



ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(4): 1903-1905
© 2023 TPI
www.thepharmajournal.com

Received: 20-01-2023
Accepted: 23-02-2023

Hridishruti Saikia
Department of Family Resource
Management and Consumer
Science, Assam Agricultural
University, Jorhat, Assam, India

Dr. Nandita Bhattacharyya
Department of Family Resource
Management and Consumer
Science, Assam Agricultural
University, Jorhat, Assam, India

Dr. Moonty Baruah
Department of Family Resource
Management and Consumer
Science, Assam Agricultural
University, Jorhat, Assam, India

Influence of colour in short-term memory performance of young children

Hridishruti Saikia, Dr. Nandita Bhattacharyya and Dr. Moonty Baruah

DOI: <https://doi.org/10.22271/tpi.2023.v12.i4w.19824>

Abstract

Perception, attention, memory, and thinking are all interconnected mental processes in human cognition. Children perceive by using their senses to gather and understand information and respond to the world around them by cognitive effort. Colour plays a crucial role in visual perception. Identifying the effective colour that can reduce the cognitive burden will help us design a product that can enhance young children's learning. Many researchers have suggested that colour can influence learning. Based on that, this paper aimed to find the effective colour that can increase the short-term memory performance of young children. Visual digit span test was used to assess children's memory with different colour backgrounds such as red, blue, green, yellow, orange and purple and also in the white background. Performances were assessed for each colour relative to the white baseline. For the study, 238 children of 6-7 years were selected from different schools and were divided into 6 study groups and one control group, each containing 34 children. The results revealed that the study groups showed a significant increase in short-term memory compared to the control group. The findings of the present study will facilitate the designers to consider the use of colour in instructional materials.

Keywords: Colour, digit span test, short-term memory, young children

1. Introduction

Perception, attention, memory and thinking are a few mental processes in human cognition. An essential and core cognitive process is memory, commonly associated with storing and remembering environmental information (Dzulkifli and Mustafar, 2013) ^[1]. The mental process of encoding, maintaining, and retrieving environmental information is referred to as memory (Radvansky, 2006) ^[3]. Short-term memory helps to remember and process pieces of data simultaneously. Short-term memory is essential in learning as it facilitates grasping information presented in a situation. Learning materials and visual aids are used by teachers to improve better comprehension of ideas and to make learning seriously fascinating. And the key elements of these materials are the design elements and the most crucial one is colour.

Colour plays a vital role in the memory performance. It enhances the cognitive processing of information by attracting attention and facilitating learning. The stimuli available to the children need to be strong enough to capture their attention and activate a deeper level of mental processing for the stimuli to be better retrieved. Previous studies have shown that colour has these potential variables (Dzulkifli & Mustafar, 2013; Bo and Renmei, 2019; Jadhao *et al.*, 2020) ^[1, 11, 12]. But colour influences learning attitudes and outcomes when adequately designed (Kumi *et al.*, 2013) ^[13]. Children are more attracted to coloured objects, and considering that variety of colours is used in creating their learning aid to teach a concept. Since colour can influence short-term memory performance, using a rightful colour in the learning aid can improve the outcome of teaching.

1.1 Colour and memory

Working memory processing in the brain includes spatial and visual working memory. The spatial system processes only spatial cues and is modality independent, whereas the visual system is modality dependent and processes only visual cues (Keller & Grimm, 2005) ^[2]. Colour can increase learners' grasping capacity because learners can process colour automatically without requiring a conscious process (Keller & Grimm, 2005) ^[2]. According to Sweller, van Merrinboer, and Paas (1998) ^[15], working memory load "may be affected either by the intrinsic cognitive load (inherent structure of the material) or by the extraneous cognitive load (how the material is delivered)". And colour can manipulate these loads. Colour has been shown to enhance memory performance by improving attention and arousal and can

Corresponding Author:
Dr. Nandita Bhattacharyya
Department of Family Resource
Management and Consumer
Science, Assam Agricultural
University, Jorhat, Assam, India

also affect cognitive task performance (Elliot & Maier, 2014) [4]. Mehta and Zhu's (2009) [16] study indicates that different colours can influence performances on different kinds of cognitive tasks. Denby (2002) [17], in his research, showed that individuals who viewed a black-and-white newspaper ad had a 6% unaided recall rate, whereas those who viewed the same ad in colour had a 21% unaided recall rate. Some researchers have investigated the effect of colour background and neutral colour background in recall and found that colour perception positively influences attention span and short-term memory compared to white (Rahman *et al.*, 2017; Jadhao *et al.*, 2020) [18, 12]. Colours aid learners in focusing their attention on specific information, allowing it to be transferred to short-term and long-term memories, boosting their chances of recalling it (Dzulkifli & Mustafar, 2013) [1]. So, it can be said that colour plays a critical role in grabbing a learner's attention, thus influencing short-term memory. However, properly selecting colours for presenting information is essential in designing instructional materials for children. Excessive use of colour can overstimulate rather than inspire, so it is necessary to ensure a good balance between bold and neutral colours.

