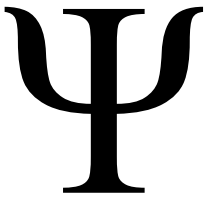
NAME OF SCHOOL

IB Psychology Standard Level Internal Assessment

The Effect of Interfering Word Stimuli upon Naming Colours Serially



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Abstract

The aim of this experiment was to investigate the level of interference on attention when naming colours in conflicting word-colour stimuli compared to naming colours serially – the Stroop effect. The lab experiment was a partial replication of J.R. Stroop's experiment 2 (1935). The independent variable was the colour stimulus named by participants. It used two tests: naming coloured squares serially (NC) and naming coloured words with interfering word stimuli (NCW_d). The dependent variable was the reaction time taken by participants to recognise and name the colours. The findings showed a causal relationship between the NC and NCW_d tests. The results indicate that naming a coloured word ("RED" in green ink) takes significantly longer than naming colours serially. The interference is caused by the introduction of the conflicting word stimulus. It reaches the conclusion that the automaticity of reading inhibits attention in naming colours serially when an interfering word stimulus is introduced because it activates a schema. However, further language considerations are necessary for a cross-cultural understanding of the Stroop effect.

Word Count: 170

Introduction

The cognitive perspective focuses on the underlying mental processes that influence behaviour. It is particularly interesting in factors that impede or facilitate information processing such as attention. Attention is the ability to concentrate on a specific stimulus thus enabling the processing of information (Colman, 2003). Attention can be affected by many factors such as trying to block out other thoughts while attempting to focus on a particular stimulus or disabling automatic processes such as reading. The ability to focus on a specific stimulus is affected by schemas – an active mental organisation of information based on prior experience. Focusing on a specific stimulus becomes difficult with conflicting stimuli such as words and colours or multiple languages.

When conflicting stimuli are presented, the mind tends to focus on what is important; based on previous experience stored in schemas. The recognition and processing of the semantic meaning of a word stimulus becomes an automatic task after practice. Reading thus interferes in naming colours if paired with a word stimulus when the task is to name the colour and ignore the semantic meaning of the word.

The Stroop task (Stroop, 1935) investigated interference in attention on naming colours. Stroop's second lab experiment investigated the effects of interfering word stimuli on naming colours serially. The colour stimulus was the independent variable and the reaction time taken to name the colours was the dependent variable. He studied naming colours serially using solid coloured squares as the control stimulus (NC test). Afterwards, Stroop introduced the interfering word stimulus: incongruent word-colour pairs ("GREEN" in red ink, NCW_d test). He found that the time taken to name colours in the NCW_d test was significantly higher. This delay in reaction time due to the word and its conflicting ink colour is termed interference – a type of error that might occur in the Stroop effect because of the faulty activation of a schema. The findings suggest that the automaticity of reading inhibits the ability to focus on the colour stimulus. Preston and Lambert (1969) studied the Stroop effect in bilinguals, and found that relative proficiency in different languages affects the level of interference.

The aim of this experiment is to investigate interference in attention. The reaction time is the delay in focusing and naming the colour stimulus. The interference is measured as the difference in reaction time between naming colours serially (NC) and naming colours with interfering word stimuli (NCW_d). This is achieved by a partial replication of Stroop's original study (Stroop, 1935b).

Method

Design

The experimental design was a laboratory experiment. It used the same experimental group and one repeated measure. Participants performed both tests individually one after another to establish a causal relationship. The independent variable was the colour-stimulus. In the control Naming Colours test (NC) the colour stimulus was a 24-point coloured square (■). In the Naming Coloured Words test (NCW_d), the colour stimulus was a word-colour in an incongruent colour (e.g. "GREEN" in red ink). The dependent variable was the reaction time taken by participants to name the colours. Participants were not allowed to leave any errors uncorrected during NCW_d.

Non-psychology students were used to avoid possible demand characteristics. This assisted in avoiding the confounding variable of previous practice.

Before the experiment participants were briefed about the nature of the experiment. Each participant signed a consent form that explained their rights for the duration of the experiment. The experiment consistently maintained considerations to avoid any possibility of physical and/or psychological harm. After the experiment participants were debriefed about the aim of the experiment. Contact information was collected and the experimenters' email addresses were provided in case the participants had any concerns after the experiment.

