Does Increased Cognitive Load Impact Response Times to Your Name?

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July 2021

Abstract

This present study investigates how visual cognitive load affects participants' response times to hearing their name. We draw on previous work that found when subjects were visually distracted, they were faster in responding when their name is included in the alert. A dual-task was created, whereby participants responded to auditory alerts (by pressing either a left or right key) that were preceded by either their name or a random name, while they underwent a multiple object tracking (MOT) task. There was a manipulation of difficulty, in this case, the number of items to be tracked and the total object number. Performance for both tasks was recorded, to observe how different degrees of visual attentional load affect response times to auditory alerts. Data suggests participants were faster in responding to their own name, compared to a random name however, there was no interaction effect found on the MOT performance.

Keywords: Personal name use, voice alerts, multiple object tracking, attention.

In today's world of fully immersive technology and virtual assistance, auditory commands and alerts are more prominent than ever. From the early days of AOL informing the user that *"you've got mail",* auditory alerts have now entered our homes, our personal lives, and our work lives. Examples such as map and sat nav apps notifying us of directions to take, virtual assistants informing us of tasks to complete, and health watches instructing us to move shows just how ingrained they now are in our lives. While some alerts are purely for assistance purposes only (e.g., public transport voice alerts informing passengers what stop they are approaching), others now assist us in keeping safe (e.g., in hospital settings and in semi-autonomous cars (Ross, 2019; Hilber, 2019; Leman, 2020)). In safety-critical environments, a fast response from the user (e.g., pressing a button on the interface) is often required to acknowledge the alert, for example, a healthcare professional pressing a monitor button to recognise a patient alarm. In another example, an alert may warn a driver of an upcoming hazard and the driver needs to take immediate evasive action. While the driver in this example may have been fully focused on the task of operating the vehicle, as we move to more semi-autonomous cars, drivers may take more of a 'back seat' role as the car undertakes more responsibility. The driver, therefore, may be distracted by their phone, by playing a game or on a video call. When inevitably the car encounters an upcoming hazard or issue it does not know how to deal with, the car will alert the driver that they need to take over. A fast response from the distraction is therefore necessary.

Previous studies have focused on how to improve response times in a driving domain. Results vary, that range from suggesting a multi-modal approach of alerts (van der Heiden et al., 2021) to proposing a more intelligent system that monitors the driver's emotional mood and adjusts the alerts accordingly (Sarala et al., 2018). Meanwhile, the work of Maidhof et al. (2019) used the driver's own name in alerts to improve response times. Since personal names can be used to attract attention, this present study focuses on distracting participants through a visual load task while they respond to voice commands. The present study investigates whether including personal first names in the alert reduces response times, even when under increasingly difficult visual load. Measuring both performances will enable us to see the effect if any, that increased visual load has on response times. While not directly tested within the semi-autonomous driving domain, results can still be applied to this area in future.

Background: Selective Attention & Personal Names, Multiple Object Tracking Tasks

Selective Attention & Personal Names

Studies of how we respond to hearing our name began with Cherry (1953) and Moray (1959) who uncovered our ability to pick out our name amongst audio noise, terming it the "cocktail party effect" (1959: 57). This effect is seen in day-to-day life, such as having a conversation with a friend at a busy bar and blocking out the background noise. Alternatively, while ignoring the background noise and concentrating on our friend's speech, we can still pick out our name amongst the background if heard. This field of research takes in many sub-disciplines such as selective attention, psychoacoustics, and speech perception. For this paper, the focus relied only on selective attention.

Research since has built on Cherry's (1953) and Moray's (1959) work and, more recent studies show we are attuned to our name by four months old (Parise et al., 2010); and that we do not have an attentional blink for our name (Shapiro et al., 1997). Additionally, other work found participants' attentional relapses were lower, and arousal was higher during monotonous tasks when they heard their name in the stimuli (Kaida & Abe, 2016). Other studies suggest our unconscious is aware of our name and hearing our name can unconsciously influence or prime our immediate actions (Pfister, 2012), while patients in minimally unconscious states showed signs of cerebral activation upon hearing their name spoken by a familiar voice (Di et al., 2007). Even when we sleep, our brains elicit a different response when our name is presented compared to wakefulness (Perrin et al., 1999). Furthermore, the "own name effect" (Devue & Bredart, 2008: 290) is not only found to be aurally attention-grabbing but also visually. Wolford & Morrison (1980) found participants were higher in their responses to seeing their name in a series of random words; while research by Devue & Bredart (2008) went further and asked if our face has higher distractive power than a random face but found mixed results. Our name, whether we are aware or not, can draw our attention and increase our alertness; and could go some way to offer powerful solutions to safety-critical tasks such as semi-autonomous driving.

Maidhof et al. (2019) studied response times to alerts containing personal names in a semi-autonomous driving domain. Alerts preceded by the participants' name yielded faster response times while drivers were distracted by a mobile phone game. In a similar study, Koo et al. (2016) found when a semi-autonomous car announces to the driver that it is taking over control, feelings of anxiety are lessened, and drivers report increased alertness. However, if we are distracted by a cognitively demanding task, we are less susceptible to novel sounds (Janssen et al., 2019) and, therefore, may miss important alerts, even when they contain our name. While these studies provide valuable insight into how alerts can increase the user's alertness and shed light on how and when we respond to alerts while distracted, they do not measure the participants' cognitive load performance. In this study, both response times and cognitive load performance will be measured, therefore investigating what effect responding to alerts has on our attention and vice versa.

