Aphasia Research and Therapy (ART) Laboratory
失語症科研及治療實驗室

The effect of colour on oral production at discourse level in neurologically healthy individuals

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Introduction

- **Colour** has a significant impact on **visual attention** in early stages of visual processing (Wolfe, 2000), thereby increasing visual redundancy and the **amount of transmitted information** (Miller and Johnson-Laird, 1976).
- Addition of colour has a **positive effect** on oral production (Rossion & Pourtois, 2004; Mazumdar et al., 2020): this effect has been observed in tasks involving **single-word picture naming** and **sentence-level picture description** among neurologically healthy individuals.
- It remains to be discussed whether this positive effect on oral production extends to **discourse**, i.e., a linguistic entity that **surpasses individual words or sentences** in terms of structure and organization (Olness, 2006).
- Further exploration is required to examine the influence of factors such as age and education level on the impact of colour on oral production

Methods

Participants

- Seventy-six **native Cantonese speakers** were recruited in Hong Kong.
- They were randomly allocated into groups of either 'Colour' (n=41) or 'Black-and-white' (n=35) .
- Within each group, they were divided into **three age groups (Young: 18 to 39 years, Middle-aged: 40 to 59 years, and Older: 60 years or above)**, and into **two educational levels** (having secondary school for the Young and Middle-aged groups, and primary school for the Older as cut-offs for 'high' or 'low' respectively).
- **The Montreal Cognitive Assessment (MoCA)** was conducted to detect participants with potential mild cognitive impairment, which may affect their language performance, and three participants were screened out.

Procedure

- **Main Concept Analysis (MCA) for oral discourse production** (Kong, 2009) was used to evaluate the discourse performance of the participants. The analysis primarily aimed to measure the extent of the presence, accuracy, and comprehensiveness of the main target concepts, as well as the efficiency in generating them.
- Two versions, **coloured** and **black-and-white**, of the same four sets of **sequential pictures** were used in the description task. The orthographic transcriptions of the participants were scored based on the six indices of MCA (Table 1). Quality of oral output in terms of the amount of information given between the colour and black-and-white groups was also measured qualitatively.

Table 1: Scoring system of MCA

AC	AI	IN	AB	MC	AC/min
Number of accurate and complete concepts	Number of accurate but incomplete concepts	Number of inaccurate concepts	Number of absent concepts	Main concept score, computed with formula: 3 x AC + 2X AI + 1 x IN	Number of AC concepts per minute

Statistical analyses

- IBM SPSS Statistics package(version 28) was used to perform statistical analyses. The criterion for determining statistical significance was selected to be a *p*-value of .05.
- Normality was confirmed for **AC/min**. Thus, an **Independent sample t-tests** was performed to compare the AC/min between the colour and black-and-white groups.
- Parametric normality assumption was not met for **AC, AI, IN, AB and MC**. Thus, **Mann-Whitney U Test** was performed to compare the 5 MCA indices between the colour and black-and-white groups.
- Within the middle-aged group, **linear regression analyses** were also performed to estimate the relationship between the **MC score** and **the educational level** in the colour and black-and-white group.

Discussion

Findings

- There were **no notable or meaningful variations** observed across **all six MCA indices** between the coloured and black-and-white groups.
  - Additionally, in the colour group, there was no statistically significant relationship between the educational level and the MC score, where there was for the black-and-white group. This suggests that the **colour stimuli** make it **easier** for the unimpaired speakers to **visually process the information** of the picture, reflecting a higher performance in spoken discourse.
- Regarding the quality of oral output, it is apparent that there was an **increase of content** in coloured pictures, with a larger amount of information provided in terms of detail.
  - For instance, the description included **more coloured terms** and the oral output was more specific, likely due to facilitated object recognition., which is supported by evidence found by Heuer (2016).

Limitations

- There was an **imbalance of different age-groups and educational level**. Generalization of findings is thus kept mindful as it may have caused an impact on the results.
- Only the influence of educational level on MC scores within the middle-aged group was investigated; future studies can include the examination of correlation between educational level in different age groups with colour in oral discourse performance.
- Other variables determining the quality and quality of oral output such as **syntactic complexity** and **length of output** were not included in this study; more investigation on such variables are needed to have a comprehensive analysis of the effect on oral discourse production.

Conclusion

- All in all, the **positive effects** of naming colour pictures, as discussed in the previous findings, **still exist** in a sequential picture description task at the discourse level, as reflected by the higher quality of oral output observed. The **colour stimuli** was also shown to be a **contributing factor** in facilitating the processing of information for the lower educational groups in the middle-aged group, enhancing their performance in spoken discourse.
- However, further investigation is needed to examine the **effects of educational level and age** on the impact of colour on oral discourse performance. Additionally, **different measurements of oral output** need to be studied to achieve a comprehensive analysis.

Key references

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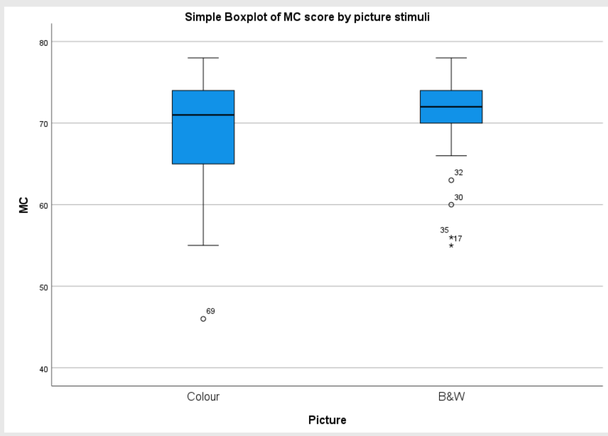
Objectives of this study

(1) to explore the **effect of colour** on oral production at the **discourse level** among neurologically healthy individuals
(2) to investigate **the influence of educational level** on the effect of colour on oral production.
Specifically, the following research questions were formulated:

1. Does the positive effect of naming colour pictures extend to a sequential picture description task at the discourse level?
2. What are the differences in the quality of oral output between coloured and black-and-white sequential picture description tasks?
3. How does the educational level impact the effect of colour on oral production at the discourse level?

