Table of Contents

Abstract

Aim

The aim of this study was to discover the dif ference in the ability of males and females to control their attentional processes. It was expected, due to previous research mentioned above, that females will complete the Stroop Test with quicker times and that they will therefore be better at controlli ng their attentional processes. Therefore, the alternative hypothesis for this study is that “the time taken to complete the Stroop test by female participants will be quicker than the time taken to complete the Stroop test by male participants.”

Procedure

The study used 13 male and 13 female participants between the ages of 17 and 18 that were selected using Opportunity Sampling in the 6 th Form Study Area at Sandown High School on the Isle of Wight. Participants were asked to complete the Stroop Test (set up on PowerPoint) and the time taken to correctly complete it was recorded.

Findings

The significance level used for this study was $p \leq 0.025$ as the study used a directional hypothesis. The Critical Value was 45 and the Observed Value is 63.5, thus meaning that the difference between the males and females was not significant.

Conclusion

As the difference was not significant, the null hypothesis that “there will not be a significant difference between the time taken to complete the Stroop test by female participants and the time taken to complete the Stroop test by male participants” was accepted. This means that there was no difference in the ability of males and females to control their attentional processing, and therefore multitask.

Introduction

Attention is a major part of everyday life, and there are several types of attention that human beings make use of, these are; focused auditory attention, focused visual attention and divided attention.

Schneider and Shiffrin (1977) presented the automacity mo del for attentional processing. This stated that there were two types of divided attention; controlled and automatic. Automatic attentional processing does not require conscious redirecting of attention as thus is a fast process that is difficult to modify, on the other hand, controlled attentional processing involves the conscious redirecting of attention and is therefore a slow process, this redirecting of attention is more commonly known as multitasking.

Meyer (2003) found that "The two sexes typically come out about the same, on average" (Shellenbarger) when performing actions that require them to multitask, a view that is backed up by Dr. M. Just's research using brain mapping (2001)[1] However, Halpern (2000) disagrees, he studied MRIs of both women and men, and found that women have a larger Corpus Callossum[2] this therefore means that women are able to synthesise the two halves of their brain better than men and thus should be able to multitask better. Equally, Gur et al. (1999) studied MRIs and foun d that there is more white matter in the male brain than in the female brain but that the female brain is made up of proportionally more grey matter which is responsible for processing information, thus giving them an even greater advantage when it comes to controlling their attentional processing.

The Stroop Test is an example of a use of controlled attentional processing. The test consists of the names of colours written in an opposing colour, the

---

[1] Just (2001) found that although women between the ages of 18 and 32 were slightly better at processing two auditory tasks, they were equal with men when asked to perform two other cognitive tasks simultaneously and therefore came to the conclusion that women were equal in their ability to multitask (Mahany 2005)

[2] The Corpus Callosum is the bunch of nerves that allow communication between the two halves of the brain.

aim of the participants being to name the colour of the t ext and not just read the word that is printed. The participants completing the Stroop Test will experience cognitive interference as their brains will automatically attempt to process the data semantically (by reading the printed word) as this is the norm in society. This means that the participants will therefore have to divert their attention to focus on the visual data (the colour of the ink) and state it out loud, making use of their ability to control attentional processing. The Stroop Test can consequently be seen as an effective way to measure the ability of males and females to divert their attention and will show whether females are more adept at multitasking when faced with two cognitive tasks.

Formulation of Aims

The aim of this study is to discover the difference in the ability of males and females to control their attentional processes. It is expected, due to previous research mentioned above, that females will complete the Stroop Test with quicker times and that they will therefore be better at controlling their attentional processes.

Statement of Alternative Hypothesis (Directional)

Therefore, the alternative hypothesis for this study is:
The time taken to complete the Stroop test by female participants will be quicker than the time taken to complete the Stroop test by male participants.

