Understanding the multitask process of eating while driving and its potential effect on driving performance

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The report aims to quantify the effect eating and drinking while driving has on driving performance. Previous research has indicated that eating while driving under certain situations can affect vehicular control and might be a contributing factor to accidents and crashes. Methods: A low-fidelity driving simulator task was utilised in order to provide a controllable and repeatable environment in a safe environment and ethical context. Twelve healthy male and female Rhodes University students participated in the study. The participants' ages ranged between 22-30 years of age. A minimum of 4 years and a maximum of 10 years driving experience participated in the study. Once in the beginning and once in the end pure driving condition was assessed, as well as the unpacking and eating condition. A 3-min break was given between each condition for the purpose of set up as well as for the participants to complete a perceived control Likert scale questionnaire. The objective measures assessed were the tracking deviation, and the percentage of gaze on the road. Results: Unpacking differed statistically significant compared to all the other conditions for all dependent variables. The subjective perceived control measure showed that there was a difference in the unpacking condition as well as the eating while driving condition. The participants’ expressed a worsening in their vehicle control during the unpacking condition compared to all the other conditions. Participants also expressed a decrease in vehicle control for the eating while driving condition although this did not reflect in the tracking deviation of the participants. The eating while driving condition was not statistically significant compared to the pure driving 1 and pure driving 2 condition for tracking deviation and percentage of gaze on the road. Discussion: The tracking deviation, percentage of gaze on the road was significantly reduced during the unpacking condition, therefore this indicates the risk motorists’ are likely to face during this condition or activity as their hand was off the wheel and their gaze was off the road. Thus, motorists may not see unexpected stimuli for example, other traffic and walking pedestrians and therefore are unable to react to the unexpected stimuli in the least effective time. Participants might have expressed a decrease in their vehicle control for the eating while driving condition as most of the participants had little or no eating while driving experience Conclusion: This study indicated that unpacking of the meal while driving, designates the greatest risk to a motorist. This study may help assess the behavioural aspect risk associated to driving, awareness of the implication thereof may assist engineers in designing well-suited in-vehicle technologies that are not cumbersome, but assist participants in the act of eating while driving. Moreover, this study may help motorists understand the implications towards the multitask process of eating while driving and its potential to incur traffic accidents that may later result in death.

1. Introduction

1.1 Background

Driving is associated with the control and operation of a vehicle (Noy, 1997). Society places great importance on the use of automobiles due to its numerous advantages and commercial usage for both professional and non-professional drivers; impacting on social and environmental changes. Some of these changes include: construction of streets, roads, and buildings all developed in order to accommodate the use of automobiles (Jakle and Sculle, 1999; Kearney, 2010). People have freedom of movement from one place to another. In the same vein, automobiles have undesirable consequences on the nation’s economy, environment, and people: increase in traffic fatalities, undesirable fumes creating pollution etc.

Research has investigated plausible causes related to the impediment of driving performance: individual differences, in-vehicle technologies (Brooks and Rakotonirainy, 2005; Choi et al., 2013), the use of alcohol,
fatigue, internal and external distractions, limited perceptions and many more. Limited research exists on the behavioural aspect of motorists and impact on driving performance (Lee, 2008; Young et al., 2008).

1.2 Statement of the Problem

Societal changes imposed by the mass production of vehicles resulted influx of fast food restaurants, high way cafés, resulting in rapid urbanisation in developing countries such as South Africa (Jakle and Sculle, 1999). Urbanisation thus inevitably compels individuals in making changes in dietary behaviours and food and eating choices. Inclination for drivers to eat while driving: factors such as urbanisation and trade liberalisation. It has been found that eating while driving has become a common practice and is often considered low risk behaviour by motorist (Stutts et al., 2005; Young et al., 2008). However, Young et al. (2008) have shown that under certain situations eating while driving can affect vehicle control and might be a contributing factor in accidents and crashes. Therefore, the focus of the study is to assess and establish the effect the multitask process of eating while driving has on driving performance.

1.3 Aim of the study

Research project aimed to investigate and understand the multitask process of eating while driving and its potential effect on driving performance.

2. Method

2.1 Research concept

This research project aims to objectively quantify and assess the multitask process of eating and drinking on driving performance variables. The main objective of the study necessitates towards analysing participants capacity to deviate minimally off track while unpacking and eating the meal while driving compared to the control condition of pure driving. A low-fidelity driving simulator was utilised in order to provide a controllable and repeatable environment thoroughly investigating the potential risky conditions in a safe environment and ethical context (Young et al., 2008). A repeated design was used, of which exposed all participants to all conditions. These conditions (pure driving, unpacking of the meal while driving, eating while driving and again pure driving) may influence the driving performance variables tracking deviation, and percentage of gaze on the road. Tracking deviation looks towards the driving ability of the participants’, and this continuous tracking task has been shown to correlate with reaction performance, moreover it reflecting behavioural aspects of motorists (attention, and performance allocation) (Göbel et al., 1998; Louw, 2013). Percentage of gaze on the road variable is an indication of the time eyes focus on or off the road. A subjective perceived control indicator is also measured, all of which will be discussed in more detail later.

