

The stroop effect and selective attention



Early “ bottleneck theories of attention” (Edgar, 2007 p. 17) allowed for only one channel of input to be semantically examined all other information was discarded. Later discrepancy to attention theory suggested that all inputs were examined but that a great deal of this is automatic and unconscious. However, automatic processes are hard to control and unlearn. This project is a study of the Stroop effect and how over learned; automatic processing could hinder a colour identification task. It was revealed that ink colour identification was slower for a list of colour names than when neutral words were used and that unconscious semantic processing was taking place.

Introduction

In the 1900's J Ridley Stroop (as cited in Edgar, 2007) demonstrated that if someone was reading information, and other conflicting inputs were added, the rate at which the person read would slow down. The rationale for this experiment is to investigate the Stroop effect, and to measure the interference of automatic, unconscious semantic processing. The experimental hypothesis is that the time taken to identify the ink colours of a list of colour names will be longer than that of a control list of neutral words. The null hypothesis is that there will be no difference in the processing time for the two lists.

Attention is a system, which permits us to select and process significant received information. Selective attention is the ability to focus on one job at a time whilst filtering out any external stimuli, which may be off putting. However, divided attention is the ability to divide ones attention between

two or more tasks. Therefore, if one of the tasks is an automatic process, it becomes more simplistic to divide ones attention between the two tasks.

However, rather than being helpful, interference can occur between the controlled process and the automatic process. Psychologists have repeatedly established that the autonomic nature of reading words, seeing that it is such a well-learned repeated activity can obstruct other tasks. This suggestion has been investigated by a number of researchers.

Kanheman (as cited in Edgar, 2007) devised a theory, which was built around the concept that the brain is a “ limited-capacity central processor” (Edgar, 2007 p. 17). He suggested that some tasks might be rather autonomic; so make less demand in terms of mental exertion, such as a reading task. Several actions can be carried out at the same time, provided that their total effort does not exceed the available capacity. So usually an autonomic task will not require much mental exertion and so often can be carried out automatically.

Shiffrin and Schneider (as cited in Edgar, 2007) researched automatic processing in great detail and identified some of the characteristics in comparison with controlled processes. A piece of research, an experiment followed with participants being required to search for particular letters (target items) amongst an assortment of digits (distracter items). For example, participants were asked to identify as quickly as possible letters from B-L (target items) within the part of the alphabet from Q-L (distracter items). After 2001 trials, the participants were able to identify the target items extremely quickly without having to think about the alphabet each

time. During a second part to the experiment, the distracter items and target items were switched around which meant that the previously learnt task of spotting letters from B-L changed into having to identify letters from Q-L. Shiffrin and Schneider found that the time taken by the participants to complete the task increased considerably. Therefore, the already learned, automatic process proved very difficult to change, this demonstrates how automatic processes become rigid and fixed after practise.

Stroop (as cited in Edgar, 2007) carried out an investigation into autonomic processing, thus inventing the Stroop effect. In this, he asked participants to read a list of colour words written in black ink. This uncomplicated task was simple for the participants to complete.

Participants were then asked to read a list of colour words written in conflicting coloured inks, (e. g., the word " blue" written in red colour ink) and to call out the colour ink the words were written in. Although this task appear to be uncomplicated and is pure and simple colour recognition, Stroop established that the participants took considerably longer to complete this task then the previous. The reason being that the powerful autonomic (unconscious) nature of reading words meant that participants automatically wanted to read the words rather than the colour ink they were written in. So, even though the participants did not often read the colour word out loud, a time delay was present whilst the participants thought of the correct response (the colour ink).

Method

Design

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The aim of the experiment is to explore whether it takes the participants longer to read a list of colours typed in colour related words, or whether it takes the participants longer to read the list of words typed in neutral colours. A between participants design will be followed.

The experimental hypothesis is that participants will take longer to identify the colour related words than the neutral words. This is a one-tailed, hypothesis. The null hypothesis is that there will be no difference in the times taken to identify either the colour related words or to identify the neutral words. The independent variable was represented by two conditions; two word lists printed in various coloured inks. One list consisted of colour related words and the other of neutral words. The dependent variable was the time taken to name the ink colours.

Participants

The twenty participants that took part in this experiment were made up of sixteen recruited from The Open University these included staff members or their family and friends. These participants were fully briefed and gave their informed consent to participate in the experiment, and were debriefed afterwards. The participants were naive to the hypothesis of the experiment . The final four were members of my own family. A verbal briefing was given to these participants at the start and a debriefing once the experiment had been completed. During the briefing it was clearly stated that ' you can withdraw at any time if you feel, for any reason, you do not want to continue.' In the debriefing it was explained that ' All results will remain anonymous, and your name will not be used in the data collection.' The

participants were offered the chance to withdraw their information if they wished to do so.

As well as the briefing and the debriefing, we also had to gain informed consent. This was mainly gained from the briefing and debriefing, but also meant we had to inform the participants of all the objectives in the investigation. Also we had to inform the participants of all the aspects of the investigation or intervention that might reasonably be expected to influence willingness to participate.

Materials

An accurate stopwatch was used to time how long it took each participant to identify the words from the two conditions. The visual stimuli consisted of a list of 15 words, presented in two columns on an A4 size sheet of paper (see appendix 2)

Procedure

In order to standardise the procedures, the following exact steps were taken in conducting the experiment:

All the materials were prepared in a quiet room in which the experiment would take place.