Statement of Null Hypothesis

The null hypothesis for this study is:
There will not be a significant difference between the time taken to complete the Stroop test by female participants and the time taken to complete the Stroop test by male participants.

Method

Design

The study used a laboratory experiment method with an independent measures design. The aim of the experiment was to look at the difference in the ability to divert attention between males and females using a stroop test, and thus, the Independent Variable (IV) was the sex of the participant, and the Dependent Variable (DV) was the stroop test scores.
There were a number of methods used to control extraneous variables, these were:

- The use of a standardised briefing, instructions and debriefing (See Appendix 1 Figure 1.1-1.3)
- The use of set timings between slides
- The insurance that the researcher sat in the same place in each repeat
- The use of the same researcher
- The selection of participants from sixth form to ensure a minimum ability of English

Participants

The study will use 13 male and 13 female participants between the ages of 17 and 18, all from Sandown High School on the Isle of Wight. They were selected using Opportunity Sampling in the 6th form social area. The study used the same researcher throughout the experiment; an 18 year old female in school uniform. It was decided that the researcher should be in school uniform so as to not intimidate the participants.

Materials

The materials used in the experiment are as follows:

- Laptop
- Stroop test on PowerPoint
- Answer sheet
- Data sheet
- Pen
- Stopwatch

Procedure

The procedure for the experiment is as follows:

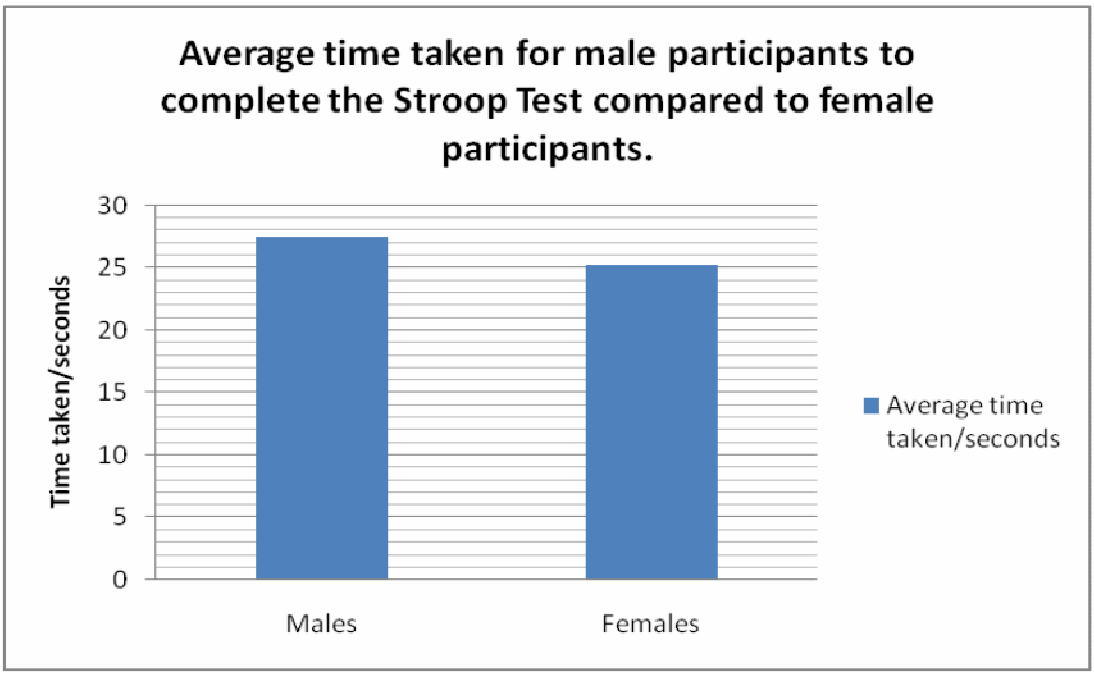
1. Read briefing part 1 to the participant (See Appendix 1 Figure 1.1)
2. If the agree read the briefing part 2 to the participant (See Appendix 1 Figure 1.2)
3. Sit the participant in front of the laptop
4. Sit next to the laptop (0.5m away)
5. Read the standardised instructions (See Appendix 1 Figure 1.3) to the participant and check they understand, if they do not, show the example PowerPoint. (See Appendix 2 Figure 1.1)
6. Start the Stroop test PowerPoint (See Appendix 2 Figure 1.2)
7. Time how long it takes each participant to answer correctly and mark this down on the data sheet (See Appendix 2 Figure 1.3) answers are on the accompanying answer sheet (See Appendix 2 Figure 1.4)

