side ○ Crosswalk length : 19.1m ○ Looking left or right before to cross 	F	○ Crosswalk section ○ Vehicle access areas on the left and right sides ○ Crosswalk length : 3.5m (No crosswalk marks) ○ Looking left or right before to cross 
C	○ Vehicle access on the left side ○ Crosswalk length : 9.4m (No crosswalk marks) ○ Looking left or right before to cross 	G	○ Crosswalk section ○ Vehicle access areas on the left and right sides ○ Crosswalk length : 6.8m (No crosswalk marks) ○ Looking left or right before to cross 
D	○ Crosswalk section, ○ Vehicle access areas on the left and right sides ○ Crosswalk length : 9.7m (No crosswalk marks) ○ Looking left or right before to cross 	H	○ Crosswalk section ○ Vehicle access areas on the left and right sides ○ Crosswalk length : 19.1m ○ Looking left or right before to cross ○ This is the same point as B 

Table 2. Features of participants behaviour

Classification			Road safety management								Dangerous behaviours		
Classification	Sex	Age	Recognizing dangerous situations	Quickly responding to unexpected incidents	Cautiousness whilst crossing	Concentrating on traffic	Looking left and right before crossing	Delayed departure	looking left and right whilst crossing	Pausing	Jaywalking habits	Standing on crosswalk	Noticing obstacles
Number of participants	20	20	20	20	20	20	20	20	20	20	20	20	20
Mean		27.75	3.70	3.70	3.60	2.85	3.35	3.55	3.20	3.00	2.65	2.70	3.35
Mode		27	4	4	4	4	3	4	3	2	3	2	4
Standard Deviation		5.190	.733	.865	.598	1.040	.933	.887	.834	1.026	.933	1.218	.933
Dispersion		26.934	.537	.747	.358	1.082	.871	.787	.695	1.053	.871	1.484	.871
Skewness value		.322	-.339	-.424	-1.245	-.296	.055	-1.424	-1.018	.000	-.487	.256	-.377
Standard error of the skew		.512	.512	.512	.512	.512	.512	.512	.512	.512	.512	.512	.512
Minimum		20	2	2	2	1	2	1	1	1	1	1	2
Maximum		37	5	5	4	4	5	5	4	5	4	5	5

Table 3. Outcome of the experiments

Classification		Measuring factors	Observing the participants		Closing interview			
					Checking the situation		Non-checking the situation	
			Checked surroundings	Did not check surroundings	Recognition of crosswalk	Non-recognition of crosswalk	Recognition of crosswalk	Non-recognition of crosswalk
Distraction zone (Music-listening)	Point A	Checked around & recognized the crossway	8 (40.0%)	12 (60.0%)	7 (87.5%)	1 (12.5%)	9 (75.5%)	3 (25%)
	Point B	Checked around & recognized the crossway	13 (65.5%)	7 (35.0%)	10 (76.9%)	3 (23.1%)	3 (42.9%)	4 (57.1%)
Non- distraction zone	Point C	Recognized the driveway	12 (60.0%)	8 (40.0%)	12 (100%)	0 (0.0%)	3 (37.5%)	5 (62.5%)
	Point D	Recognized the driveway	12 (60.0%)	8 (40.0%)	4 (33.3%)	8 (66.7%)	0	8 (100%)
Distraction zone (sending text messages)	Point E	Checked around & recognized the crossway	4 (20.0%)	16 (80.0%)	4 (100%)	0 (0.0%)	6 (37.5%)	10 (62.5%)
	Point F	Checked around & recognized the crossway	7 (35.5%)	13 (65.0%)	3 (42.9%)	4 (53.8%)	6 (46.2%)	7 (53.8%)
Non- distraction zone	Point G	Checked around & recognized the crossway	7 (35.5%)	13 (65.0%)	5 (71.4%)	2 (28.6%)	6 (42.9%)	7 (57.1%)
	Point H	Checked around & recognized the crossway	12 (61.5%)	8 (38.5%)	12 (100%)	0 (0.0%)	8 (100.%)	0 (0.0%)

distraction zone), with points and C and D (a non-distraction zone). Researchers noticed that 8 participants (40%) looked around before crossing points A and B, whereas 12 participants (60%) did so at points C and D, even though points C and D had no crosswalk markings.

Researchers proposed that this could be evidence that the risk of an accident for pedestrians could increase due to reduced or blocked hearing when walking. This contrasts with Walker's[16] study showing that pedestrians actually show increased visual awareness due to blocked auditory reception.