2.2 Participants

Six males and six female Rhodes University students between 22-30 years (average age of the participants was 22.9 years) with a minimum of 4 years and a maximum of 10 years driving experience (average 5 years) participated. Participants had to be in possession of a valid driver’s license, good eye sight (participants that wore glasses or contact lenses were excluded from the study). In addition they had to be in good health (no sleep disorders, not epileptic, did not suffer from narcolepsy and did not have food allergies).

2.3 Conditions

Two independent conditions namely unpacking of the meal, eating, and drinking of the meal were compared to two control conditions of pure driving. The pure driving therefore accredits towards the driver fully controlling and operating the vehicle. It is expected that unpacking of the meal while driving will indicate the worst driving performance of the participants as the effect of having hands away from the wheel and eyes focusing off the road (Deery, 1999). This increases the loss of vehicle control and may incur a traffic
accident leading to traffic fatality (Deery, 1999; Horberry et al., 2006; Lee, 2008; Mitsopoulous-Ruben et al., 2011; Choi et al., 2013). Noteworthy, the study does not compare the effect different types of foods have on driving performance, but aims to understand the multitask process associated with the consumption of foods and its effect on driving performance. The packaging of the meal consisted of a paper bag enclosed with the individual food items (Burger, chips, canned cold beverage, straw and serviette enclosed with salt and barbeque sauce).

### 2.4 Dependent Variables

The various dependent variables measures were measured during the testing sessions, and include the objective indicators namely, the tracking deviation and the percentage of gaze on the road. The subjective indicator to measure driving ability required the use of perceived control Likert scale.

The *tracking deviation* is an indication of the driver's (in) consistency to remain on the middle line separating the two lanes of the simulator scene. The further the participants swerve away from the line, the less vehicle control the driver has, and the less the participants swerves away from the line, the better the drivers vehicle control. The mean deviation is calculated from the target line in meters and the in (accuracy) of the driving on the target, a percentage was given.

The *percentage of time the eyes focus out of the field view* when driving this may deteriorate a driver's ability to drive accurately in this instance may reduce the tracking deviation of the participants and incur accidents (Mitsopoulous-Ruben et al., 2011).

The *perceived control* scale measures the driver's subjective estimation of perceived control and driving skills. The perceived control scale is a scale that aims to assess the control and driving ability of the participants. A five point Likert scale was used with scores ranging from poor to excellent. The scale was assigned numbers from one to five in order to quantify the perceived control of the participants. The numerical value one indicates the worst driving ability and five the best driving ability.

### 2.5 Procedure

Participants attended introduction and habituation session prior testing.

Participants were required to complete 4 conditions:

- Condition 1: pure driving
- Condition 2: unpacking of the meal while driving
- Condition 3: Eating while driving
- Condition 4: pure driving

For all conditions participants were required to steer the yellow arrow (representative of the bonnet of a vehicle) and trace the middle line separating the two lanes, as accurately as possible. Each condition lasted 3 minutes.

A three minute break was given for: setting-up for the next condition and so that participants may complete the perceived control questionnaire.

### 2.6 Ethical considerations

Ethical clearance was obtained from the Human Kinetics and Ergonomics ethics committee.

### 2.7 Statistical analysis

Statistical analyses were performed using STATISTICA (version 11) statistical software programme on the data collected. Descriptive statistics on the demographic of the sample population, tracking deviation, percentage of gaze on the road, and the perceived control was calculated to mean and standard deviation and coefficient of variation.

In order to analyse differences between *pure driving 1* and *pure driving 2* condition which would indicate either a learning or habituation or fatiguing effect a t-test for dependant samples was calculated for tracking performance and perceived control. As the percentage gaze on the road for both *pure driving conditions* was
100% for all participants (i.e. no variance in the sample) this step was omitted for percentage gaze on the road.

To identify differences between all conditions for tracking deviation and perceived control one-factorial analysis of variance (ANOVA) was performed. If there was significance between the conditions, Fischer Least Significant Difference (LSD) Post Hoc Analyses were conducted on the data identifying differences between specific conditions.

Due to the above mentioned lack of variance in both pure driving conditions for the percentage gaze on the road analysis of variance was not possible. Therefore, single sample t-tests comparing the unpacking and eating condition to 100% have been performed separately.

**Results and Discussion**

**3.1 Tracking Deviation**

The worst driving ability was that of the unpacking while driving condition (figure 1). Following this, was the eating while driving condition. Statistical significance was found between conditions (p<0.05). Tracking deviation during unpacking is significantly different to all other conditions, while there is no difference between the other three conditions (pure driving 1 and 2 and eating condition).

