Impact of Earphone Usage on Cyclists' Lateral Position

Tomass Pankrats

s4025377

Department of Psychology, University of Groningen

PSB3E-BT15: Bachelor Thesis

Group number: 47

Supervisor: Dr. Arjan Stuiver

Second evaluator: Eva Postuma

In collaboration with: Sven Norden, Aaryen Vreeling, Sven Walgien and Eva Wilbers

July 20, 2023

A thesis is an aptitude test for students. The approval of the thesis is proof that the student has sufficient research and reporting skills to graduate, but does not guarantee the quality of the research and the results of the research as such, and the thesis is therefore not necessarily suitable to be used as an academic source to refer to. If you would like to know more about the research discussed in this thesis and any publications based on it, to which you could refer, please contact the supervisor mentioned.

Abstract

This study aimed to investigate the impact of using earphones while cycling on lateral position and swerving behavior. We hypothesized that cyclists would adjust their safety margins under more demanding conditions. The analysis of lateral position and swerving did not reveal any statistically significant differences across the four conditions, though certain data-related factors might have influenced the results. Additionally, participants' self-perceived working memory usage was measured for each task. It was found that listening to music while cycling showed no significant increase in working memory usage compared to cycling without earphones. This suggests that music might not impose substantial cognitive demands on cyclists. In contrast, listening to a podcast or participating in a call led to a greater self-reported utilization of working memory, with the call condition showing the most pronounced effect. However, our study was unable to establish a significant link between self-reported working memory and actual cycling performance.

Keywords: Cycling, Lateral position, SDLP, Working memory

Impact of Earphone Usage on Cyclists' Lateral Position

Cycling is a sustainable and popular transportation mode that has numerous benefits for individuals and society, including reducing traffic congestion, improving public health, and reducing carbon emissions. However, cycling also presents several risks, including navigating through traffic, sharing the road with motor vehicles, and coping with various environmental factors. According to the World Health Organization (2011), over 1.3 million people die each year due to road traffic accidents globally. The Netherlands has the highest proportion of cyclist fatalities at 26% of all road fatalities, the European average is 8.4% (European Commission, 2020). Goldenbeld, Houtenbos, and Ehlers (2010) discovered from an online survey involving 2500 cyclists that a considerable portion of them listen to music while cycling. According to their findings, 15% of cyclists aged 18-34 reported listening to music during every ride, while younger cyclists (aged 12-17) reported an even higher frequency, with 40% almost always listening to music while cycling. In addition, 76% of the youngest age group and 54% of 18-34 year-olds occasionally listen to music while cycling. Older age groups also reported listening to music while cycling, with 23% of 35-50 year-olds and 14% of those aged 50+ reporting occasional music-listening while cycling. (Goldenbeld et al., 2010).

The use of electronic devices during cycling, such as making phone calls, texting, or listening to music, has been associated with detrimental impacts on cycling performance and safety. In a field observation study conducted by Terzano (2013) in The Hague, Netherlands, six different intersections without traffic signals were selected for observing cycling behavior and identifying potential unsafe actions. The study findings demonstrated an association between performing secondary tasks while cycling and an increased occurrence of unsafe behaviors. Specifically, among cyclists who refrained from any secondary tasks, only 20.8% engaged in unsafe behaviors. In contrast, 48.9% of cyclists who performed secondary tasks exhibited unsafe behaviors. The unsafe behavior frequencies for all secondary task types ranged from 42.9% to 51.1%, with smoking having the lowest percentage and the manual use of a cell phone displaying the highest incidence.

While previous studies provide valuable insights into the potential hazards of using mobile phones while cycling, they may not present a comprehensive understanding of the issue. With the availability of wired and wireless earbuds, mobile phone use has become less conspicuous, which may have led to an underestimation of the risks associated with this behavior. For instance, De Waard's (2011) study demonstrated that using earbuds significantly increased the likelihood of missing auditory stop signals, while completing tasks on mobile phones, even when hands-free, led to reduced auditory perception and longer response times to signals. Surprisingly, only a small fraction (0.5%) of accident-involved cyclists in De Waard's (2010) three-part study reported using their phone at the time of the accident. In a controlled experiment where participants used their phones while cycling, they experienced reduced speed and peripheral vision performance, as well as increased risk and mental effort ratings. Text messaging had the most substantial negative effect on cycling performance with the most swerving and largest lateral position from the edge of the road. Listening to music and talking on the phone did not have a significant effect on lateral position or its stability.

It appears that cyclists compensate for the increased demands of the task by slowing down, but they also experience heightened mental effort and risk perception. Another compensation mechanism is that riders tend to maintain a larger distance from the curb when using a mobile phone as reported by De Waard et al. (2014). This suggests that cyclists who use mobile phones may be increasing their safety margins in terms of keeping a greater distance from the curb. However, this increased distance from the curb could also increase the risk of colliding with other vehicles on the road, as noted by De Waard et al. (2015). It should be noted that compensatory behavior is not only limited to situations where cyclists actively perform a task. According to a study by Stelling-Konczak, Van Wee, Commandeur, and Hagenzieker (2017), approximately 70% of cyclists reported engaging in compensatory behaviors while listening to music. The reported behaviors they found were: looking around more frequently, turning the music down or off and using one earbud instead of two.