Results

Fig. 1 Simple boxplot demonstrating the distributions of the MC score in the coloured and black-and-white group



Independent sample t-tests and Mann-Whitney U test :

- The colour group had significantly higher AB than the black-and-white group, but the effect size is small.
- **No significant differences** between **the remaining 5 MCA indices** of the colour and black-and-white group respectively

Table 2: Result of the Independent sample *t*-tests and Mann-Whitney U Test

MCA index	Black-and-white	Colour	No significant difference	Significant difference	Effect size
AC	M = 20.5, SD = 4.33	M = 20.0, SD = 4.97	Z = -.072, p = .942	_	
AI	M = 4.51, SD = 3.83	M = 4.18, SD = 3.97	Z = -.958, p = .358	_	
IN	M = .69, SD = .963	M = 1.05, SD = 1.25	Z = -1.389, p = .165	_	
AB	M = .34, SD = .802	M = .74, SD = 1.03	_	Z = -.931, p = .352	**Small r = 0.27**
MC	M = 71.0, SD = 5.40	M = 69.1, SD = 7.37	Z = -.931, p = .352	_	
AC/min	M = 9.92, SD = 3.63	M = 8.59, SD = 3.67	t (71) = .1.56, p = .124	_	

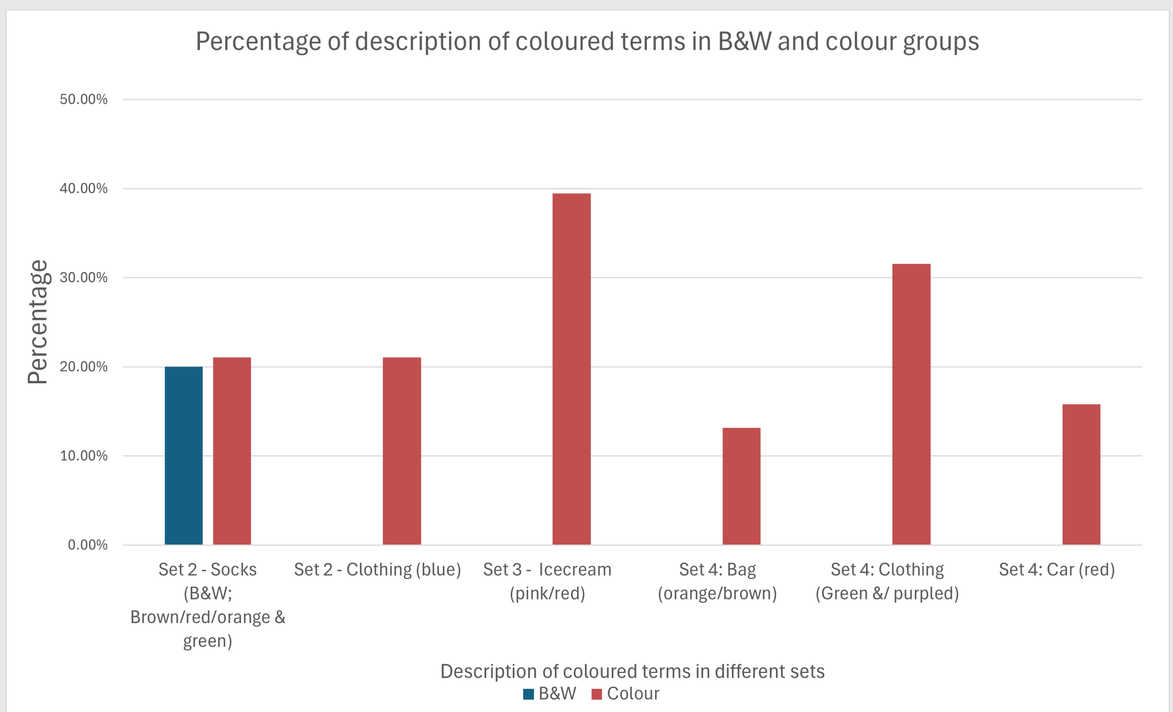
Linear regression analysis:

- In the **colour** group, 7.6% of the variance in MC score can be predicted from the educational level. **Educational level** does not show a statistically significant relationship with the MC score (p = .225), suggesting that the educational level **does not reliability predict** the MC score.
- In the **black-and-white** group, 32.9% of the variance in MC score can be predicted from the educational level. **Educational level** shows a statistically significant relationship with the MC score (p = .016), suggesting that the educational level **reliability predict** the MC score for the black and white group.
  - High educational level group scored above mean of 71.0 at 72.2
  - Low educational level group scored below mean of 70.1 at 67.6.

Qualitative analysis:

Under coloured sequential picture sets,

- **More coloured terms** (e.g. red, blue, green) were provided in oral discourse to describe the main concepts.
- **More details** were provided, such that 28.9% of the participants named the flavour of the ice-cream with reference to the colour of it (e.g. watermelon and strawberry flavour due to the reddish and pinkish colour), while those participants under black-and-white pictures stimuli could only describe the target as 'ice-cream'.
- **Naming of characters and objects** were facilitated. 76.3% of the participants could specifically name and were sure of the object being an 'orange', while only 31.4% could for the black-and-white picture sets. Moreover, 78.9% of the participants in the coloured picture sets could identify the character being a 'grandpa' with the greyish hair on him, while only 20.0% could for the black-and-white picture sets.



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