Results

Due to the fact that there were anomalies in the collected data, it was decided that the average median would be used. The averages were taken from the raw data (See Appendix 3 Figure 1.1 and 1.2) and organised into a table.

	Average time taken/seconds
Males	27.55
Females	25.3

Table to show the average time taken in seconds to complete the stroop test by males and females.



Graph to show the average time taken in seconds to complete the Stroop Test by males and femles

As can be seen in the graph above, there is a difference in the results and therefore a test needs to be conducted to determine how significant the difference is.

Inferential Statistics

It was decided that the Mann Whitney test would be used to analyse the significance of the difference in results. This is due to a number of factors. The study used an independent design as each participant only encountered one condition (this also meant that th e data was unrelated), as well as this, it was possible to rank the values as the results were the time taken for males and females to complete the Stroop Test.

Level of Significance

A significance level of 2.5% was used for this test. This is due to the fact that this study uses human beings and therefore there has to be an allowance for those outside the statistical norm. A significance level of 1%, for example, would be too strict whereas a significance level of 10% for example, would be too leniant as the results could be put down to chance.
The hypothesis used in this study is directional and thus a one tailed test was used. There were 13 participants in each group and therefore N=13.

From this information, the critical value can be found (See Append ix 3 Figure 1.6)

As can be seen in the Appendix 3 Figure 1.5, the Critical Value when $p \leq 0.025$ is 45 and the Observed Value is 63.5 (See Appendix 3 Figure 1.3 - 1.7)

For the Alternative Hypothesis to be accepted, the Observed Value must be less than the Critical Value, however, as can be seen above, the Observed Value (63.5) is greater than the Critical Value (45) and therefore, the Alternative Hypothesis must be rejected and the Null Hypothesis must be accepted:

“There will not be a significant differe nce between the time taken to complete the Stroop test by female participants and the time taken to complete the Stroop test by male participants.”

Discussion

Explanation of Findings

Although the study shows that the female participants performed slightly better than the male participants (with average times of 25.3 and 27.55 seconds respectively), the Mann-Whitney test showed that this difference in results was not significant. Because of this, the null hypothesis; "There will not be a significant difference between the time taken to complete the Stroop test by female participants and the time taken to complete the Stroop test by male participants" was accepted.

However, despite the fact that women generally did better than men in this study, it was in fact a man who completed the Stroop Test fastest with a time of 21 seconds. This could be attributed to a possible interest in art which would have meant that the participant would have been more used to focussing on colour than on words and thus performed better in the Stroop test.

Overall though, the female participants were, on average, 2.25 seconds quicker than the men. This means that, with a larger number of participants, the difference in results may have been significant.

Relationship to Background Research

Meyer (2003) came to the conclusion that the two sexes are typically equal in their ability to multitask. This is the same conclusion as was reached at the end of this study. The similarity in conclusions could be due to the similar demands made from the world at the time of the two studies; both studies were conducted recently, in a time when education offers the same opportunities for males as it does for females, and when both sexes are encouraged to strive for the best that they can do. This means that both sexes should be able to use the left and the right sides of their brains in conjunction with each other and thus be able to multitask to cope with the stresses that the current environment puts on them.