In this study, we aim to investigate the effects of four conditions on cyclists' lateral position, namely control, listening to music, having a conversation, and listening to a podcast. Our primary focus will be on examining how lateral position (distance from the wheel to the side of the road) and the standard deviation of lateral position (SDLP), which indicates swerving, vary across these conditions. Additionally, we will explore the cognitive demands associated with each task. We hypothesize that there will be an inverse relationship between SDLP and the cognitive demands of each condition due to cyclists compensating for the demands of a condition by swerving less. Furthermore, we anticipate that lateral position will be larger for more cognitively demanding tasks, as cyclists may increase their distance from the curb. Conditions are expected to be cognitively demanding from least to most in this order: control, music, podcast, call. The reason for this ordering is that the control condition has no additional cognitive demands, music doesn't require active listening and can be "tuned out" when need be, next is the podcast condition that requires active listening, but no engagement. Finally the call condition requires both active listening and active engagement.

Method

Participants

The participants of the research were recruited by word of mouth. Convenience sampling was used. Participation in this study was entirely voluntary and participants were not compensated. The study was successfully completed by 23 people. No participants were excluded from the study. This brings the number of valid participants to $N = 23$ The mean age of the participants was 24 years old (*M* = 23.61) with a standard deviation of 6 years (*SD* = 6.394) Of these participants, 10 were female and 13 were male.

Design and Procedure

The study used a within-subjects design. The research design consisted of four experimental conditions to which the participants were randomly assigned. The conditions were randomly assigned to the participants to ensure that any observed effects on cycling performance were not due to pre-existing differences between groups. Every participant completed each of the four conditions once. The following conditions were included in the experiment: (1) control condition, (2) listening to music while cycling, (3) having a hands free phone call while cycling, (4) listening to a podcast while cycling. During each of the non-control conditions, participants were instructed to use their earphones or headphones in the manner consistent with their customary usage to create a more ecologically valid and representative experimental condition.

At least a day before their participation, the participants received an email with general information such as location and time, an information form, a map and video of the route, and a reminder to bring a charged mobile phone and earphones with a working microphone. After the participants arrived, they were again informed about the procedure, and filled out an informed consent. The participants were told to cycle as they normally would do. The participants then filled out a questionnaire, after which they completed the four conditions of the experiment in a random order. After each condition, they filled out a smaller questionnaire. After the experiment ended, a debriefing took place about the goals of the experiment, and the participants had an opportunity to ask questions. The experiment had a duration of approximately 45 to 60 minutes. The data were acquired in dry conditions during the end of May 2023.

Location

The experiment was carried out on a one-and-a-half kilometer long asphalted cycle path, in the north of Zernike Campus (see figure 1) in Groningen. The long straight sections of the route were non-segregated, so cars and cyclists shared the same space. The bicycle lane was marked with red colored pavement and white striped lines on the edges (see figure 2). The width of the bicycle lane was approximately 2 meters. The cyclists followed the street on one side, turned left to cycle on a segregated path, crossed the street, and went left again to follow the non-segregated street until the end of the route.

Figure 1

Cycling route

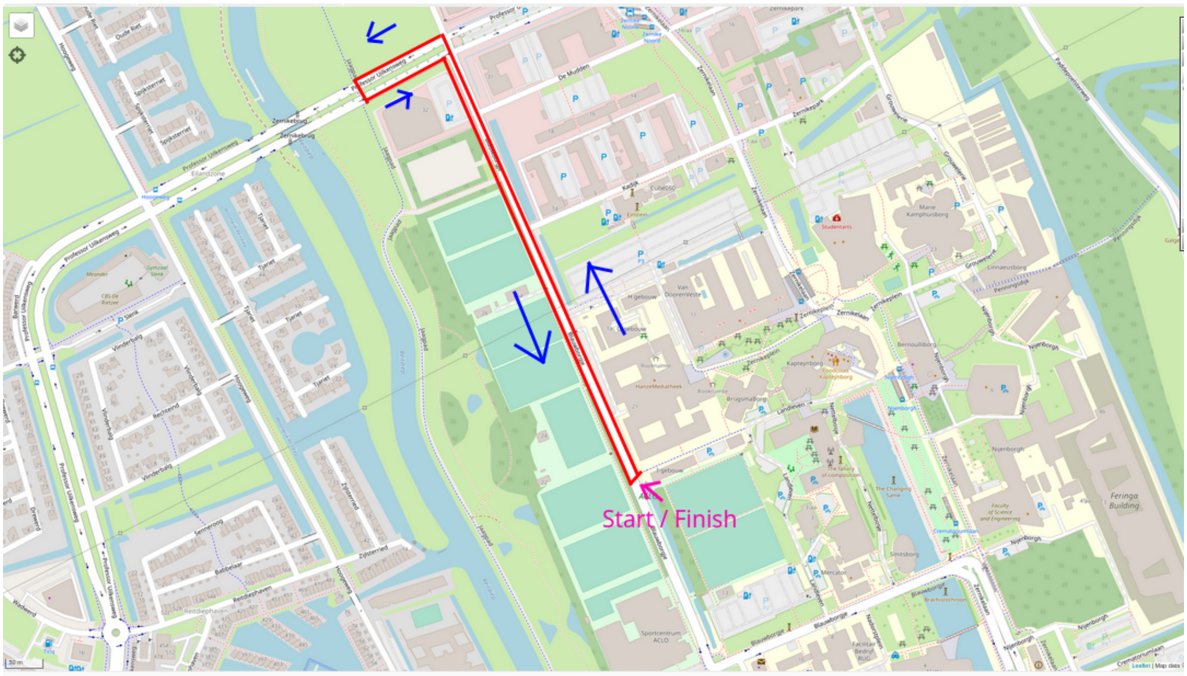

Figure 2

The cycling path.