Bronkhorst (2015) discusses how our attention is very adaptable and, can not only ignore audio presented to one ear and focus on the other but also focus on a specific voice amongst other audio noise. Moreover, we can process semantic cues, such as hearing our name amongst audio noise, pre-attentively (2015). The idea of recognising our name amongst audio noise was investigated when Wood & Cowan (1995) reproduced Moray's (1959) original experiment. Participants were presented with a shadowing task in the target ear, while they were informed to ignore the non-target ear that provided auditory distractions and instructions preceded by their name. Results showed when presented with their name in the non-target ear, participants were slower to respond to the shadowing task in the target ear. The results support the idea that we can switch attention and, while we can ignore distracting background noise when we do attune to it or hear our name, the noise diverts our attention, if even momentarily. Cowan & Wood (1995b) conducted a similar experiment exploring the relationship between memory and selective listening. They replicated Cherry's (1953) study and discovered during a shadowing task; listeners noticed no change between ordinary speech to backwards speech. Cowan & Wood (1995b) found that those who did notice the speech reversing were slower in their response times to the shadowing task. Results from both studies show that when under an audiological attention task, we can block out background noise to focus on a specific piece of audio. But when there is a noticeable change in background noise, or when we hear our name, our attention shifts, causing a delayed response time in the shadowing tasks. While participants in this experiment will not be audibly distracted (instead, visually distracted), results from the discussed studies propose that hearing their name should still produce a faster response time than an alert with a random name.

The literature so far has discussed participants paying attention to one ear and ignoring audio in the other, with an assessment of their attenuative on the other ear by its influence on the primary task. While this work focused on the lexical aspect of listening, Rivenez et al. (2006) examined the role semantic items and priming play on response times. The participant listened to a continuous list of lexical items in one ear and was asked to respond when a presented word belonged to a target semantic category. For example, if the target category was 'birds', the participant would respond when they heard 'blackbird'. In the other ear, they were presented with nonsense audio at a different pitch that contained the target word but were informed to ignore this channel. In the attended channel, the target word was preceded by the target word in the unattended channel. Results showed significantly faster response times when the target word was presented in the unattended audio before the target word was presented in the attended audio. The authors conclude that we do not consciously listen or attend to a specific channel of audio, but we are still attuned to it and, as such, the unattended audio primed the participant for the target word. Since priming produces increased response times, we would expect participants primed with their own name to be faster in response times.

We are, therefore, susceptible to a priming effect as suggested by Rivenez et al. (2006), and this idea can be applied to the work of Maidhof et al. (2019) when they investigated if using the participant's name in an auditory command increased their reaction time. The experiment was conducted in a driving simulator and participants watched a driving video while responding to alerts either preceded by their name or by a random name. Results showed participants were quicker in response to commands preceded by their name. The results reinforce the preconceived notion that our name attracts our attention and suggests that hearing our name primes us to pay attention to what is said next. While Maidhof et al. used a dual-task (watch a video and respond to auditory alerts) experiment, they did not measure the participants' performance on the distraction task. In conclusion, they suggest future work would do well to focus on multi-tasking and incorporate an additional cognitive load resource. A measurable visual cognitive load task in the form of a multiple object tracking method has therefore been introduced to this study.

Multiple Object Tracking

So far, the role personal names play in our lives and how being distracted dulls our response times have been discussed. The other aspect of the dual-task is the multiple object tracking (MOT) task used in this study to manipulate the visual load. An MOT task is visually cognitively demanding and requires participants to concentrate on focus items, track their movements around the screen and correctly identify the correct focus item, therefore requiring constant visual attention (Wenhan, 2017). Pylyshyn & Storm (1988) devised the MOT task to test the hypothesis that humans can track multiple objects simultaneously, independent of eye movements. In other words, while we track multiple objects in a field of other similar objects serially, we can also track the objects in parallel with the others (1988). In recent years, however, the MOT task has been used to examine other areas of cognitive psychology and recent experiments have evidenced the effect an MOT task has on our attentional resources, in areas such as working memory, attentional selection and verbal tasks (Huang et al., 2012; Franconeri et al., 2007; Oksama & Hyönä. 2004; Kunar et al. 2008).

A multiple object tracking (MOT) task is often used to simulate distracting conditions since features of the task can easily replicate other attentionally demanding tasks. For example, as the objects constantly change position and move around, a high level of visual attention is required to keep track of the specific object(s). Manipulating the task difficulty has been noted to expend attentional resources and can be undertaken in numerous ways. Meyerhoff et al. (2017) reviewed the literature and notes that performance decreases as the number of focus objects increases (Alvarez & Franconeri, 2007; Drew, Horowitz, Wolfe, & Vogel, 2011; Pylyshyn & Storm, 1988), the total number of objects increases (i.e. distracting objects) (Bettencourt & Somers, 2009; Sears & Pylyshyn, 2000), the trial length increases (Oksama & Hyönä, 2004), object speed increases (Holcombe & Chen, 2012; Meyerhoff, Papenmeier, Jahn, & Huff, 2016; Tombu & Seiffert, 2011) and objects are in closer proximity to each other (Bettencourt & Somers, 2009; Franconeri, Jonathan, & Scimeca, 2010). Combining the MOT task with an additional task to create a dual-task provides interesting results, for example testing performance on both the auditory task and the MOT task.