2. The present study

The use of colour in instructional material also depends on how information is presented to young children. For example, suppose the instructor wants children to remember a particular part of the information which will be asked later. In that case, the colour, which is considered more influential, can be implemented in that part of the information. Likewise, to make understand some process or sequence, colour can be used to increase the attention span and reduce children's cognitive load. This technique of presenting information is known as colour coding. The appropriate use of colours in a color-coded instructional material can enhance learning. Additionally, such instructional designs can also facilitate learning in slow learners. Therefore, it is necessary to investigate the effective colour that can increase the short-term memory performance of young children. Based on this broad objective, two research questions were formulated:

RQ1: Is there any difference between white and other colours in terms of short-term memory?

RQ2: Which is the most effective colour in improving the retention capacity of young children?

3. Method

3.1 Participants

Participants were purposively selected from different schools in the Jorhat district of Assam. The children 6-7 years old were selected, who did not have colour blind or colour deficient, memory impairments, ADHD, vision problems, reading disorders or another form of learning disability, or epilepsy. For colour blindness Ishihara colour blind test was conducted, teachers and parents of the children were contacted to identify other developmental anomalies, if any. Finally, a total of 238 numbers of children were selected for the study. The participants were randomly divided into 6 study groups for the six colours and one control group for white, each containing 34 children. The nature of the study was explained to the school authority and the parents and written informed consent was obtained before the procedure.

3.2 Materials

Visual Digit span test was used to assess the memory

performance of young children. The digit span was prepared on a laptop in PowerPoint. The standard RGB colour value system was used to determine the colours. The colours selected were: Red: RGB (255,0,0), Blue: RGB (0,0,255), Yellow: RGB (255,255,0), Green: RGB (0,204,0), Orange: RGB (255,140,0) and Purple: RGB (255,0,255). These colours were in the background of the slides, and the digits were in black.

3.3 Procedure

The participants were properly instructed about the test procedures, and trials were given for optimum performance. The test was performed in a quiet and adequately illuminated room. There were six study groups for six colours and one control group for white. All the participants were exposed to colours using the background screen colour. For the visual digit span test, digits from 1 to 9 were grouped in seven series and were shown on a 15-inch laptop screen. In every series, each digit was shown for 2 seconds. The digit span's starting series consists of a minimum of three random numbers, and the last series consists of a maximum nine random numbers. In the first series, three random numbers were shown to the participant of each group and asked to recall it in the same manner (forward recall). If the participants successfully recalled the numbers, the second series consisting of four random numbers were shown to them. Thus, the cycle was repeated until the participants failed to recall any of the series shown to them. The last successful recall of the participants was then given scores. For example, if the children successfully completed the third series of 5 numbers and failed in the 6th series, then the respondent will get 5 score.

4. Results and Discussion

The data were analysed in SPSS software. A Kruskal Wallis test was conducted to determine whether there is an effect of colour on the short-term memory of the children. The results indicate a significant difference, $\chi^2(6) = 65.84, p = .001$, in the short-term memory performance of the children between the Control group (white) and the 6 study groups (Red, Green, Blue, Yellow, Orange, Purple). The mean performance score of each group was presented graphically:

The top of this paragraph illustrates a sub-subheading.

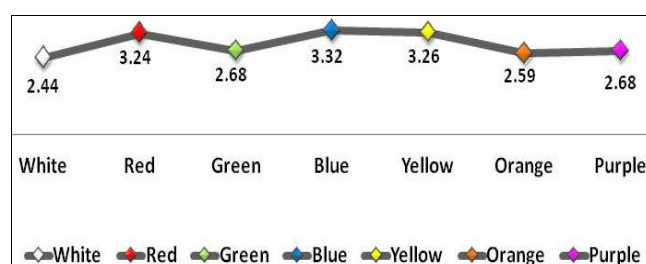


Fig 1: Mean plot of short-term memory performance scores of the children in different colours

The findings can answer the two research questions: RQ1: Is there any difference between white and other colours in terms of short-term memory? Yes, there is a noticeable difference in the short-term memory performance score of the children between the white and the other colours. The scores were better in all six colours compared to white; thus, it can be said that colour increases the retention capacity of young children. RQ2: Which is the most effective colour in improving the retention capacity of young children? The mean scores were

compared of all the groups and found that Blue scored the highest, followed by Yellow and Red (Fig.1). Blue was considered the most effective colour in improving the retention capacity of the young children among the selected six colours.