Materials

The study utilized an online questionnaire through the Qualtrics platform (a system in which questionnaires can be created and managed), a consent form, an information form, two GoPro cameras with handlebar mounts, and a calibration stick. Participants were instructed to use their own bicycle, mobile phone, and earphones or headphones as part of the experimental procedure.

Story. ChatGPT was used to generate a simple story with interspersed questions for the call condition. The generated story had 32 questions in total and was made to be long enough so that no participant could realistically hear it all in one attempt. The plot of the story involves a young girl finding a magical book that takes her on various adventures. The story was generated in English, but a Dutch translation was available for participants to choose.

Questionnaire. For the current research, data was gathered using an online questionnaire in the Qualtrics platform. The data collection process involved the implementation of two distinct questionnaires. The first questionnaire was administered before the experiment began, while the second questionnaire was administered during the intervals between the experimental conditions. Notably, the in-between questionnaire exhibited distinct variations corresponding to each specific experimental condition, featuring specific sections that were relevant to each experimental condition.

The first questionnaire (See Appendix A) consisted of a total of 21 questions that encompassed various aspects including demographic information, bicycle use, cycling behavior, the use of electronic devices while cycling, immersion experiences, and two manipulation checks. The section of bicycle use and cycling behavior included a combination of open-ended and Likert scale questions. An example item was: ‘’I feel confident in my cycling abilities, such as handling my bike in different conditions or situations’’, which was measured using a 5-point Likert scale (1 = ‘’strongly disagree’’ to 5 = ‘’strongly agree’’).

Regarding the use of electronic devices while cycling, participants encountered multiple-choice questions and Likert scale questions. Example items were: ‘’What kind of earphones/headphones do you use while cycling? (multiple answers are possible)’’ (answer options: ‘’noise canceling headphones or earphones’’, ‘’non-noise canceling headphones’’, ‘’non-noise canceling earphones’’, ‘’other’’) and ‘’What do you usually do when you are cycling on an (electric) bike or moped/scooter and you receive a phone call?’’.

Immersion-related questions were answered using a 6-point Likert scale. An example item was: ‘’I often become completely engrossed in a movie or TV show’’ (1 = ‘’strongly disagree’’, 2 = ‘’disagree’’, 3 = ‘’not agree, not disagree’’, 4 = ‘’agree’’, 5 = ‘’strongly agree’’, 6 = ‘’don’t know / no opinion’’).

To evaluate if the questionnaire was answered honestly by the participants, manipulation checks were incorporated within the questionnaire. One particular question, namely ‘’Answer ‘disagree’ on this question’’ served as a means to assess whether participants were responding honestly or randomly. This measure aimed to verify the participants’ engagement with the questionnaire. If a participant answered any other answer than ‘disagree’ their questionnaire would be excluded from the analysis due to the inability to ensure the accuracy and sincerity of their answers.

The in-between questionnaire (See Appendix B) consisted of four standard questions related to immersion, distraction, and working memory. These questions were: ‘’I was absorbed in my thoughts’’, ‘’I was aware of what was happening around me’’, ‘’My attention was on cycling alone (so no daydreaming and or being distracted by my surroundings)’’, and ‘’I used a lot of my working memory during the ride’’. All these questions were answered with a rating scale from 1 to 10, where 1 meant ‘’not at all’’ and 10 meant ‘’completely’’. The podcast and music conditions incorporated additional questions. In the music condition, participants were presented with an extra item regarding the genre of music they were listening to, utilizing a multiple-choice format that included various music genres as options. The podcast condition included several supplementary open-ended questions that focused on the content of the podcast.

Measures

Lateral position. The measurement of the cyclists' lateral position involved the placement of a GoPro camera in a strategic position that allowed for capturing the front wheel of the bicycle. To establish an accurate calibration, a 1.5 meter calibration stick was employed, serving two purposes: determining the lateral position from the wheel to any pixel on the left side of the cyclist, and correcting for lens distortion. The alignment of the wheel and stick formed a 90-degree angle with the road edges. The measurement of lateral position was based on the distance to the white stripes situated on the left side of the cyclist.

Prior to commencing cycling, a brief video was recorded for the purpose of extracting a calibration image. By capturing a screenshot from the video, a calibration image was obtained which was used to manually mark the length of the calibration stick. While making the picture it was important to ensure that the image of the road edge was clear and easily distinguishable. At the end of each measurement process, the procedure of generating a calibration image was repeated. The software application GIMP, which specializes in photo editing, was used to enhance clarity of the final image. Additionally, a line was drawn on the image to indicate the lateral position of the wheel. Subsequently, the GIMP image, the desired start and end time for measurement, and the corresponding video file made by the GoPro camera were imported into MATLAB, a programming environment, for further analysis and processing.

Exploratory variables. In addition to assessing lateral position, head movements, and speed, this study used questionnaires to measure various additional variables. These variables included participants' cycling experience, immersion tendencies, distraction, cognitive workload, and sleep duration. By incorporating these measures, the study aimed to gather a comprehensive understanding of various aspects related to participants' cycling behaviors during the experimental conditions. This allowed for a more thorough analysis of the data and insights into how these factors may impact participants' cycling behavior.