Participants

The target population was Danish students at Nyborg Gymnasium studying the Danish Studentereskamen[1]. The school is roughly split between both genders ages 16 to 20 years old. Experimenters found several classes that were half male and half female. All 3 classes are partially representative of the target population. The first class (3c) asked agreed to participate and contained 9 males and 9 females (n=18) all aged 19. Because of age restrictions (>16 without parental consent) and convenient class schedules 3c was used as an opportunity sample. Colour-blindness was not an issue. Because the experiment requires a repeated measure, participants remained in the same experimental group.

Materials

- Informed Consent Form[2]

[1] Danish diploma to enter higher education
[2] See Appendix 1 (p. 8)

- Standardised Instructions / Briefing Note[3]
- Debriefing Note[4]
- A4 Sheet for NC test[5]
- A4 sheet for NCW_d test[6]
- Stopwatch

Procedure

The experiment was conducted in a quiet, well-lit room. Participants are seated and given two minutes to allow their eyes to adjust to lighting conditions while they read and sign the consent form. Afterwards a short briefing of the experiment along with standardised instructions for ethical considerations was read, including the right to withdraw at any time.

Participants were instructed to name the colours as fast as possible following Western reading order (from left to right) for both tests. The A4 sheet for the NC test is presented to participants and their time taken to name the colours was recorded. Afterwards participants were told that if they made errors during the NCW_d test, they would have to try again until they named the correct colour before proceeding. The A4 sheet for the NCW_d test was then presented and the time taken to name the colours was recorded.

Upon completion participants received written debriefing explaining the aim of the experiment, right to ask questions and view the final report. It also contained the experimenters' contact information.

Results

The score recorded after each test was verbally confirmed by both experimenters. The raw data was collected in one table[7].

The overall reaction time for the NC test ranged from ≈ 9 to ≈ 22 seconds (range ≈ 13). The range for the NCW_d test was significantly higher ≈ 17 to ≈ 46 seconds (range ≈ 29).

[3] See Appendix 2 (p. 8)
[4] See Appendix 3 (p. 8)
[5] See Appendix 4 (p. 9)
[6] See Appendix 5 (p. 9)
[7] See Appendix 6 (p. 9)

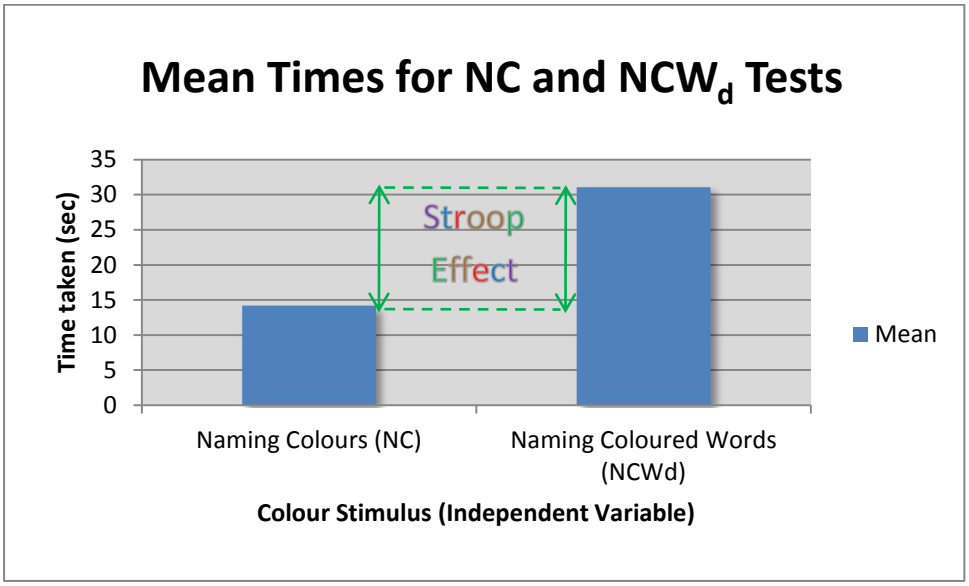
The mean reaction times and standard deviation calculations for both tests were used because reaction times are interval data[8]. Mean scores are the average reaction times taken by participants and the standard deviation is a measure of the dispersion of the data (see Table 1).

Table 1: Mean, Standard Deviation and Range for NC and NCW_d Tests

Test	Mean (s)	Standard Deviation (s)	Range ≈ (s)
Control (NC)	14.176	3.780	13
Interfering Word Stimulus (NCW_d)	31.088	6.904	29

The calculations show a significant difference between both the mean scores and the standard deviations for each test. The percentage mean difference of the NCW_d test was 119.298% higher than the NC test; more than twice as long[9]. These calculations show a clear causal relationship as expected. Figure 1 illustrates this difference.