Kunar et al. (2008) utilised the MOT methodology and investigated the effect a secondary auditory task has on MOT performance. The study used the context of holding a telephone conversation whilst driving as its motivation and investigated the impact that holding a telephone conversation has on visual attention. Using an MOT task to hold the participant's visual attention, they were either tasked with holding a conversation or listening to an audiobook. Meanwhile, other participants were given the same MOT task but simultaneously asked to generate novel words or repeat out loud words they had just heard. The results showed that while listening to an audiobook or repeating words had little effect on the MOT results, engaging in a full conversation or word generation had a significant effect on the participant's MOT results. Therefore, our attention to track a moving object whilst paying attention to a conversation limits our resources. The authors surmise that the act of being distracted by engaging in conversation whilst driving is not caused by the overlapping of basic cognitive functions, but rather it is the cognitive process of producing a spontaneous lexical item that impedes visual attention (Kunar et al., 2008). The authors show that it is the act of 'thinking on the spot' and generating novel linguistic items that lead to reduced MOT performance. These results are relevant for the present study, as they show it is the creative aspect of language that causes distraction. This prompts the question of whether this is linguistic specific or is related to other motor activities, such as hearing an order (such as 'left' or 'right') and then generating a follow-up motor action by responding with their hand.

Method

The goal of this experiment was to compare the speeds at which people respond to a command that is preceded by either their own name or a random name under two conditions of visual cognitive load. We instructed participants to perform a simple dual-choice response task, in which a command ("left" or "right") was preceded either by their first name or another name. To visually load participants' attention, they followed a multiple object tracking task. To manipulate the load, two different levels of the MOT task were presented: track two disks out of four and track three disks out of six. All other variables remained static. To gain base level measurements, participants also undertook MOT tasks with no auditory alerts and responded to auditory alerts only with no MOT task.

Based on the literature discussed, we hypothesised the following effects:

1. The 'easy' (two out of four objects to track) condition is rated as cognitively easier as the 'hard' condition (three out of six objects to track).
2. Participants are quicker to respond to alerts that are preceded by their name relative to another name relative to another name (c.f. Maidhof et al. 2019).

3. MOT performance (i.e., identifying the correct focus disk) is lower for the more difficult MOT task (three out of six disks) than for the easier MOT task (two out of four disks) (c.f. Kunar et al., 2008).
4. MOT performance is higher in the solo MOT tasks than in the dual-task.
5. Alert response times are faster in the single task than in the dual-task.

Design

The study followed a 48 trials within-subject design with the following blocks:

- 12 X 4 Focus Disks (6 trials of own name and 6 trials of random name)
- 12 X 6 Focus Disks (6 trials of own name and 6 trials of random name)
- 12 X MOT only (6 trials of 4 disks and 6 trials of 6 disks)
- 12 X Auditory alerts only (6 trials of own name and 6 trials of random name)

The two variables were first name only (own or random) and difficulty (easy or hard).

Participants

Previous papers used participant numbers from 8 through to 201, with an average of 18 (excluding 201; see Table 4, appendix). The present study included 21 participants. The participants were selected from opportunity sampling (word of mouth, adverts). All participants confirmed they had normal or corrected vision and no hearing-related issues. The experiment was approved by the ethics committee of the Faculty of Social and Behavioural Sciences of Utrecht University on 10 May 2021 (approval number 21-1667). All participants gave written informed consent before taking part.

Materials

The MOT task was coded in Java and the audio file was taken from an online text-to-speech programme (Free Text-To-Speech and Text-to-MP3 for Dutch, 2020). The audio file and MOT file were combined in iMovie with the experiment then assembled and presented in Gorilla. All participants undertook the experiment remotely in their own home at a time that suited them. They were instructed to find a quiet place with no distractions and where they would not be disturbed. Subjects used their laptop of choice and were instructed to use headphones or earphones. Before the experiment began, an audio test was given to ensure the volume was loud enough. A total of 48 randomised trials were completed by each participant with the experiment lasting 10 – 15 minutes in total.

Materials: Multiple Object Tracking Task

Participants were instructed to pay attention to the screen and follow several disks that were briefly highlighted around the screen. To begin, participants saw a total of either four disks for the easier task (with two focus disks and two grey disks) or six disks for the more difficult task (with three focus disks and three grey disks) and asked to memorise the orange disks (see Figure 1). Sets of focus disks and total disks were determined based on previous literature (see Table 4, appendix for a comprehensive overview). Previous findings (Alvarez & Franconeri, 2007) report participants can track up to eight focus disks at a time, while others (Alvarez and Cavanagh, 2005; Pylyshyn & Storm, 1988; Scholl et al., 2001; Yantis, 1992) found a maximum capacity of four focus disks. Preliminary trials in the present study found participants struggled to respond to multiple auditory alerts while simultaneously tracking four focus disks in a total of eight. The experiment was simplified to use two focus disks in four for the lower cognitive load and three focus disks in six for the higher load. The one change (from two to three focus disks) enables us to acutely observe the change in response time performance as the cognitive load changes, while other variables remain static. While we intended to replicate the methodology of Kunar et al. (2011) closely, the trial time of the MOT was extended to five seconds (from their three seconds). This decision was based on the work of Bettencourt & Somers (2009) who also were replicating an MOT study and increased their tracking time to give more movement to the disks. Additionally, the extended time gave more time for the disk's locations between the start and end times to advance. In other words, the lower the tracking time, the less distance the disks have moved and the better idea the participant has of where the focus disks are. A longer movement time allows for a better test of the participant's attention. Moreover, the longer each trial lasts, the more expectant the participant becomes to hearing the alert since they know an alert is coming; therefore, a shorter time reduces their 'trigger finger' anticipation. The time of five seconds began once the disks started moving and after the two-second focus disk assignment.