![Tracking deviation graph](image)

Figure 1: Average tracking deviation for all four conditions (error bars indicate standard deviation)

**3.2 Percentage of gaze on the road**

The unpacking while driving condition indicates the least percentage of time participants’ gaze was on the road. Second to this, was eating while driving condition (figure 2). The two pure driving conditions had no variance as participants gaze was on the road 100% of the time. There was a significant difference of the percentage of gaze on the road for the unpacking condition at a reference constant of 100. There was no significance for the eating while driving condition. Eating while driving does not negatively affect driving performance unlike the unpacking while driving condition in terms of observing the road.
3.3 Perceived control

Participants indicated least driving ability during the *unpacking while driving* condition (figure 3). The *eating while driving* condition was considered as average with a score of 3. The two *pure driving* conditions were considered as good with a score of 4. Unpacking while driving is significantly different to all other conditions for the perceived control. The *eating while driving* condition is statistically significant different to the two *pure driving* conditions for the perceived control. Whilst there is no difference between the two *pure driving* conditions.

3. Discussion

The driving simulator is particularly ideal in indicating and identifying the negative outcomes that may result from inattentive type of driving (Petridou and Moustaki, 2000). It has been seen that motorists are inclined to participate in internal activities that are potentially distracting to the main task of driving and may
lead to driver error (Horberry et al., 2006). Middle-income countries such as South Africa endure the most accidents and traffic fatalities because of the complex and dynamic socio-economic changes like urbanisation (Kearney, 2010). Therefore, these societal changes place greater demand on citizens to purchase vehicles so that individuals may travel from one geographical location to another (Kearney, 2010).

From the results the different dependent variables (tracking deviation, percentage of gaze on the road, and perceived control) were investigated under four conditions (before and after pure driving conditions, unpacking of the meal while driving and eating condition). The objective measures indicate that the unpacking of the meal while driving illustrated the worst results in all three dependent variables. The participants’ tracking deviation was reduced as the participants’ one hand was off the steering wheel; seemingly, the percentage of gaze on the road was reduced. This implies that participants may not see unexpected stimuli such as walking pedestrians, stray domestic animals on the road and therefore motorist may fail to react to stimuli effectively and appropriately.

In addition, the eating while driving condition was found not to be statistically significant to the pure driving conditions and unpacking condition for gaze on the road and tracking deviation. For the subjective measure, eating while driving compared to the two pure driving conditions and unpacking showed differences in perceived control. This illustrated that participants were insecure and less confident in their driving ability.

The perceived control scale is rated from 1 to 5. With the value, one indicating poor vehicle control and five indicates excellent vehicle control. The participants’ perceived control results were consistent with the tracking deviation. There is an inverse relationship between tracking deviation and perceived control such that the greater the participants perceived their vehicle control the less the tracking deviation, and the lower the perceived vehicle control the higher the tracking deviation. For both the pure driving conditions, participants perceived their vehicle control as good, whilst for the unpacking condition as fair and for the eating condition as average.

4.1 Tracking deviation

The reason for the differences may be the fact that the participants used different techniques to steer and fulfill the conditions proposed. The unpacking of the meal while driving condition showed statistical significance and the worst outcome of the participants driving performance compared to the other conditions as participants used one hand to unpack the meal and used another hand to steer the wheel. Other participants put the food packaging on their laps and then proceeded to unpack the food packaging and items, whilst it was observed that other participants briefly released both their hands off the steering wheel and unpacked the food packaging.

Second, to affect driving performance of participants was the eating while driving condition. It was observed that there were brief moments where the participants manipulated their food in attempt to eat while driving, while the other hand was kept on the steering wheel in order to control the driving task. The participants would then control the steering wheel using the base of lateral palm, pollex, or the distal end of the digitus primus, digitus index finger, digitus secondus, digitus medius, digitus tertius and digitus medicinalis. According to the k53 motorist rules and regulation and by law, motorists are taught and required to drive with both hands on the steering wheel, to increase the ability to control the vehicle and decrease chances of risk (Deery, 1999; Ginsburg et al., 2008). This meant that participants steered the wheel using adapted methods of driving as compared to the unpacking of the meal while driving condition. What was consistent throughout the testing session for the pure driving condition was the fact that, participants had both hands on the steering wheel; this increased the accuracy and efficiency at which the drivers controlled the steering wheel.