In recent years, several researchers have acknowledged the crucial role of colour in ergonomics (Elliot, 2015; Siu *et al.*, 2017; Ng, 2018) [5, 7, 6]. Colour can be a key element in ergonomics as it can address the issue of perception and visual cognition. It also can reduce cognitive load by improving the learner's attention and retention capacity. In this study, the colours were used as a background of the stimulus because background colour always exists in a learner's visual learning material, whether they are aware of it or not. When a learner concentrates on studying to-be-remembers items, only an item and its background can be seen (Isarida and Isarida, 2007) [10]. Therefore, background colours of visual materials can positively influence the learner by increasing the retention capacity of the children. It can be suggested from the study that appropriate use of colours should be considered while designing visual learning materials for children to reduce the material's cognitive load.

5. Conclusion

This study's contribution demonstrates that colour significantly influences children's memory performance. In an era of digitalisation in education, our work suggests that effective use of colour may create effective multimedia learning materials and digital visual aids, enhancing learning in children and slow learners. Researchers indicated that colour effects differ greatly depending on their multiple attributes, such as hue, saturation, and lightness. Each colour attribute may have a different impact on perception (Camgöz *et al.*, 2002; Camgöz *et al.*, 2004) [8, 9]. Given the limited literature, there is a clear need to undertake more investigations on colour ergonomics, particularly selecting the rightful colour, to reduce cognitive load and increase learning in young children.

6. References

1. Dzulkipli MA, Mustafar MF. The influence of colour on memory performance: A review. *The Malaysian journal of medical sciences: MJMS*. 2013;20(2):3.
2. Keller T, Grimm M. The impact of dimensionality and color coding of information visualizations on knowledge acquisition. In *Knowledge and Information Visualization*. Springer, Berlin, Heidelberg; c2005, p. 167-182
3. Radvansky Boston G. *Human memory*. Pearson Education Group; c2006.
4. Elliot AJ, Maier MA. Color psychology: Effects of perceiving color on psychological functioning in humans. *Annual Review of Psychology*, 2014;65:95-120. doi:10.1146/annurev-psych.010213-115035.
5. Elliot AJ. Color and psychological functioning: a review of theoretical and empirical work. *Frontiers in psychology* 2015;6:368.
6. Ng AW, Chan AH. Similarities and differences between male and female novice designers on color-concept associations for warnings, action required, and signs and equipment status messages. *Color Research and Application*. 2018;43:89-99.
7. Siu KWM, Lam MS, Wong YL. Children's choice: color associations in children's safety sign design. *Applied Ergonomics*. 2017;59:56-64.
8. Camgöz N, Yener C, Güvenç D. Effects of hue, saturation, and brightness on preference. *Color Research & Application*. 2002;27(3):199-207.
9. Camgöz N, Yener C, Güvenç D. Effects of hue, saturation, and brightness: part 2: attention. *Color Research & Application*. 2004;29(1):20-28.
10. Isarida Takeo, Isarida Toshiko K. Environmental context effects of background color in free recall. *Memory and Cognition*. 2007;35(7):1620-1629.
11. Bo Chang, Renmei Xu. Effect of colors on Cognitions and Emotions in Learning. *Tech., Inst., Cognition and Learning*. 2019;11:287-302
12. Jadhao A, Bagade A, Taware G, Bhonde M. Effect of background color perception on attention span and short-term memory in normal students. *National Journal of Physiology, Pharmacy and Pharmacology*. 2020, 1(11). doi:10.5455/njppp.2020.10.06162202017072020.
13. Kumi R, Conway C, Limayem M, Goyal S. Learning in color: How color and affect influence learning outcomes. *IEEE Transactions on Professional Communication*. 2013;56(1):2-15. doi:10.1109/TPC.2012.2208390
14. Keller T, Grimm M. The impact of dimensionality and color coding of information visualizations on knowledge acquisition. *Knowledge and Information Visualization: Searching for Synergies*. 2005;3426:167-182. doi:10.1007/11510154_9
15. Sweller J, Van Merriënboer JGG, Paas FWC. Cognitive architecture and instructional design. *Educational Psychology Review*. 1998;10:251-296.
16. Mehta R, Zhu R. Blue or red? Exploring the effect of color on cognitive task performances. *Science*, 2009;323(5918):1226-1229. doi:10.1126/science.1169144
17. Denby C. Importance of memory color; c2002.
18. Rahman, Juliet, Damilare, Love, Aanuoluwa. Effect of colour on memory; Does colour background affect the rate of retention?; c2017.