Whilst observing points C, D, E and F, researchers noticed that 12 participants (60%) looked around whilst walking through points C and D (a non-distraction zone). However, only 4 (20%) participants did so whilst walking through point E and 7 (35.5%) participants did so whilst walking through point F (both text-messaging distraction zone).

By comparing point B (music listening distraction zone) and H (non-distraction zone) which are the same crosswalk area, researchers found that 13 participants (65.5%) looked around before crossing point B whereas 12 participants (61.5%) did so at point H. Through the closing interview researchers noticed that all 12 participants who passed point H recognized the crosswalk whereas 13 participants (10 who recognized the crosswalk, 3 who did not) did so whilst walking through said points. Therefore, participants played more attention to traffic when walking without distraction. This could demonstrate that sending text messages whilst walking puts pedestrians at greater risk of traffic accidents.

Results of this study suggest that sending text messages or listening to music with earphones whilst walking compromises pedestrian safety.

4. Discussion

Technological development has benefited civilization by making life more convenient, but humanity's newfound reliance on technology may also yield adverse effects.

This study has evaluated how much influence potential technological distractions, such as using smartphones, may have on pedestrians whilst walking, and if there may be an association with such activities and pedestrian traffic accidents. In this study, twenty participants (9 males, 11 females) were instructed to walk a prescribed path, and instructed to use or not use smartphones at certain intervals whilst walking. Participants were observed for their pedestrian behaviours (e.g. looking around before crossing the street), at various points along their prescribed path which intersected with vehicle traffic paths.

The researchers hypothesized that listening to music and sending text messages on a smartphone whilst walking were distracting behaviors which might increase the likelyhood of vehicle collisions with pedestrians. The researchers proposed that if participants exhibited safe behaviors at crossing points (e.g. looking to the left and right before crossing, recognizing whether or not the path may intersect with traffic), that they would not be putting themselves at greater risk of traffic accidents.

There were 2 observation points each in the music-listening and text messaging distraction zones and 4 observation points in the non-distraction zones. Therefore, there were 8 total points at which participants would be observed.

When comparing points A and B (the music-listening distraction zone) with points C and D (non-distraction zone), researchers observed 8 participants (40%) looking around before crossing point A, whereas 12 participants (60%) did so at points C and D.

By comparing point B (music listening distraction zone) and H (non-distraction zone) which are the same crosswalk area with different direction, researchers found that 13 participants (65.5%) looked around before crossing point B whereas 12 participants (61.5%) did so at point H. Through the closing interview, researchers noticed that all participants who passed through point H recognized the crossway while as 10 participants who recognized the crosswalk and 3 participants who did not whilst walking through point B.

Because participants were observed not paying attention to their surroundings whilst walking (and admitted to not doing so in closing interviews) it could be concluded that listening to music whilst walking increases the risk of traffic accidents for pedestrians. This contrasts with earlier findings from Walker (2012) implying that listening to music whilst walking actually increases pedestrians' visual attention from psychological compensation due to blocked auditory senses.

Whilst observing points C, D, E and F, researchers noticed that 12 participants (60%) looked around whilst walking through points C and D (a non-distraction zone). However, only 4 (20%) and 7 (35.5%) participants did so whilst walking through point E and F (a sending text message distraction zone) respectively.

Listening to music involves somewhat less cognitive complexity than conversation, and has been shown in previous work to have minimal influence on safe automobile driving[19,20].

In the study, as presented by Hyman's research (2010), we suggested objective evidence that smartphone usage may cause inattentional blindness even during a simple activity that should require cognitive resources. In conclusion, therefore this study suggests that text messaging behaviours whilst walking decreases focus on traffic more dramatically than listening to music.

One potential shortcoming of this study may be that directly comparing each kind of crossing along the participants' prescribed path was limited because of slightly different road conditions at each point.

Nonetheless, this study showed a tendency for participants to fail to accurately recognize their surroundings whilst potentially distracted by smart devices, such as listening to music or sending text messages on a smartphone.

The participants' road safety habits were noticeably reduced in the distraction zones, so ultimately it could be concluded that performing such activities as participants did in said zones (listening to music and sending text messages whilst traversing road traffic paths) bears a higher risk of traffic accidents. If pedestrians hesitate or do not recognize the signals from oncoming vehicles, their likelihood of being involved in a traffic accident could dramatically increase. The road environment also should be built to protect all pedestrians, including those who are distracted, by removing them from hazardous environments[21,22].

Results of this study demonstrate that listening to music with earphones or text messaging whilst walking could jeopardize pedestrians traffic safety.

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