After two seconds of static, the orange focus disks then changed to grey, and all disks started moving. After five seconds they stopped, and one random disk was highlighted green. Participants were asked if the green disk was part of the orange set (see Figure 2). Previous work (c.f. Kunar et al., 2008; Alvarez & Franconeri, 2007) used the probe-one method of focus disk identification (by changing colour for the highlighted disk), which was applied here as well. Orange was chosen for the change in colour since this is a colour-blind friendly palate, as in Kunar et al. (2008). Each task the participant underwent was novel to them, no MOT task was repeated. While the highlighted disk was random, it was still an even balance between the focus disk and the non-focus disk.

Figure 1.

An example of the start of multiple object tracking task that participants will see

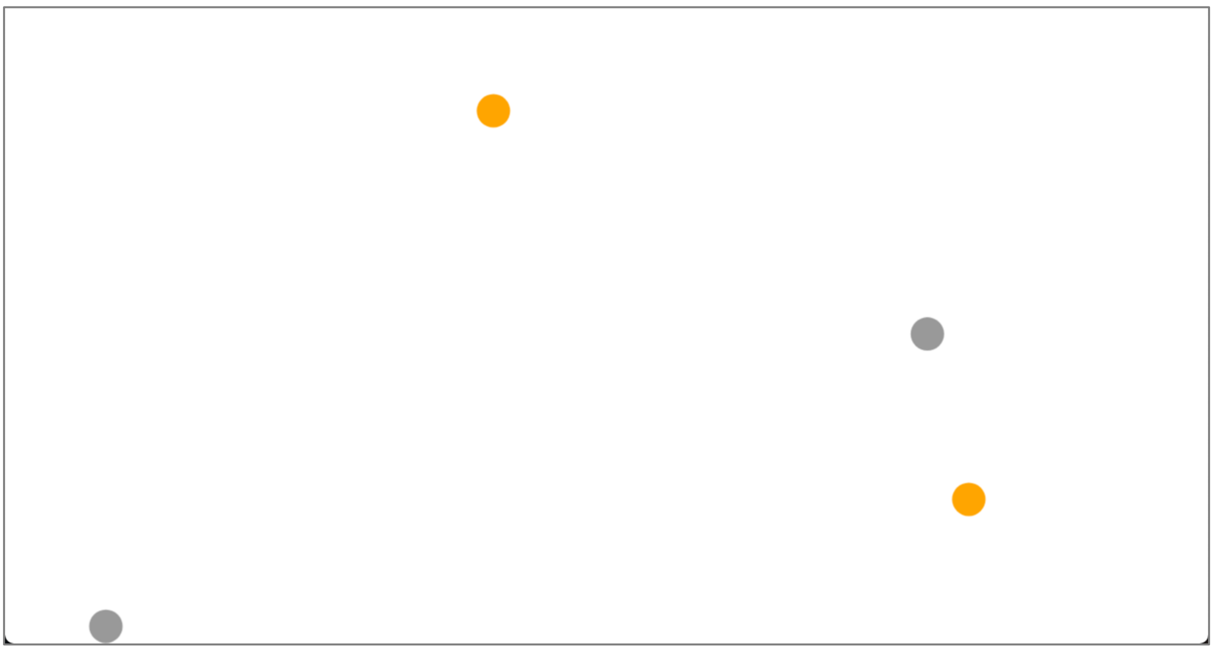
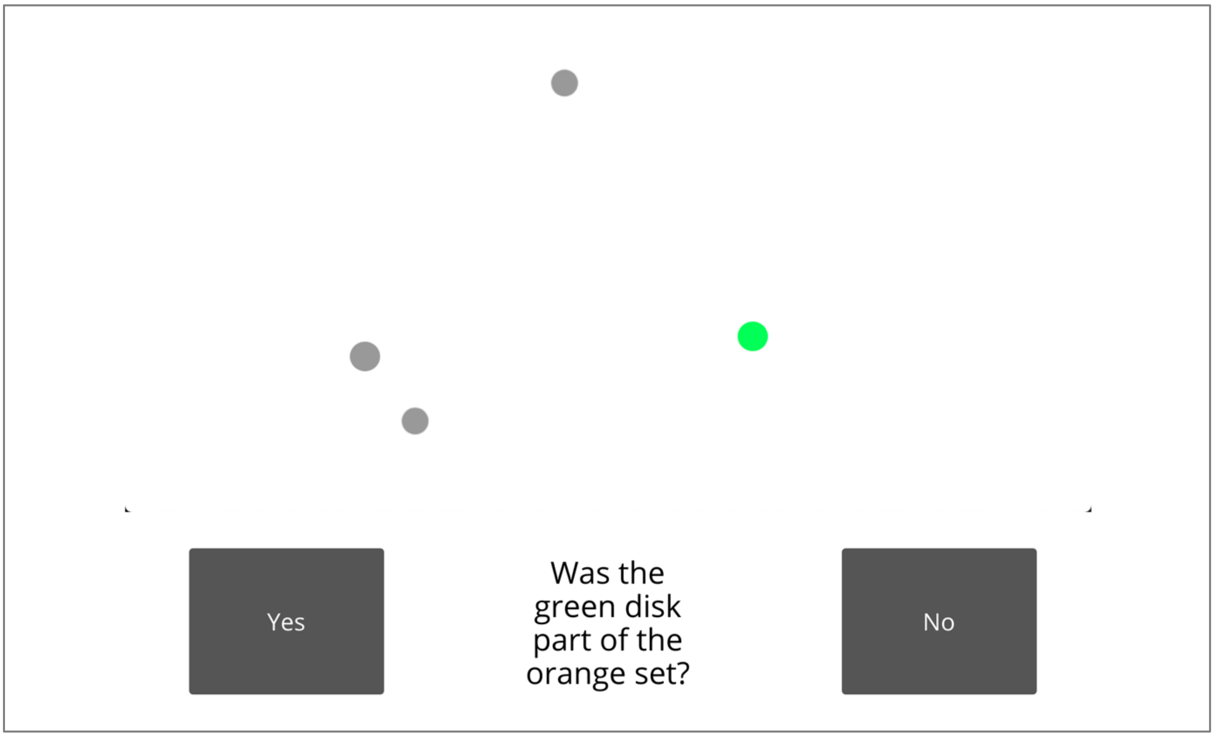