Results

Descriptive statistics

The means and standard deviations of SDLP, lateral position and working memory usage were calculated and are displayed in tables 1, 2 and 3 respectively.

Table 1

Mean and Standard Deviation of SDLP (cm)

Condition	*M*	*SD*
control	22.13	4.50
music	20.74	5.98
call	20.13	5.72
podcast	19.42	4.67

Table 2

Mean and Standard Deviation of Lateral Position (cm)

Condition	*M*	*SD*
control	106.80	20.87
music	110.19	22.42
call	103.30	22.73
podcast	106.88	25.40

Table 3

Mean and Standard Deviation of Working Memory Usage (self report in range [1,10])

Condition	*M*	*SD*
control	4.17	2.06
music	3.78	2.11
call	7.13	1.14
podcast	5.87	1.69

Assumption checks

Three GLM Repeated Measures procedures were carried out to investigate the difference in means between the four conditions for SDLP, lateral position and working memory usage. The assumption of sphericity for each analysis was tested using Mauchly's Test of Sphericity and it was nonsignificant for SDLP ($p = .539$) and lateral position ($p = .929$) indicating that the condition of sphericity has been met. However, it was significant for working memory usage ($\varepsilon = .775$, $p = .002$) indicating that the condition of sphericity has not been met, thus the Huynh–Feldt correction will be applied. The assumption of normality was checked using the Shapiro-Wilk Test for all conditions of all variables totalling 12 tests. All normality tests were found to be nonsignificant ($p > .05$) indicating that the null hypothesis of normality should be retained.

GLM Repeated Measures Results

First, for SDLP, a significant main effect of group was not observed ($F(3, 20) = 2.342$, $p = .104$, $\eta_p^2 = .260$). This suggests that the different groups did not significantly differ in terms of their SDLP scores. Similarly, the analysis examining the lateral position did not yield a significant main effect of group ($F(3,20) = 1.670$. $p = .205$, $\eta_p^2 = .200$). The lack of statistical significance suggests that the various groups did not significantly differ in their lateral position scores.

In contrast, the analysis of working memory usage revealed a significant main effect of group ($F(2.324, 51.123) = 23.055$, $p < .001$, $\eta_p^2 = .512$). This finding indicates that the groups differed significantly in their working memory usage. The effect size ($\eta_p^2 = .512$) demonstrates a large association between group membership and working memory usage, suggesting that changing the condition explains a substantial proportion of the variance in working memory usage scores. It is important to note that the Huynh-Feldt correction was applied to the analysis of working memory to correct for failure to meet the sphericity assumption. This correction adjusts the degrees of freedom and p-value, while the F statistic is kept the same.

Figures 3, 4 and 5 display the estimated marginal means for each variable. For SDLP and lateral position, all error bars overlap indicating no statistically significant differences between the conditions. On the other hand, control and music conditions scored notably lower than call and podcast conditions for working memory usage and the call condition scored higher than the podcast. This is reflected in tables 4, 5 and 6, which display the exact statistics pertaining to the aforementioned pairwise comparisons.