The research of Dr. M. Just (2001) also came to the same conclusion as this study when he looked at brain scans of 18 to 32 year olds who were completing two tasks at the same time. This may be due to the similarity in age of the participants in the two studies; both studies incorporated participants who would be pushing to be equal in educational attainment due to their age, and so they would have had to develop their brains to equal levels in order to compete for jobs and promotions. This means that any advantage held by the female participants from being biologically more adept at multitasking and diverting their attention would have been reduced by the education levels of the men and so the two sexes came out all but equal in their times for the Stroop Test.

However, the research of Halpern (2000)[3] disagrees with this study. He concluded that women would be able to synthesise the two halves of their brain better than men, making them more able to multitask. There is nonetheless, a reason for this difference . This study, as well as that of Gur et al. (1999)[4] looks only at the biological theory for the ability to multitask, whereas Meyer (2003), Just (2001) and this study, looked at the actual ability of participants to multitask, thus taking into account the demands of the environment. This means that Haplern (2000) and Gur et al. (1999) came to the conclusion that women were better at multitasking (and thus diverting their attention) than men, yet when the environmental factors were taken into account, it is seen that women and men are all but equal in their ability to divert their attention.

Limitations and Modifications

There were multiple limitations that affected the results of this study, the most important being the number of methods used. This study only made use of one method to come to its conclusion on the ability of males and females to

[3] Halpern (2001) studied MRIs of women and concluded that they have a larger Corpus Callossum, thus allowing them to synthesise the two halves of their brain better.

[4] Gul et al. (1999) studied MRIs and found that there is more white matter in the male brain than in the female brain but that the female brain is made up of proportionally more grey matter which is responsible for processing information, thus giving them an even greater advantage when it comes to controlling their attentional processing.

divert attention. This is a limitation because there are many different situations where people may have to divert their attention, and these situations all use different combinations of senses and thought processes. The Stroop Test only tested the ability to divert attention from the semantics of a word to the colour of the word and came to the conclusion that the two sexes were equally able to complete this test. However, other combinations of senses and thought processes may produce different results and so these need to considered equally. One way to deal with this is to use multiple methods, for example, asking the participants to listen to two conversations at t he same time and reconstruct them or asking the participants to read a text whilst copying down a dictation.

Another important limitation was the range of subjects that participants were studying. There was not a large range of subjects as the participants all came from one school and as the were selected from the library it was unlikely that many participants were studying art or design and technology, therefore meaning that most of the participants naturally focussed on the semantics of the words given rather than the colour. This could be dealt with by ensuring that the participants were selected from a range of subjects so as to remove the bias towards language based participants.

Another limitation would be that the research was too casual as the participants knew the researcher. This meant that the participants would treat the study with less respect and therefore, the results would be less valid. One way to solve this issue is to use an independent researcher that is not known by the participants so as to acquire more valid results.

The number of people used in the study is also a limitation. This is a problem because it means that the results are not reliable and so cannot be generalised to the rest of society. This can be dealt with by using a larger number of participants and thus acquiring more reliable results.

Implications and suggestions for future research

The real life implications of this study are that men and women can be set equal workloads. This is because both sexes are equally able to d ivert their

attention and so should be able to complete the same amount of work per day. Another real life implication is that although women are biologically suited to multitasking eg. Cooking and holding a conversation, this can be changed and people are able to develop both sides of their brains and so the education system could focus more on this to help men close the gap even more. Further research however could be conducted to further clarify these results. A study into how age affects the ability to divert attention would be beneficial as it would clarify whether the equality between men and women in their ability to multitask is restricted to those aged 16 -18 or whether it varies depending upon the age of the participants.

