An analysis on the relationship between Audio Visual Interruptions and Tetris Gameplay Performance

Results

The aim of this study was to evaluate the difference in the performance outputs of 2 sets of participants playing the game of Tetris who were interrupted with either auditory or visual cues. Data was gathered from 64 participants whose game scores scale ranged from 0 to 100.

Data Cleaning

Before running inferential statistics, data had to be checked for any anomalies. Visually inspecting the data through boxplot (Figure 1) shows that the data points are all within the data range so, no outlier in the dataset was observed. The data were normally distributed (Shapiro-Wil test: $p > .05$) and variance was homogeneous (Levene's test: $p > .05$).

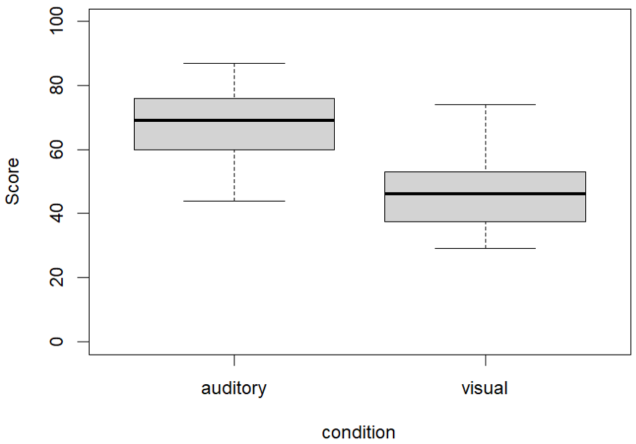

Figure 1: Boxplot of auditory and visual conditions

	Mean	SD
Auditory	67.94	11.05
Visual	46.62	11.80

Table 1: Descriptive statistic for Tetris game score conditions

Inferential Statistics Analysis

Independent means T-test was conducted as each participant only experienced either visual or auditory disturbance whilst gaming (i.e., there is between-subjects variable). Though the T test command it was found that the mean Tetris score for the auditory condition (M = 67.94) was significantly greater than the mean Tetris score for the visual condition (M = 46.62), t(61.74) = 7.46, p < .001. (Figure 2), indicating that there is a significant difference in the effect of visual interruptions and the effect of audio interruptions on participant's Tetris gameplay performance.