Once chosen, the participants were briefed as much as they could be without jeopardising the main point of the experiment and informed consent to carry out and use the results of the experiment was gained (see appendix 1).

Each participant was taken into the same, well lit quiet room individually each time and was read out a sheet of instructions (see appendix 4)

The participant was presented with a list of words and was then instructed to read through the list of words as fast as you can.

At the beginning of the recitation of words the stopwatch was started and at the end, it was stopped and the results were recorded.

This was repeated with a following list (see appendix 2).

Results were collected and the participants were debriefed (see appendix 3).

Results

Condition

Mean response time in seconds

Standard deviation

Condition 1

Colour related words

24.90

4.855

Condition 2

Neutral words

22. 05

3. 170

The experimenter found that the mean time for the colour related words was 24. 90 seconds and for the neutral words it was 22. 05 seconds. The difference between the two word list was 2. 85 seconds, this shows that the experimental hypothesis was correct. Participants do take longer to identify colour words written in colour ink than neutral words written in colour ink.

The inferential test used to analyse the data was an independent samples t-test. The results of this test showed that there was a statistically significant difference between the mean colour related word response time and the mean neutral word response time (see appendix 5)

$(t(38) = 2.341, p = 0.0125, \text{one-tailed}, d = 0.7553126805)$

This result is statistically significant as the p value is lower than the 0. 05 acceptance level, on this basis the null hypothesis, that there would be no difference between the time taken to identify the colour related words and the time taken to identify the neutral words can be rejected.

Discussion

The results showed a significant increase in the time taken to read the colour words over the neutral words. This is consistent with previously reported data and supports the experimental hypothesis of this study.

The Stroop effect conflicts with the “ bottleneck” (theories such as Broadbent’s for the reason that, if channels were selectively filtered,

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information on a second channel would be ignored and there would be no conflict. The results show that involuntary semantic processing is happening. Intrusion such as this is consistent with the automatic processes of Kahneman's model, and with the definitions of automaticity cited by Shiffrin and Schneider. The operation of reading is so well learned that, despite attempting to attend to the colour of the ink, the unconscious process of interpreting the meanings of the words is still happening. When the word is itself a colour, the meaning of the word conflicts with the subject's attention to the ink.

The reason for an increase in reading time is unclear. It was observed that some of the participants seemed consciously to slow down when reading colour words, possibly to provide more attention. Others would read both lists at the same pace but slip up; realising their mistake, they would take up time in correcting it. Comments from the participants confirmed this view. On a few occasions, uncorrected mistakes were made; this indicates the practical consequences of the failure of selective attention in real life events.

The findings from the Stroop effect do have greater implications. The discovery that the autonomic nature of reading tasks can interfere with other controlled processes is very significant, in for example texting on a mobile phone whilst driving. This experiment shows that the automatic process of reading may draw attention away from the task of driving and could cause interference. This could result in a serious car accident

Conclusion

The experiment found that unconscious semantic processing of words on an unattended channel was intruding upon a task of naming ink colours. This was consistent with the Stroop effect.

References

Phoenix, A. (2007). Perception and attention. In D. Miell, A. Phoenix, & K. Thomas (Eds.), *Mapping Psychology* (2nd ed., pp. 3-50). Milton Keynes: The Open University

Appendices

Appendix 1

Consent to participate

I have been asked to participate in an experiment that investigates one aspect

of cognitive psychology and give my free consent by signing this form.

I have been informed about the research and why it is taking place.

I understand that my participation in this research is voluntary.

I understand that I can withdraw from the research at any time.

I understand that my data will be anonymous.

I understand that I will be provided with a debrief after taking part in the experiment.

Signature _____

Date _____

Appendix 2

Condition 1

SKY

PLUM

PLUM

BLOOD

LEMON

LEMON

GRASS

GRASS

CARROT

BLOOD

BLOOD

SKY

PLUM

CARROT

CARROT

LEMON

SKY

PLUM

GRASS

GRASS

BLOOD

CARROT

LEMON

SKY

CARROT

BLOOD

GRASS

LEMON

SKY

PLUM

Condition 2

STY

PLAN

PLAN

BLAME

LEDGE

LEDGE

GRADE

GRADE

CAREER

BLAME

BLAME

STY

PLAN

CAREER

CAREER

LEDGE

STY

PLAN

GRADE

GRADE

BLAME

CAREER

LEDGE

STY

CAREER

BLAME

GRADE

LEDGE

STY

PLAN

Appendix 3

Table 2 Data from twenty participants in the colour-associated words experiment

Participant number

Age (years)

Sex (male/female)

Condition 1 (colour-related words) time (seconds)

Condition 2 (neutral words) time (seconds)

1

48

female

24

18

2

25

female

21

22

3

38

female

26

25

4

31

male

20

19

5

18

female

21

17

6

38

female

36

28

7

39

male

21

18

8

27

male

24

24

9

53

female

30

26

10

42

female

18

21

11

55

female

22

19

12

68

male

25

22

13

20

female

29

25

14

69

male

28

22

15

18

female

22

21

16

40

female

26

24

17

40

male

20

19

18

21

female

23

21

19

66

male

35

27

20

37

female

27

23

Appendix 4

Instructions

A piece of A4 paper will be placed in front of you that will have two columns of words. What I would like you to do is to read the words and speak them as quickly as possible, starting with the left column. When you have finished the words in the left column, start on the right column again reading the words and speaking them as quickly as possible.