Figure 3

Estimated Marginal Means of the Lateral Position

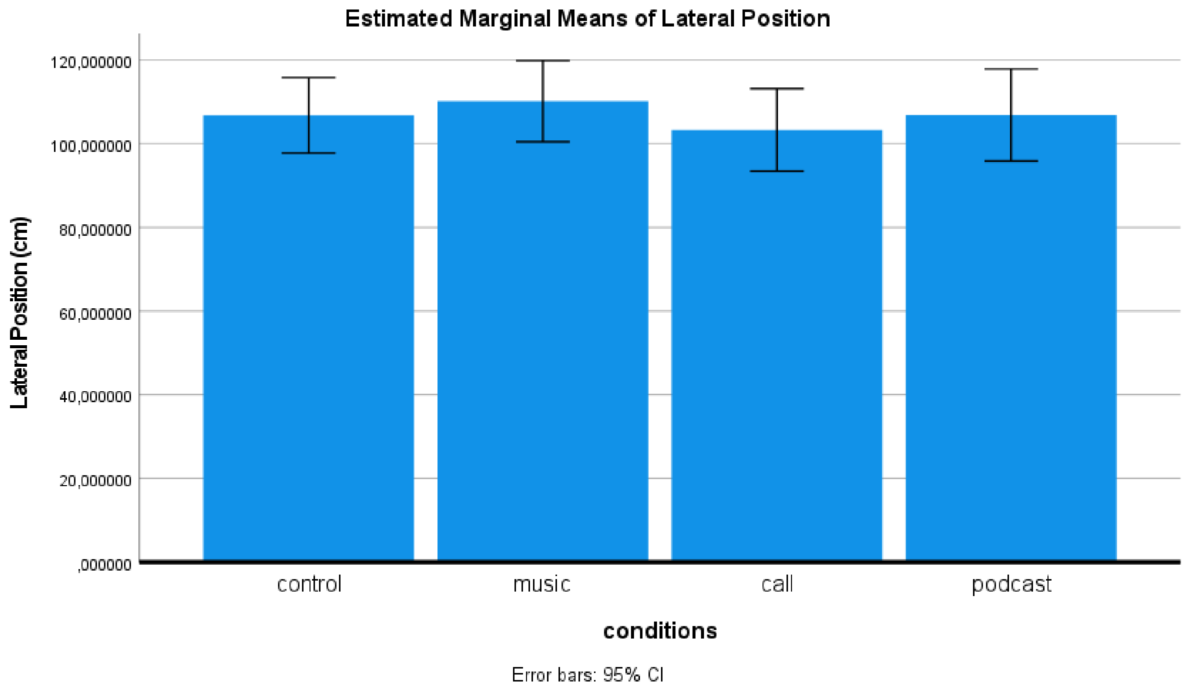

Figure 4

Estimated Marginal Means of SDLP

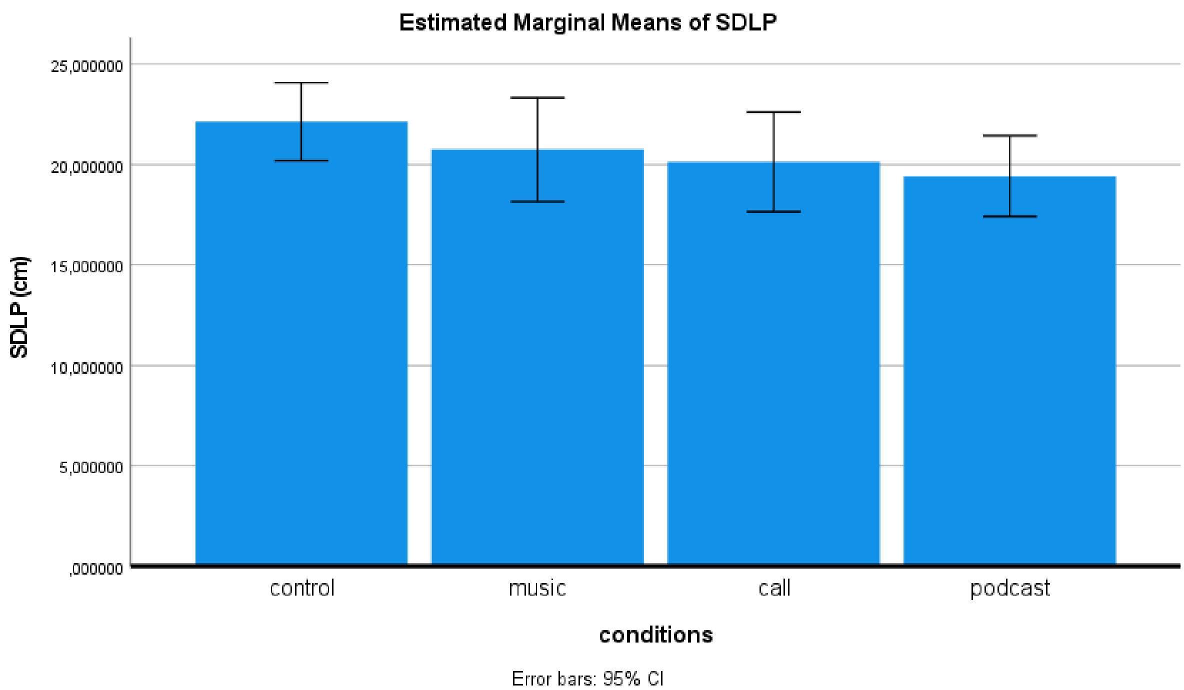

Figure 5

Estimated Marginal Means of Working Memory Usage

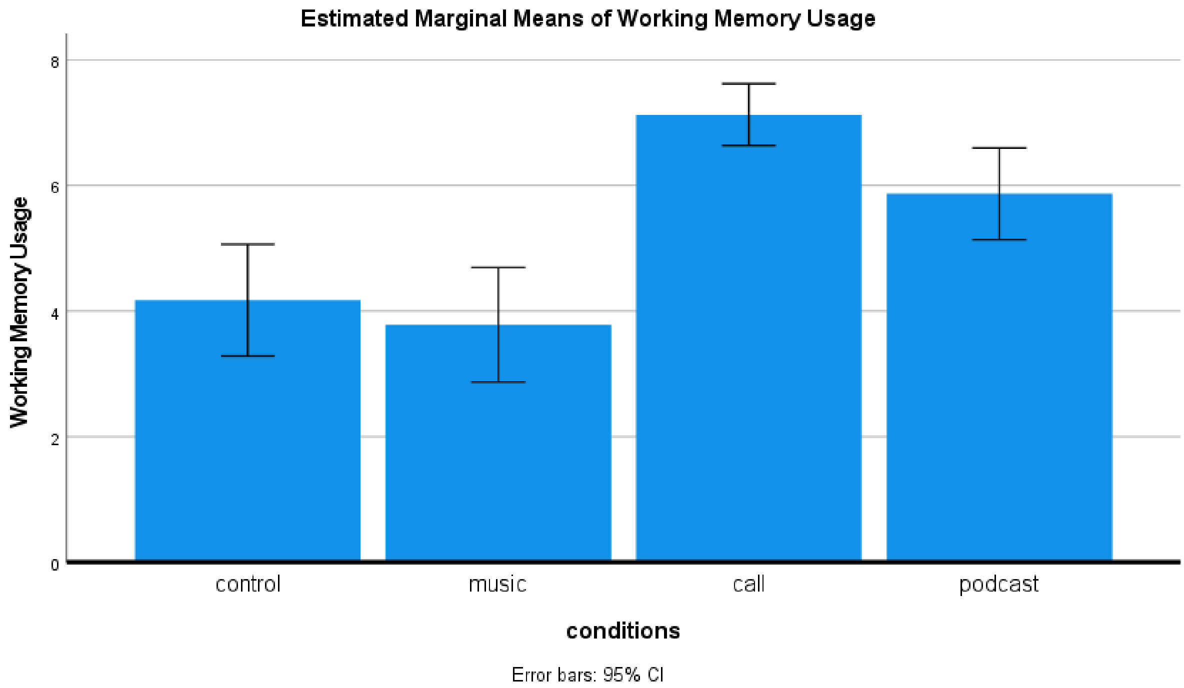

Table 4

Pairwise Comparisons of Lateral Position

Conditions	Conditions	SE	Sig[a]	95% Confidence Interval for Difference[a]	
				Lower Bound	Upper Bound
control	music	2.71	1.0	-11.23	4.45
	call	3.30	1.0	-6.06	13.07
	podcast	2.83	1.0	-8.30	8.13
music	call	3.01	.19	-1.84	15.62
	podcast	2.97	1.0	-5.30	11.91
call	podcast	3.16	1.0	-12.74	5.57

a. Adjustment for multiple comparisons: Bonferroni.

Table 5

Pairwise Comparisons of SDLP

Condition	Condition	SE	Sig[a]	95% Confidence Interval for Difference[a]

				Lower Bound	Upper Bound
control	music	.99	1.0	-1.48	4.26
	call	1.23	.71	-1.57	5.57
	podcast	1.00	.08	-.19	5.62
music	call	1.03	1.00	-2.36	3.59
	podcast	1.17	1.00	-2.07	4.72
call	podcast	1.09	1.00	-2.44	3.86

a. *Adjustment for multiple comparisons: Bonferroni.*

Table 6

Pairwise Comparisons of Working Memory Usage

Condition	Condition	SE	Sig[a]	95% Confidence Interval for Difference[a]	
				Lower Bound	Upper Bound
control	music	.43	1.0	-.87	1.65
	call	.49	<.001	-4.39	-1.53
	podcast	.58	.048	-3.38	-.01
music	call	.47	<.001	-4.70	-1.99
	podcast	.43	<.001	-3.34	-.84
call	podcast	.28	.001	.441	2.08

a. *Adjustment for multiple comparisons: Bonferroni.*

Discussion

In the introduction, it was argued that cyclists would increase their safety margins in response to more demanding tasks when cycling. In the present study, none of the pairwise comparisons conducted for SDLP or lateral position yielded statistically significant results, meaning that we cannot link any observed cycling behavior back to the perceived working memory usage of a given task.

Although the differences were not significant, the means of SDLP exhibited an interesting pattern: the control condition had the highest swerving, followed by the music, calling, and podcast conditions in a linear, descending order. It could be argued that the experiment had some sources of noise in the data that could increase the variance. For example, there were several instances throughout the experiment where the road-facing camera leaned towards the road as the ride progressed. Another issue is that in some cases even though the calibration stick was within the frame of the video during recording, the tip of the stick would occasionally get cropped off in software during the undistortion process. Lastly, the present study was conducted near a sports pitch, thus quite frequently the participants had to maneuver around pedestrians walking on the bike path as well as parked cars. Those sections of the footage were discarded from the lateral position / SDLP analysis. It's possible that this alone would add noise / reduce the length of usable footage which would make it less representative of the participant's actual behavior. It is also a possibility that the participants cycled a little differently for a few seconds before and after they had returned back into their lane.