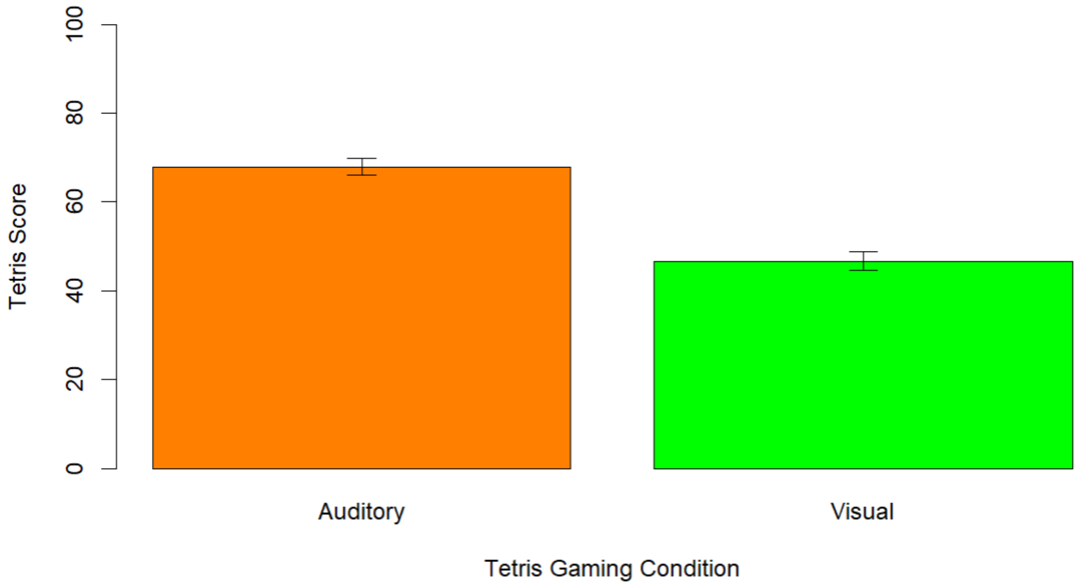

Figure 2: Graph of Condition Means

Discussion

This study attempts to explore differences in the scoring results of 2 set of players; one set was interrupted with Visuals while the other with audios. The game score of these 2 sets were analysed using the t-test by comparing the means between the two groups.

This research discusses the effect of audio and visual interruptions on performance of an individual. The research involves participants engaging in a task of Tetris fed with audio or visual cues. This study finds that visual cues had a statistically higher effect on performance of an individual than audio cues. Similar studies have existed in the past which claimed superiority of audio interruptions when individuals were already engaged in a task (Wickens et al, 2005). Their research found that auditory interruptions showed higher performance data compared to visual interruptions in both the Ongoing Task as well as the Interrupting Task. In this study, it was also found that auditory interruptions remained superior even when visual scanning was not required in the ongoing task.

Further research has indicated that creating multimodal interfaces to increase audio feedback over visual feedback would have positive effects on performance of the users (Zhao et al, 2013). It suggests that visual interruptions during tasks such as driving proved to be significant sources of distractions.

Our research reaffirms the above in our study involving Tetris as the ongoing task.

Prior research also discusses how increasing multimodal interfaces promotes a more accessible and appropriate ecosystem (Warnock et al, 2011).

Limitations

Our research is based solely on the task being playing the game of Tetris. Since individuals are primarily engaged in a visual task, it is possible that visual interruptions have a disadvantage over audio interruptions. Perhaps if we obtained data of multiple kinds of tasks that involved visual, auditory, tactile and olfactory senses, the data would help us come to a stronger conclusion.

Research has indicated that there is little to no difference between various modalities in terms of performance, and it is more dependent on the person, the task and the environment (Warnock et al, 2011). Their research argues that humans take a mental snapshot of the task at hand while absorbing information and then proceed in an identical way irrespective of which kind of interruption. Further, while they claimed little to no difference in performance, they also indicated that audio interruptions had a slightly slower response time as compared to visual interruptions. In environments where response time could be critical, perhaps we would need to further test performance of the ongoing tasks.

We have also seen research in the past discuss how it is important to have multimodal interfaces where the interruption is dependent on the ongoing task (Zhao et al, 2013). It is discussed that audio cues are superior for multitasking in tasks such as driving but visual cues remain better for simple actions like walking.

Furthermore, the data does not account for the scenario that results may be different if individuals learn how to respond to these interruptions in the given setting. It is interesting to question whether individuals would perform better in visual cues itself if they were trained.

Conclusion

Using the data collected from participants playing the game of Tetris, this study found that there exists a significant difference in the performance depending on whether they were interrupted with audio or by visual. The participants who were interrupted in visual showed poorer performance. While we saw limitations to this study, the results are generally consistent with the existing body of research published in this area.

References

Edwards, J., Janssen, C., Gould, S., & Cowan, B. R. (2021). Eliciting spoken interruptions to inform proactive speech agent design. In CUI 2021-3rd Conference on Conversational User Interfaces (pp. 1-12).

Wickens, C. D., Dixon, S. R., & Seppelt, B. (2005). Auditory preemption versus multiple resources: Who wins in interruption management?. In Proceedings of the Human Factors and Ergonomics Society Annual Meeting (Vol. 49, No. 3, pp. 463-466). Sage CA: Los Angeles, CA: SAGE Publications.

Warnock, D., McGee-Lennon, M., & Brewster, S. (2011). The role of modality in notification performance. In IFIP Conference on Human-Computer Interaction (pp. 572-588). Springer, Berlin, Heidelberg.