Figure 2.

An example of the end of the multiple object tracking task



For the dual-task and single auditory tasks, one auditory instruction was given per trial. Using one alert per trial enables us to compare results as the cognitive load increases, instead of multiple response times per trial.

The total number of 48 trials resulted from 12 easy dual-tasks (6x own name, 6x random name), 12 hard dual-tasks (6x own name, 6x random name), 12 single MOT tasks (6x easy, 6x hard) and 12 single audio tasks (6x own name, 6x random name). Previous MOT studies used over 100 trials per participant (Drew et al., 2011; Bettencourt & Somers, 2009), but also 18 to 20 trials have demonstrated effects (Franconeri et al., 2009). While more trials may produce more reliable results, participants were undertaking this experiment online, compared to other lab-controlled experiments. Therefore, a higher trial number at home may cause participants to become bored, drop out of the experiment or lose focus. A lower trial count was chosen to counteract these foreseeable issues while still gaining reliable results.

Materials: Audio Task

All alerts consisted of: ‘first name’ + ‘instruction’. The name was either their first name or a random first name and the instruction was either left or right. Participants were not informed before each trial which name they would be hearing. One audio alert was presented in each trial. The number of ‘left’ and ‘right’ alerts in each trial was randomised, so the participants could not predict which alert would be presented next, however, this was still a 50/50 split. Additionally, participants underwent 12 trials of the control name and 12 trials of their own name in a randomised order for the same reason. In response to each instruction, participants had to press a corresponding key:

Table 1.

Alert and corresponding key

Alert	**Action**
‘*Personal name* left’	Press ‘Q’ key
‘*Personal name* right’	Press ‘P’ key
‘*Random name* right’	Press ‘Q key
‘*Random name* left’	Press ‘P’ key

All alerts were generated through an online text-to-speech application (Free Text-To-Speech and Text-to-MP3 for Dutch, 2020) and the random names were chosen from the top twenty of the top 100 baby names of 2020 (The Baby Centre, 2020).