Figure 1: Mean for NC and NCW_d Tests



The mean percentage difference between NC and NCW_d is termed the Stroop Effect – the interference in attention caused by the stimulus change from naming colours serially (NC) to interfering word-colour pairs (NCW_d).

[8] See Appendix 7 (p. 10)
[9] See Appendix 8 (p. 10)

Discussion

The findings of this experiment coincide with Stroop's 2nd experiment; the automaticity of processing words inhibits attention from naming colours in the NCW_d test. However, the mean difference Stroop observed was 75% compared to 119% in this experiment. Possible reasons for this are bilingualism. All participants were studying the Studentereksamen, so experimenters assumed Danish was their strongest language. It was evident that several students had a non-Nordic background and it is possible that Danish was not their native tongue. The Western reading order may have troubled ethnic participants if reading from right to left dominated their schema. This aspect of their schemas might have further increased their level of interference. Future studies should include this cultural difference.

Experimenters used consistent conditions for each participant, so any errors incurred were consistent. Stroop's original experiment did not use an equal amount of males and females to account for gender differences. Demand characteristics were addressed to correct the extraneous variable of familiarity and previous practice. However, practice does not significantly reduce the level of interference (Stroop, 1935c). Nonetheless, demand characteristics should be addressed in future studies of similar nature. Colour-blindness must be addressed to avoid unreliable data.

Linguistic symbols (*, &) may serve as a more appropriate control (Stroop, 1935c) than coloured squares. This stimulus change would confine both tasks to a similar set of symbols. However any similarity between symbols used should be distinct from letters used in different languages (e.g. Arabic, Russian) to avoid possible confusion in schemas.

Testing both genders from different cultures and all age groups in Nyborg Gymnasium, stratified by ethnicity and age would allow for a more reliable and comprehensive sample. Participants should be asked what their native tongue is along with proficiency in other languages to account for bilingual differences in future experiments.

The evidence suggests that the automaticity of reading inhibits attention from naming colours when the interfering word-colour stimulus is introduced. However further considerations for different reading orders in other languages (Arabic) are necessary for a cross-cultural understanding of The Stroop Effect.

References

Colman, A. M. (2003). *Oxford Dictionary of Psychology.* New York: Oxford University Press.

Glassman, W. E., & Hadad, M. (2006). *Approaches to Psychology* (4th Edition ed.). Berkshire, England: Open University Press.

Macleod, C. M. (1991). Half a Century of Research on the Stroop Effect: An Integrative Review [Electronic Version]. *Psychological Bulletin , 109* (2), 163-203.

Stroop, J. R. (1935). Studies of Interference in Serial Verb Reactions [Electronic Version]. *Journal of Experimental Psychology , 18* (6), 643-662.

Appendices

Appendix 1

Consent Form (translated; signed by participants)

I hereby understand the following:

1. The nature of the experiment has been satisfactorily explained
2. My identity and anonymity will be protected
3. The right to withdraw for any reason is at my disposal and the reason need not be disclosed
4. I will not receive any form of compensation for my participation
5. The experiment will be conducted in a non-derogatory manner
6. I will be fully debriefed afterwards and have the opportunity to see the results and ask any questions

The undersigned gives his/her informed consent to participate in this experiment

Signature _____ Date_____

Contact Number _____

Appendix 2

Briefing/Standardised Instructions (translated)

"You are about to participate in a psychology experiment. We will be testing your reaction time in naming colours serially. You have the right to withdraw from this experiment at any stage. Your name, age and identity will remain confidential. At the end of the experiment you will be fully debriefed. During the first test, please name the colour squares you see on the sheet of paper from left to right, starting at the top left corner. Continue in the same manner for the following rows. For the second test please name the colour of the ink the word is printed in. Name the colours as fast as you can. If you make a mistake we will ask you to try again before proceeding. If you have any questions or concerns please address them now. Are you ready to begin?"