References

Cooper, D. *Does Color Incongruency Affect Responses to Words?*<http://www.sewanee.edu/chem/chem&art/Detail_Pages/ColorProjects_2003/Cooper/DAC%20Final%20Version.html> Accessed 18th June 2008

Criss, B. *Gender Differences in Multitasking* <http://clearinghouse.missouriwestern.edu/manuscripts/815.asp > Accessed on 26th June 2008

Schneider, W. and Schiffrin, R.M. (1997) in Gross, R., McIlveen, R., Coolican H., Clamp, A. and Russell, J. (2000) *Psychology: A new introduction for A level. 2nd Edition.* Hodder and Stoughton. Pages 376 – 377

Sex Differences in Brain Gray and White Matter in Healthy Young Adults: Correlations with Cognitive Performance (1999, May 15) <http://www.jneurosci.org/cgi/content/full/19/10/4065 > Accessed on 24th September 2008

Stroop Effect <http://en.wikipedia.org/wiki/Stroop_effect > Accessed on 18th June, 2008

Stroop Task: A test of capacity to direct attention <http://www.snre.umich.edu/eplab/demos/st0/stroopdesc.html > Accessed on 26th June 2008

Teen's ability to multi-task develops late in adolescence (2005, May 17): <http://www.eurekalert.org/pub_releases/2005-05/sfri-tat051205.php> Accessed on 26th June 2008

Weiman, H. *Gender Differences in Cognitive Functioning* <http://homepages.luc.edu/~hweiman/GenderDiffs.html > Accessed on 24th September 2008

Appendix 1

SCRIPT

Fig 1.1

BRIEFING

Hello, would you mind helping me with my psychology coursework?

If no – Thank you *(go to Fig 1.2)*
If yes – Ok, have a good day.

Fig 1.2

INSTRUCTIONS

Hi, thank you for agreeing to help with my psychology coursework. I will now explain the nature of this study.
The study will involve you completing a stroop test, this is where the name of a colour is written in a different coloured ink and you are asked to name the colour of the ink rather than the name of the colour that is written.
Here is an example:

(Show example PowerPoint)

Does everyone understand?

It is meant to be a challenging task so don't worry if you find it hard. I will simply be recording whether you got the answer right or wrong and, if you decide to continue, all data will be recorded anonymously.
If you wish to know your result, please feel free to ask me when all the data has been collated.

Do you still wish to take part in this experiment?

If yes – Thank you, please wait here until your turn *(carry on reading)*
If no – Ok. Thank you.

Ok, you will have as long as you want for each word, I simply want you to tell me the colour of the ink that the word is written in.

Do you understand?

If no – Show example again

You may begin

Fig 1.3

DEBRIEFING

Thank you for your time, may I assure you once again that your results were recorded anonymously; no one will know your results.
The aim of the experiment was to look at the difference in the ability to divert attention between males and females, however, I was unable to disclose this at the beginning of the experiment as you may have tried harder and this would have affected the validity of the results. I do apologise for this, but thank you for completing the experiment; your time is much appreciated. Are there any questions? Have a good day!

Appendix 2

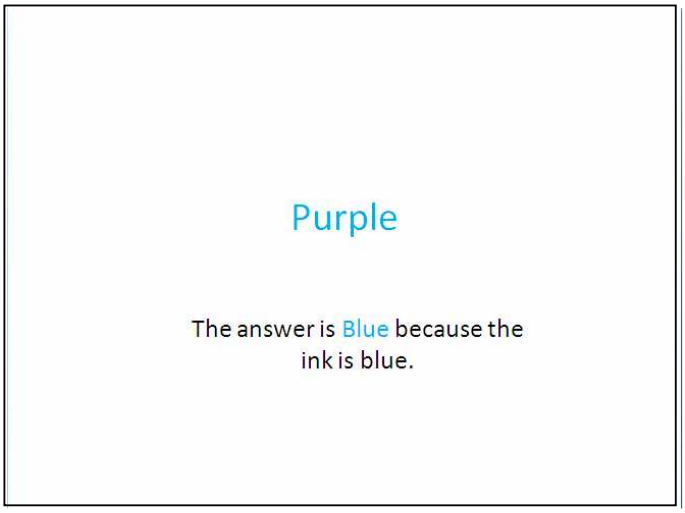


Fig 1.1

EXAMPLE STROOP TEST SLIDE TO SHOW HOW TO COMPLETE THE TEST

Fig 1.2

POWERPOINT PRESENTATION OF STROOP TEST

Participant Number	Time taken to complete test
Example	*26.5*
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	
Average	