Taking into account the initial hypothesis that cyclists would increase their safety margins for more difficult conditions, the lack of significant findings with regards to SDLP and lateral positioning may be due to the fact that the participants are increasing their safety margins in other ways, such as reducing their speed. Consequently, once safety margins are adequately adjusted through other means, the need to modify their lateral position or SDLP for that specific purpose diminishes. The location of the study may contribute to the unwillingness of participants to cycle further from the curb, as there is nothing physically separating them from the cars to their left. For this same reason, it is possible that cyclists already try to limit their swerving to a significant degree.

A statistically significant difference was observed in self-reported working memory usage. Specifically, the control and music conditions scored lower in working memory usage compared to the call and podcast conditions, and the call scored higher than the podcast. This is largely in line with what was hypothesized in the introduction except that the present study did not find a statistically significant difference between the music condition and control in this regard. One possible reason for the absence of statistical significance could be that the working memory demands do not significantly increase when listening to music while cycling compared to cycling without music. It is probable that working memory becomes relevant only when participants need to remember specific information during the task.

Limitations

Apart from the factors discussed above that contributed to the lack of statistical significance, it is important to address other limitations inherent in this study. One notable limitation pertains to the relatively small sample size, consisting of only 23 participants. Increasing the sample size could have improved the statistical power and sensitivity of the analyses, potentially leading to more robust findings. Additionally, the use of a convenience sample, where participants were recruited based on word of mouth by the researchers, might have implications for the generalizability of the results. Also, the study utilized a within-subjects design, wherein each participant experienced multiple conditions. This approach offered the convenience of employing a smaller sample size. However, this design may suffer from potential carryover effects, where prior conditions could influence subsequent ones.

There are also limitations regarding the questionnaires administered. Post-trial questions asked participants to rate their experiences on a scale from 1 to 10 for each trial. This means that participants had varying amounts of prior trials to use as reference points, with the first trial lacking a direct comparison point. Additionally, the call condition presented a fictional story about a girl finding a magical book, with questions asked approximately every minute. This fictional scenario may not closely resemble a typical phone call that a cyclist would encounter while cycling, thus compromising the ecological validity of the study.