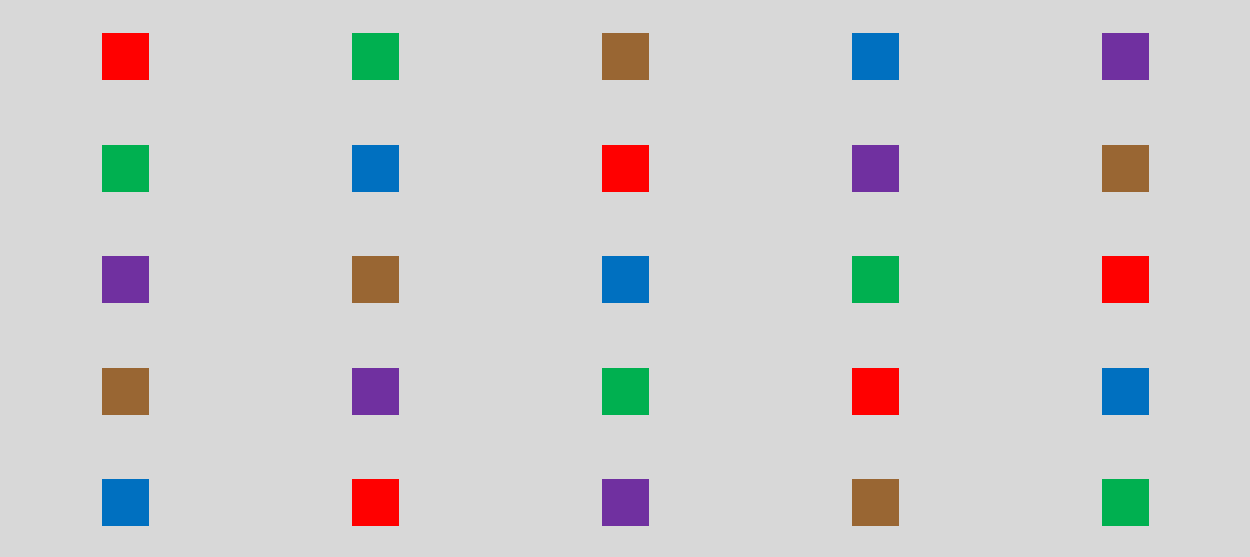
Appendix 3

Debriefing (translated)

"The aim of our experiment was to test your reaction time in naming colours. More specifically we measured the interference of interfering word stimuli in your overall reaction time between the first and second test. Your results were highly beneficial to our experiment and we value and appreciate your participation. Our email addresses are provided below in case you have any concerns or questions and so that you may request a copy of the finished report if you wish to read it.
ibpsychrevision.blogpot.com Mobile: XX XX XX XX

Appendix 4

Table used for NC test (landscape orientation, scaled to fit)



Appendix 5

Table used for NCW_d test (landscape orientation, scaled to fit)

LILLA	BLÅ	GRØN	RØD	BRUN
RØD	BRUN	BLÅ	GRØN	LILLA
BRUN	RØD	GRØN	LILLA	BLÅ
BLÅ	GRØN	LILLA	BRUN	RØD
LILLA	GRØN	RØD	BLÅ	BRUN

Appendix 6

Raw data for NC and NCW_d

Participant No.	Gender	NC Test (sec)	NCW_d Test (sec)
1	Female	22.390	29.782
2	Female	16.360	25.157
3	Female	10.812	46.344
4	Female	15.750	34.109
5	Female	17.094	31.188
6	Female	12.625	31.719

7	Female	11.891	29.828
8	Female	11.437	34.954
9	Female	10.844	22.860
10	Male	16.281	34.750
11	Male	18.140	36.594
12	Male	21.172	31.281
13	Male	13.656	33.609
14	Male	11.187	34.813
15	Male	14.000	38.735
16	Male	11.797	20.547
17	Male	9.140	17.453
18	Male	10.594	25.859

Appendix 7

Statistical Calculations

Mean: $\mu_X = \frac{1}{n}\sum_{i=1}^{n} X_i$

Naming Colours (NC): $\sum x = 255.17,\ n = 18$

$\frac{255.17}{18} = 14.1761$ seconds

Naming Coloured Words (NCW_d): $\sum x = 559.582,\ n = 18$

$\frac{559.582}{18} = 31.0879$ seconds

Mean percentage difference: $\frac{31.0879 - 14.1761}{14.1761} \cdot 100 = 119.298\%$

Range percentage difference: $\frac{29 - 13}{13} \cdot 100 = 123.076\%$

Appendix 8

Standard Deviation Calculations

$$\sigma_X = \sqrt{\sum_{i=1}^{n} \frac{(X_i - \bar{X})^2}{n}}$$

Standard deviation for NC: 3.780 seconds

Standard deviation for NCW_d: 6.904 seconds