Materials: NASA TLX Questionnaire

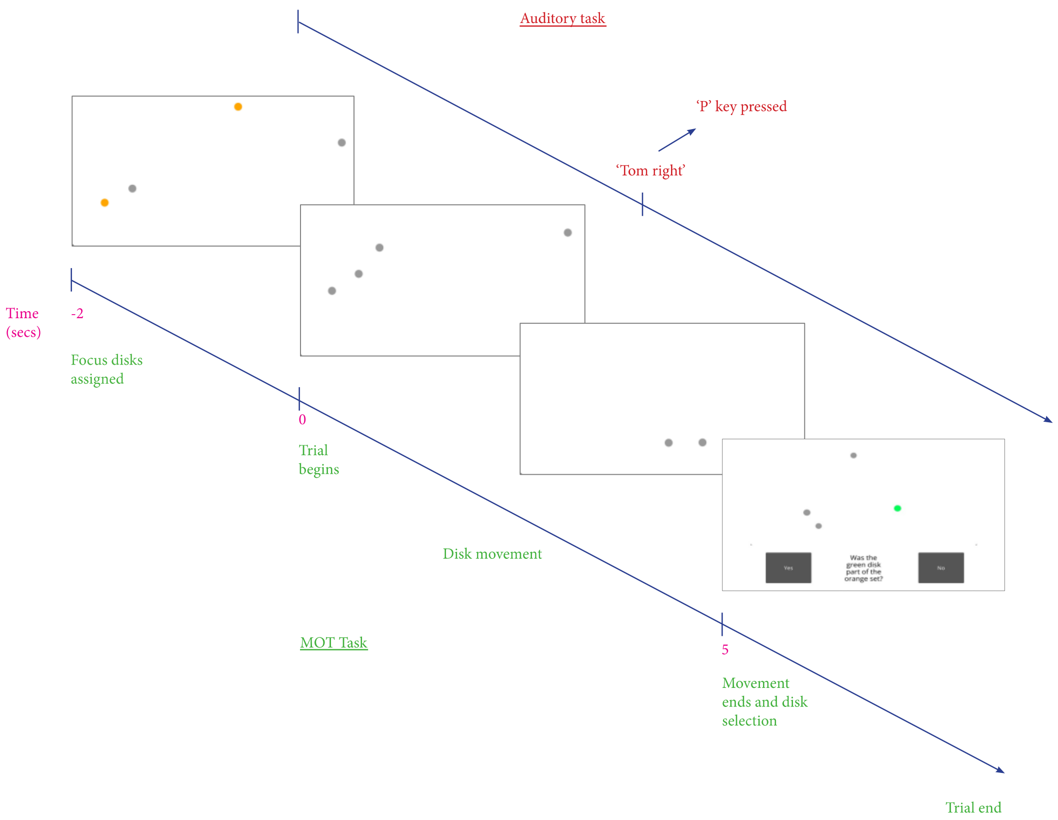
Once all 48 trials were finished, participants were asked to rate their levels of mental, temporal, effort, and frustration on both the easy task and the harder task. These four questions were taken from the NASA Task Load Index (TLX) questionnaire, a standard tool for the assessment of perceived workload (Gore, 2020).

Procedure

Participants were presented with written instructions that outlined the task, along with a consent request. Participants were told to listen to the auditory alerts and to press ‘Q’ when they heard a left instruction and ‘P’ when they heard the right instruction. Additionally, they were instructed to track the disks which they believe to be the focus disks simultaneously with the key presses. Once the disks had stopped moving, participants were asked if a selected disk was the focus disk or not. Participants underwent two practise trials of the dual-task to ensure they understood the requirements. The main trials then followed. Figure 3 shows an example of how the dual-task trial followed.

Figure 3.

An example of the dual-task trial.



Results

NASA TLX Questionnaire

Participants were asked to evaluate the easy and hard MOT levels of difficulty and respond on a scale of 1 to 20 on how they found each cognitive subscale. The mean results are given in Table 3. For statistical analysis, SPSS was used.

Table 2.

T-test results from the NASA TLX questionnaire

Question	**Results**
Mental	$t(20) = -4.68$, $p = <0.001$
Temporal	$t(20) = -1.53$, $p = 0.70$
Effort	$t(20) = -1.28$, $p = 0.106$
Frustration	$t(20) = -2.78$, $p = 0.006$

Table 3.

Mean TLX Results Across Conditions (0 – 20)

Question	**4 Disks**	**6 Disks**
Mental	7.75	10.75
Temporal	5.3	6.7
Effort	9.15	10.1
Frustration	3.1	4.8

Single MOT Task

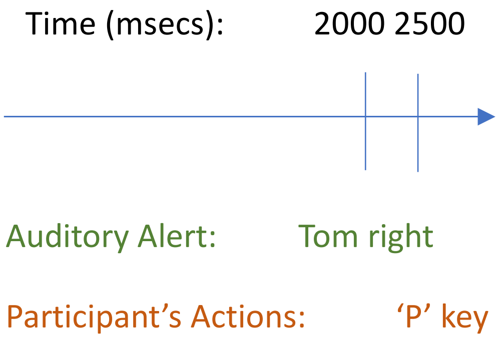
Participants' mean performance (%) for the single MOT task did not differ statistically: $t(20) = 2.872$, $p = 0.500$. Performance for the 4-disk task was descriptively lower *(M = 96.8, SD 8.5)* compared to the 6-disk task *(M = 98.3, SD = 5.1).*

Single Audio Task

Response times are defined as the difference between the time a participant responded (i.e., by pressing the respective key) and the onset of the alert word (left or right). The schema below shows an example, where the response is 500 milliseconds:

Figure 4.

An example of the response time (time in milliseconds along the top)



Participants’ mean response time (ms) to their own name *(M = 916, SD = 211)* was significantly faster than their response to the random name *(M = 1102, SD = 329)*: $t(20) = 2.872$, $p = 0.009$.