As a result, the findings related to the call condition may not fully reflect real-world scenarios, limiting the generalizability of the results.

Conclusion

We aimed to investigate how using earphones while cycling affects lateral position and swerving. The present study was unable to find any significant difference in swerving nor lateral position across all four conditions. However, it should be noted that there were some factors that introduced noise into the data meaning that there may very well be a difference and it was not detected.

Cyclist's self perceived working memory usage for each task was also measured. It was found that listening to music while cycling did not result in any significant increase compared to cycling without using earphones. The lack of a substantial increase in working memory usage while listening to music suggests that this particular auditory task might not place significant cognitive demands on cyclists. In contrast, listening to a podcast or participating in a call led to a greater self-reported utilization of working memory, with the call condition showing the most pronounced effect. Unfortunately, our study cannot tie the self reported working memory results to actual cycling performance due to the lack of statistical significance of the latter.

References

De Waard, D., Edlinger, K., & Brookhuis, K. (2011). Effects of listening to music, and of using a handheld and handsfree telephone on cycling behaviour. *Transportation Research Part F-Traffic Psychology and Behaviour*, *14*(6), 626–637. https://doi.org/10.1016/j.trf.2011.07.001

De Waard, D., Lewis-Evans, B., Jelijs, B., Tucha, O., & Brookhuis, K. (2014). The effects of operating a touch screen smartphone and other common activities performed while bicycling on cycling behaviour. *Transportation Research Part F-Traffic Psychology and Behaviour*, *22*, 196–206. https://doi.org/10.1016/j.trf.2013.12.003

De Waard, D., Westerhuis, F., & Lewis-Evans, B. (2015). More screen operation than calling: The results of observing cyclists' behaviour while using mobile phones. *Accident Analysis & Prevention*, *76*, 42–48. https://doi.org/10.1016/j.aap.2015.01.004

De Waard, D., Schepers, P., Ormel, W., & Brookhuis, K. (2010). Mobile phone use while cycling: Incidence and effects on behaviour and safety. *Ergonomics*, *53*(1), 30-42. https://doi.org/10.1080/00140130903381180

European Commission. (2020). *Cyclists: Facts and Figures*. European Road Safety Observatory.

Goldenbeld, C., Houtenbos, M., & Ehlers, E. (2010). Gebruik van draagbare media-apparatuur en mobiele telefoons tijdens het fietsen: Resultaten van een grootschalige internetenquête. Leidschendam: Stichting Wetenschappelijk Onderzoek Verkeersveiligheid SWOV. https://doi.org/10.1016/j.jsr.2011.08.007

Stelling-Konczak, A., Van Wee, G., Commandeur, J. J., & Hagenzieker, M. (2017). Mobile phone conversations, listening to music and quiet (electric) cars: Are traffic sounds important for safe cycling? *Accident Analysis & Prevention*, *106*, 10 22. https://doi.org/10.1016/j.aap.2017.05.014

Terzano K. (2013). Bicycling safety and distracted behavior in The Hague, the Netherlands. *Accident; analysis and prevention*, *57*, 87–90. https://doi.org/10.1016/j.aap.2013.04.007

World Health Organization. (2011). Mobile phone use: a growing problem of driver distraction.

Appendix A

Participant number:

___

Cycling with headphones

Q1 How old are you?

___

Q2 How much sleep did you get last night?

- ○ less than 4 hours (1)
- ○ more than 4, less than 6 (2)
- ○ more than 6, less than 8 (3)
- ○ more than 8 (4)

s

Q3 What kind of earphones/headphones do you use while cycling? (multiple answers are possible)

- ☐ noise cancelling headphones or earphones (1)
- ☐ non noise canceling headphones (2)
- ☐ non noise canceling earphones (3)
- ☐ other (4)

Q4 How many times per week do you cycle?

____

Q5 How many cycling accidents have you had in the last 2 years?

____

Answer This Question If:

The answer to the previous question is greater than 0

Q6 In how many of these accidents were you using earphones or headphones?

____

Q7 I feel confident in my cycling abilities, such as handling my bike in different conditions or situations

- ○ strongly disagree (1)
- ○ disagree (2)
- ○ neutral (3)
- ○ agree (4)
- ○ strongly agree (5)

Q8 I feel that I have good balance and coordination while cycling

- strongly disagree (1)
- disagree (2)
- neutral (3)
- agree (4)
- strongly agree (5)

Q9 When you listen to music while cycling, do you change the way you ride your bike in any way? If you do, what do you do differently? (multiple answers are possible)

- Cycling with one earbud (1)
- Turning the volume down (2)
- Cycling slower (3)
- Cycling faster (4)
- Making less head movements (5)
- I don’t listen to music while cycling (6)
- I do not change the way I cycle (7)

Q10 When you make a phone call while cycling, do you change the way you ride your bike in any way? If you do, what do you do differently? (multiple answers are possible)

- Cycling with one earbud (1)
- Turning the volume down (2)
- Cycling slower (3)
- Cycling faster (4)
- Making less head movements (5)
- I don't make phone calls while cycling (6)
- I do not change the way I cycle (7)

Q11 I feel that listening to music while cycling makes me less aware of my surroundings

- strongly disagree (1)
- disagree (2)
- neutral (3)
- agree (4)
- strongly agree (5)

Q12 I feel that calling while cycling makes me less aware of my surroundings

- strongly disagree (1)
- disagree (2)
- neutral (3)
- agree (4)
- strongly agree (5)

Q13 I feel that listening to music while cycling is distracting and negatively impacts my performance

- ○ strongly disagree (1)
- ○ disagree (2)
- ○ neutral (3)
- ○ agree (4)
- ○ strongly agree (5)

Q14 What do you usually do when you are cycling on an (electric) bike or moped/scooter and you receive a phone call?