Zhao, S., Brumby, D. P., Chignell, M., Salvucci, D., & Goyal, S. (2013). Shared input multimodal mobile interfaces: Interaction modality effects on menu selection in single-task and dual-task environments. Interacting with computers, 25(5), 386-403

R Script

```
## Reading in the dataframe
 setwd("C:/Program Files/R/qda")
 tetris  = read.csv ("tetris.csv")
 head(tetris)
 tail(tetris)

## Creating new data frames which only contains data as subset data frame
 tetris$condition = factor(tetris$condition)
 levels (tetris$condition)

  auditory = subset (tetris$score, tetris$condition=="auditory")
  auditory

  visual = subset (tetris$score, tetris$condition=="visual")
  visual

## descriptive statics for overall score as well for the 2 conditions
mean (tetris$score); sd (tetris$score); max (tetris$score); min (tetris$score); median(tetris$score); IQR(tetris$score)
mean (auditory); sd (auditory); max (auditory); min (auditory); median(auditory); IQR(auditory)
mean (visual); sd (visual); max (visual); min (visual); median(visual); IQR(visual)

## We want to make sure that the data for both conditions is in between the specified score range
## We use boxplot to visually access the same
```

```
boxplot (tetris$score,main="boxplot of Tetris scores", ylim= c(0,100), ylab = "Score")


##Also checking boxplot for both the conditions


boxplot(tetris$score~tetris$condition, main="boxplot of tetris scores by condition",
ylim= c(0,100),xlab = "condition", ylab = "Score")

##Boxplot doesn't show any odd data


## histogram to check data distribution for anomalities

hist (auditory, xlab="Tetris Scores", main="Tetris Quality scores for visual (green)
and auditory (orange) conditions", xlim=c(0,100), breaks=seq(0,100,10),
col=rgb(1,.5,0,1/3))

hist (visual, breaks=seq(0,100,10), col=rgb(0,1,0,1/3), add=TRUE, )

legend("topleft",c("auditory","visual"),fill=c(rgb(1,.5,0,1/3),rgb(0,1,0,1/3)))

##Histogram shows normal distribution


##Assumptions test:

##Doing the Shapiro-Wilk test to check if the data is normally distributed

shapiro.test (visual)

shapiro.test (auditory)


##Shapiro-Wilk test has passed as p value > .05. So the assumption of Normality
has been met




##Levene Test

library ('car')

leveneTest(tetris$score, tetris$condition)

##The Levene test has passed as well cause p>.05


##We can run t-test now as our assumptions are met

t.test (auditory, visual, paired=FALSE)
```

```r
##The mean tetris score for the auditory condition (M = 67.94)
##was significantly greater than the mean tetris score for the visual
##condition (M = 46.62),  t(61.74) = 7.46, p < .001.

##Visulaize with boxplots:
##dataframe that hold the means and SDs for both conditions.
tetris.mean = c( mean(auditory), mean(visual) )
tetris.sd = c( sd(auditory), sd(visual) )

##Labeling means
names(tetris.mean) = c("Auditory", "Visual")

##Barplot
barplot (tetris.mean, main = "Graph of Condition Means", xlab= "Tetris Gaming
Condition", ylab="Tetris Score", ylim=c(0,100),col=c(col=rgb(1,.5,0,1),rgb(0,1,0,1)))

##Error Bar
se.bar = function(x, y, sds, n, upper=sds/sqrt(n), lower=upper, length=0.1,...)
{
  if(length(x) != length(y) | length(y) !=length(lower) | length(lower) != length(upper))
    stop("vectors must be same length")

  arrows(x,y+upper, x, y-lower, angle=90, code=3, length=length, ...)
}

##Barplot with Error Bars
bp = barplot (tetris.mean, main = "Graph of Condition Means", xlab= "Tetris Gaming
Condition", ylab="Tetris Score", ylim=c(0,100),col=c(col=rgb(1,.5,0,1),rgb(0,1,0,1)))
se.bar(bp,tetris.mean,tetris.sd,32)
```