Dual-Task

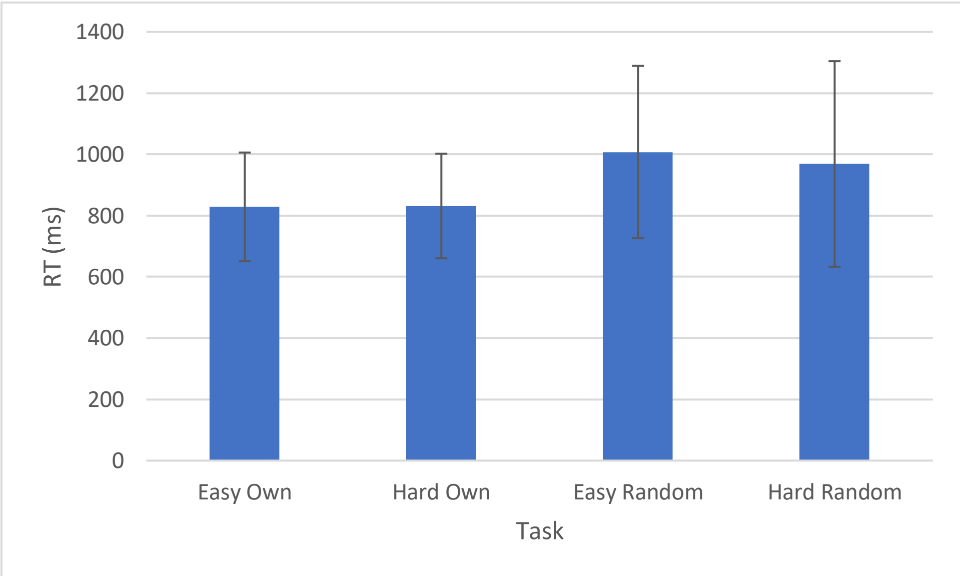
To analyse the effects of name and difficulty as well as their interaction, a 2x2 within subject ANOVA on response times was performed. A statistically significant main effect was found for name ($FI(1,20) = 13.333$, $p = 0.002$). No main effect was found for difficulty ($FI(1,20) = 0.438$, $p = 0.516$). No statistically significant interaction effect was found $FI(1,20) = 0.630$, $p = 0.437$).

Participants’ mean response times (ms) for their own name under the easy condition were descriptively faster *(M = 828, SD = 177)* compared to the random name *(M = 1007, SD = 281)*.

Meanwhile, for the harder condition, response times were still faster for the own name *(M = 831, SD = 170)* compared to the random name *(M = 968, SD = 335).* Figure 5 shows the response time data from all four dual conditions of the dual-task.

Figure 5.

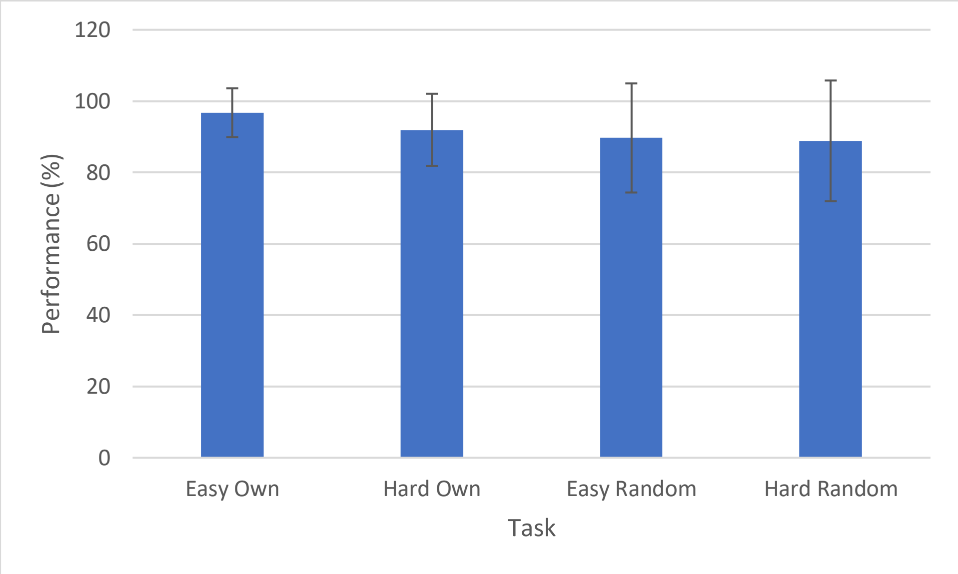
Chart showing the mean response times (ms) across the four dual-tasks. Whiskers represent the standard deviation



In terms of the MOT performance (in other words how well participants correctly identified the focus disk) (%) for the dual-task, under the easy level, participant's performance was descriptively better under their own name *(M = 96.7, SD = 6.8)* compared to the random name *(M = 89.6, SD = 15.2).* For the harder level, performance was again descriptively better under the own name *(M = 91.9, SD = 10.10)* compared to the random name *(M = 88.8, SD = 16.9).* Figure 6 shows the MOT performance across all dual-tasks.

Figure 6.

Chart showing the mean MOT performance (%) times across the four dual-tasks. Whiskers represent the standard deviation



Discussion

This thesis describes an investigation into the question of whether cognitive load affects the reaction time to the own versus random name. From the dual-task data, the results suggest participants were faster in responding to their own name, reaffirming the concept that using a personal name increases response times. No statistically significant results were found for the MOT performance results or interaction effect results. This was due to the manipulation of load having no effect, therefore there are no findings.

The hypothesis of *participants will be overall quicker to respond to alerts that are preceded by their name in both the easy and difficult MOT tasks* was supported. Participants' response times were overall slower in the more difficult dual-task, but response times to the own name were still faster than to the random name. These results echo those of Maidhof et al. (2019) who found a similar pattern. Moreover, the faster response time to the own name can be applied to the work of Rivenez et al. (2006) who suggest priming the participant first increases response times. While their work did not directly use personal names, the theory of priming can still be applied to the present study, where the personal name may prime the participant to pay attention. Rivenez et al. (2006) state we are not consciously monitoring the sound around us, therefore, we hypothesise that participants become so engrossed in the visual task, they ‘switch off’ listening out for audio but are still attuned to it. Upon hearing their name, participants may tune back in and respond. In other words, since we are so familiar with our name, the presentation of it pulls our attention back to the response task. It may be the case that hearing the random name pulls our attention back, but not in the same way our personal name does.