Fig 1.3

DATA TABLE, THE TIME TAKEN FOR THE PARTICIPANT TO CORRECTLY IDENTIFY THE COLOUR OF EACH WORD IS MARKED IN THE RELEVANT BOX. ONE TABLE FOR MALES AND ONE FOR FEMALES.

Slide Number	Correct Colour
1	Green
2	Red
3	Purple
4	Blue
5	Blue
6	Red
7	Green
8	Orange
9	Red
10	Green
11	Orange
12	Purple
13	Orange
14	Blue
15	Purple
16	Green
17	Purple
18	Green
19	Orange
20	Red
21	Purple
22	Red
23	Blue
24	Green

Fig 1.4

CORRECT ANSWERS FOR STROOP TEST.

Appendix 3

	Time/minutes	
Participant	Male	Female
1	34.3	23.5
2	28.8	21.4
3	33.5	27.8
4	21.0	25.8
5	23.8	28.2
6	31.9	26.8
7	21.1	32.8
8	22.2	26.9
9	31.1	21.3
10	30.4	21.2
11	26.3	22.2
12	30.5	24.8
13	22.6	26.4

Figure 1.1

TABLE OF RAW DATA (RED PRINT SIGNIFIES ANOMALIES)

	Male	Female
	21.0	21.2
	21.1	21.3
	22.2	21.4
	22.6	22.2
	23.8	23.5
	26.3	24.8
	28.8	25.8
	30.4	26.4
	30.5	26.8
	31.1	26.9
	31.9	27.8
	33.5	28.2
	34.3	32.8
Average	27.55	25.3

Figure 1.2

DATA ORGANISED INTO TIME ORDER AND AVERAGES CALCULATED (RED PRINT SIGNIFIES ANOMALIES)

Male	Rank	Female	Rank
34.3	26	23.5	9
28.8	19	21.4	5
33.5	25	27.8	17
21.0	1	25.8	12
23.8	10	28.2	18
31.9	23	26.8	15
21.1	2	32.8	24
22.2	6.5	26.9	16
31.1	22	21.3	4
30.4	20	21.2	3
26.3	13	22.2	6.5
30.5	21	24.8	11
22.6	8	26.4	14
	R_b=196.5		R_a=154.5

Figure 1.3

TABLE TO SHOW RANKS OF RESULTS (RED PRINT SIGNIFIES ANOMALIES)

$$U_a = N_aN_b + \frac{N_b(N_b + 1)}{2} - R_b$$

Figure 1.4

FORMULA FOR MANN-WHITNEY TEST

$$U_a = N_aN_b + \frac{N_b(N_b + 1)}{2} - R_b$$

$$U_a = 13 \times 13 + \frac{13(13 + 1)}{2} - 154.5$$

$$= 169 + \frac{182}{2} - 154.5$$

$$= 169 + 91 - 154.5$$

$$= 105.5$$

$$U_b = N_aN_b + \frac{N_a(N_a + 1)}{2} - R_a$$

$$U_b = 13 \times 13 + \frac{13(13 + 1)}{2} - 196.5$$

$$= 169 + \frac{182}{2} - 196.5$$

$= 169 + 91 - 196.5$

$= 63.5$

Figure 1.5

CALCULATIONS FOR U_A AND U_B

	$N_a = 13$
$N_b = 13$	45

Figure 1.6

TABLE TO CALCULATE CRITICAL VALUE

63.5 > 51 so Null Hypothesis retained

Figure 1.7

CONCLUSION FROM CALCULATIONS