The reasons behind the performance decrements are strongly related to studies that have investigated hazard perception and detection skills of motorist as well as time-sharing ability implying the ability for motorists to manage their resources switching their attention while under two or more concurrent tasks (Deery, 1999; Lee, 2008). Moreover, it is with accordance of participants participating in other activities internally, which is descriptive of the internal distractions reported vast majority of the literature related to driving safety (Horberry et al., 2006; Young et al., 2012). For the unpacking condition, whilst differences in packaging of meal were not investigated it may be inferred that unpacking condition results are dependent on the type of packaging. The participants during the eating condition all illustrated some insecurity concerning their driving ability despite the fact that that this was not reflective in their tracking deviation.
Reasons may be the fact that eight out of the twelve participants expressed that the behaviour of eating and drinking was only performed once in a week and during long distance travelling, of which only once after many months. Various websites have suggested that eating while driving is detrimental to driving performance and is considered as harmful as operating a cell phone (Siu, 2013). In addition, it has been found that eating while driving decreases the driver’s reaction time by 44% and when drinking a beverage by 22%, which reiterates the fact that drivers may not react to unexpected stimuli in the least effective time (Siu, 2013). Moreover, it has been found that motorist commonly eat and drive and do so under the impression that eating while driving is not as dangerous as texting while driving or participating in other internal activities (Loxley, 2013). This, mindset and unawareness therefore, contributes to the fact that motorists engage in behaviours that are potentially harmful and do so against their better judgement. The various websites highlight that eating while driving is potentially dangerous as it acts as distraction and affects motorist behavioural domain, which encourages motorists to look away from the road and have their hands off the wheel (Loxley, 2013). Various websites and literature, however fail to document the effects unpacking of meal while driving may have on driving performance and for this reason, the current evidence on unpacking of the meal while driving may not be substantiated by evidence. However, does suggest that the act of unpacking the meal while driving is perhaps the greatest influence in reducing a motorist tracking deviation.

4.2 Percentage of gaze on the road

For the percentage of gaze on the road, unpacking of meal while driving showed statistical significance at a *p* value of 0.0245 against the reference constant of 100%. Participants had their eyes on the road 93.52% of the time, however still decreased the tracking deviation. This finding illustrates that a driver’s driving performance is significantly deteriorated when the driver’s eyes are off the road even at a value of 6.48% of the time (Lee, 2009). This indicates that brief visual or perceptual distractions and interruptions in the gaze on the road may impair driving ability, thus visual perceptual determinants of driving performance are necessary to investigate for driving related research (Lee, 2008).

4.3 Perceived Control

The result indicated that for both the pure driving condition participants considered their driving ability as good, whilst for the eating condition as fair and for the unpacking condition as poor. There is an inverse relationship between the tracking deviation and the perceived control. This means that the higher the perceived control score, the lower the tracking deviation of the participants. The lower participants perceived their driving ability the higher the tracking performance. These results showed that unpacking of the meal condition was considered the worst in terms of driving ability, following this was eating condition and the least of this was the pure driving conditions. It should be noted that whilst perceived control is subjective in nature, it may have been influenced by individual factors, unknown to the researcher, and may have been influenced by the context in which participants perceived their driving ability. Participants may have been tempted to rate their perceived control based on the tracking deviation values they saw appear on the white projector screen after every test condition was conducted.

5 Conclusion and recommendations

The results of the present study illustrate that there is statistical significant difference established for the unpacking of the meal while driving condition across the dependent variables (tracking deviation, percentage of gaze on the road and perceived control). The unpacking of the meal condition proposes the greatest threat to drivers driving performance as opposed to the pure driving conditions and eating while driving condition. Although not investigated it is hypothesised that the unpacking while driving condition may be dependent on the type of packaging. The unpacking of the food propels participants to have their hand off the wheel while driving to open the food contents, and at the same time, increase the time participants’ eyes are off the road. The participants used different techniques to open the package, which explains the large variance within the population sample and explains why the variance for this condition is greater than the other conditions. Some participants did not look away and unpacked the meal using only the hand; feeling for the food items. Whilst others looked away often in order to see what they were unpacking and if it were
done correctly. The eating condition was not statistically significant compared to the two pure driving conditions, yet participants were less confident with their driving ability, this may be due to the lack of experience while eating and driving.

Future research is needed concerning the investigating of varying food types as well as the packaging thereof during the different testing conditions, and whether these will have any effect on the driving performance variables. The study would require increasing the sample size and looking at sex-related differences between the population sample.

In closing, the behavioural aspect and process of unpacking a meal and consuming the meal while driving decreases the time hands are on the steering wheel and eyes off the road, which in turn affects driving performance and may result in traffic accidents. Awareness of this type of behaviour while driving may minimise the risk within the middle-income countries and decrease the number of traffic fatalities to occur. Furthermore, this finding may contribute in the existing body of knowledge currently available, it may influence national road safety policy in completely eliminating the potential cause of traffic accidents through eating or establish well-suited in vehicle technologies that are not cumbersome, but assist motorists in the act of eating while driving.

References