Descriptively (but not statistically significantly), MOT performance decreased as the level of difficulty increased. The single MOT saw the highest performance, followed by the easier level and finally the more difficult level. As seen in Figure 6, a ceiling effect was found, with participants performing well in every MOT task. In the single audio task, as predicted, participants were statistically significantly faster in responding to their own name compared to the random name.

Finally, as expected, participants found the easier level less cognitively demanding. As shown in Figure 3, both the mental demand and the frustration level were statistically significant. This is understandable, since tracking three out of six disks can be assumed to be more demanding than two out of four disks.

Limitations, Future Work and Applications of Results

Due to COVID-19 restrictions, the experiment was conducted entirely online and remotely, and not under usual laboratory conditions. Moreover, due to the coding limitations of Gorilla, we were unable to create the dual-tasks through a Java or Python programme. Instead, the tasks were produced ‘artificially’ and manually in iMovie, with the audio alerts timed to the millisecond. While this worked well under the current climate, it would be beneficial to conduct this study again under laboratory conditions and with more accurate timings for the audio alerts.

As mentioned in the discussion, a ceiling effect was observed within the MOT performance data, with the mean performance being nearly 100%. While there is some minor variance between the tasks, it is clear the MOT trials were too easy, allowing participants to score well each time. Kunar et al. (2008) found it was the generation of novel linguistic words and conversation that impaired participants' MOT performance. We briefly questioned whether this theory could be applied in the present study, however, generating a left or right response to an alert has no bearing on the MOT performance. Future work may want to increase the difficulty, for example, either through the number of total disks, the number of focus disks, or the speed.

The results confirm previous work that identified our personal name as an attractor of attention (Cherry, 1953; Moray, 1959) and reinforces the work of Maidhof et al. (2019) who found similar results. As discussed in the introduction, previous work has identified ways to improve response times in situations that require a fast response from the user (such as semi-autonomous cars). These include combining visual and audio alerts and intelligent systems that monitor the user's emotional state (Sarala et al., 2018). From the data, it may be that using the driver's own name in alerts can increase response times and pull their attention away from their distracting task faster. Use of the name should, however, be used sparingly since the driver may become desensitised to the overuse of their name, known as the "cry wolf" effect (Breznitz, 2013: 14). Another important aspect to note is the pronunciation must be accurate. In the present study, all participants were native English speakers, with the text-to-speak app using an English accent. The app, however, did struggle with pronouncing some Dutch names; therefore, these names and participants were unable to be used. Based on this, future use of personal names in applied settings need to be pronounced correctly and in the corresponding accent. Moreover, future work may want to consider other factors such as age, circadian cycles, and other distractors such as loud music.

Conclusion

The present study found that participants respond faster to alerts that are preceded by their own name in the single audio task, however, the dual-task data found no statistically significant effects for the MOT performance or any interaction effect. A ceiling effect was evidenced in the MOT performance results, therefore there was no difference in difficulty levels. No interaction effect was found; therefore, the original research question cannot be answered sufficiently, and further work is required.

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Appendix

Table 4.

An analysis of previous studies

Study Name	Participants	Single or Dual?	Length	Main Disk Colour	Focus Disk Flash Colour	Number	Speed	Probe One or Mark All?	Manipulation
Kunar et al (2008)	12	Dual	3 seconds	Grey	Yellow	8 Disks / 4 Focus Disks	6.7 per sec	Probe One	None
Kunar et al (2008)	12	Single	3 seconds	Grey	Yellow	8 Disks/ 4 Focus Disks	6.7 per sec	Probe One	None
Alvarez & Franconeri (2007)	14	Single	6 seconds	Black	Green	16 Disks/ 1 - 8 Focus Disks	0 - 42 per sec	Probe One	Speed
Drew et al (2013)	29	Single	2 seconds	Grey	Red	6 Disks/ 3 Focus Disks	2.2 per seconds	Probe One	Number of disks/ focus disks
Bettencourt & Sommers (2009)	16	Single	10 Seconds	Grey	Red	10 Disks/ 5 Focus Disks	1 - 13 per second	Probe One	Number of disks/ focus disks
Oksama & Hyona (2004)	201	Single	5 - 13 seconds	White	White	12 Disks / 2 - 6 Focus Disks	4 - 8 per seconds	Probe One	Speed
Holcombe et al (2014)	8	Single	3 - 4 seconds	Red	Blue	4 Disks/ 2 Focus Disks		Probe One	Speed
Meyerhoff et al (2016)	20	Single	8 Seconds	White	Red	8 Disks / 4 Focus Disks	8 per second		Speed
Tombu & Seiffert (2011)	29	Single	6 seconds			8 Disks / 4 Focus Disks	89 per second	Mark All	Speed
Franconeri et al (2010)	23	Single	6 seconds	Black		12 Disks / 6 Focus Disks		Probe One	Speed