- ○ I answer the phone while cycling (1)
- ○ I stop immediately and answer the phone (2)
- ○ I wait until it's quiet and call back while cycling (3)
- ○ I wait until it's quiet and stop to call back (4)
- ○ I ignore the ringing (5)
- ○ I never hear it (6)
- ○ That never happens (7)

Q15 What do you usually do when you are cycling on an (electric) bike or moped/scooter and you hear/feel that a new message has arrived on your phone or smartwatch?

- I message back while cycling (1)
- I stop immediately and message back (2)
- I wait until it's quiet and message back while cycling (3)
- I wait until it's quiet and stop to message back (4)
- I ignore it (5)
- I never hear it (6)
- That never happens (7)

Q16 Answer 'disagree' on this question.

- strongly disagree (1)
- disagree (2)
- neutral (3)
- agree (4)
- strongly agree (5)

Q17 I think I am able to hear traffic around me when cycling with music or while listening to a podcast

- strongly disagree (1)
- disagree (2)
- neutral (3)
- agree (4)
- strongly agree (5)

Q18 To what extent do you agree or disagree with the following statement:

When I am working on something, I easily lose track of time

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Not agree, not disagree (3)
- ○ Agree (4)
- ○ Strongly agree (5)
- ○ Don't know/ no opinion (6)

Q19 I can easily block out external distractions when I am focused on something else

- ○ Strongly disagree (1)
- ○ Disagree (2)
- ○ Not agree, not disagree (3)
- ○ Agree (4)
- ○ Strongly agree (5)
- ○ Don't know/ no opinion (6)

Q20 I often become completely engrossed in a movie or TV show

- ◯ Strongly disagree (1)
- ◯ Disagree (2)
- ◯ Not agree, not disagree (3)
- ◯ Agree (4)
- ◯ Strongly agree (5)
- ◯ Don't know/ no opinion (6)

Q21 Have you answered this questionnaire honestly?

- ◯ No (1)
- ◯ Yes (2)

Appendix B

Start of Block: Between conditions questionnaire **CONDITION: 1 (Normal)**

Q1 I was absorbed in my thoughts
(choose an answer between 1 and 10; 1 = not at all, 10 = completely)

____

Q2 I was aware of what was happening around me
(choose an answer between 1 and 10; 1 = not at all, 10 = completely)

____

Q3 My attention was on cycling alone (so no daydreaming and or being distracted by my surroundings)
(choose an answer between 1 and 10; 1 = not at all, 10 = completely)

____

Q4 I used a lot of my working memory during the ride
(choose an answer between 1 and 10; 1 = not at all, 10 = completely)

____

Start of Block: Between conditions questionnaire: **CONDITION: 2 (Music)**

Q1 I was absorbed in my thoughts
(choose an answer between 1 and 10; 1 = not at all, 10 = completely)

____

Q2 I was aware of what was happening around me
(choose an answer between 1 and 10; 1 = not at all, 10 = completely)

____

Q3 My attention was on cycling alone (so no daydreaming and or being distracted by my surroundings)
(choose an answer between 1 and 10; 1 = not at all, 10 = completely)

____

Q4 I used a lot of my working memory during the ride
(choose an answer between 1 and 10; 1 = not at all, 10 = completely)

____

Q5 What kind of music did you listen to while cycling?

○ Hip Hop / Rap

○ Rock

○ Dance / EDM (Techno, House, Dubstep)

○ R & B

○ Classical music

○ Other: ________________

Start of Block: Between conditions questionnaire **CONDITION: 3 (Call)**

Q1 I was absorbed in my thoughts
(choose an answer between 1 and 10; 1 = not at all, 10 = completely)

____

Q2 I was aware of what was happening around me
(choose an answer between 1 and 10; 1 = not at all, 10 = completely)

____

Q3 My attention was on cycling alone (so no daydreaming and or being distracted by my surroundings)
(choose an answer between 1 and 10; 1 = not at all, 10 = completely)

____

Q4 I used a lot of my working memory during the ride
(choose an answer between 1 and 10; 1 = not at all, 10 = completely)

____

Start of Block: Between conditions questionnaire **CONDITION: 4 (Podcast)**

Q1 What was the first drug Steve-o talked about?

____

Q2 How many Steve-o's were in the bed?

____

Q3 How many days did his ketamine trip last?

____

Q4 What other drug did Steve-O combine with using cocaine?

____

Q5 What did Steve-o think about not being able to do when he got a bad trip from ketamine?

____

Q6What happened to Steve-o's hotel room when he was on a ketamine trip?

____

Q7 What was Steve-o's higher power?

____

Q8 I was absorbed in my thoughts
(choose an answer between 1 and 10; 1 = not at all, 10 = completely)

____

Q9 I was aware of what was happening around me
(choose an answer between 1 and 10; 1 = not at all, 10 = completely)

____

Q10 My attention was on cycling alone (so no daydreaming and or being distracted by my surroundings)
(choose an answer between 1 and 10; 1 = not at all, 10 = completely)

____

Q11 I used a lot of my working memory during the ride
(choose an answer between 1 and 10; 1 = not at all, 10 = completely)

____