Effects of Colour, Perceived Positive Reinforcement, and Gender on Adolescents' Recall

Mildred C. Ojiaku[*] and Philip C. Mefoh

Department of Psychology, University of Nigeria, Nsukka, Nigeria.

[*]Corresponding Author

DOI: https://dx.doi.org/10.47772/IJRISS.2025.909000129

Received: 26 August 2025; Revised: 03 September 2025; Accepted: 05 September 2025; Published: 01 October 2025

ABSTRACT

Despite extensive research on memory recall, comprehensive investigations that explore the combined effects of colour, perceived positive reinforcement, and gender on adolescents' recall are scarce. This study examined the interplay between colour, perceived positive reinforcement, and gender in enhancing adolescents' memory recall. One hundred ninety-two non-colour-blinded adolescents (10-14 years) were randomly selected via a stratified sampling technique and participated in this study. The stimulus materials utilized are the first and second prose passages, the First Prose Assessment Test, and the Second Prose Assessment Test. Other materials include yellow, blue, and simple white coloured A4 papers; a simple mathematics task; two stopwatches; pens; and packets of sweets and biscuits. Three-way analysis of variance (ANOVA) was employed to test the hypotheses, yielding compelling results. In contrast to expectations, colour had no significant effect on recall ($F(2, 180) = .154$, $p = .05$). However, the study revealed noteworthy main effects, indicating that perceived positive reinforcement ($F(1, 180) = 20.220$, $p < .001$) and gender ($F(1, 180) = 12.350$, $p < .001$) significantly impact adolescents' recall. Furthermore, an intriguing interaction effect emerged ($F(1, 180) = 3.296$, $p < .05$) among colour, perceived positive reinforcement, and gender on adolescents' recall. The study recommends that by tailoring strategies to leverage positive reinforcement and considering gender-specific learning tendencies, practitioners can create more effective and inclusive learning environments for adolescents. The intricate interaction effects highlighted in this study underscore the importance of adopting comprehensive and nuanced approaches in educational interventions.

Keywords: Recall, Colour, Perceived positive reinforcement, Gender, Adolescents.

INTRODUCTIONS

Recall is one of the primary mental processes of human memory and involves the retrieval of past information (Naim et al., 2020). It entails recalling facts, events, or objects that are absent at the time and involves the direct retrieval of information from memory, such as by recalling the name of a person, place, or thing. Recall is often a difficult task even when the information being recalled is encoded in the memory. It typically appears to be challenging because it requires more strategic and extensive reinstatement of the learning material or information (Caruso et al., 2020). In the recall or retrieval process, total commitment, a more in-depth process, and the individual's effort are highly needed. Additionally, Onyishi et al. (2019) noted that recall entails information that has been previously learned and stored in memory, thereby becoming conscious. People's ability to recall information, prior experiences, and autobiographical memories is essential to cognition and endows people with a sense of self (McCormick et al., 2020).

The academic performance of secondary school students (adolescents) in Nigeria appears to be below average, despite teachers' efforts to teach them, as the students can recall some of what they have been taught but forget others easily. This troubling situation could induce pressure for good grades and academic success among

students, thus propelling them to engage in academic dishonesty (Susanti et al., 2019). Many factors have been proven to affect human recall, such as interim testing of studied information (Yang et al., 2018; Ragland et al., 2020) and the time interval (Tlhabano et al., 2013). Additionally, other measures have been implemented to enhance adolescents' memory recall, including the enactment effect (Badinlou et al., 2017), nonmusical and silent environments (Musliu et al., 2017), and sleep (Rasch & Born, 2013). However, adolescents still struggle to recall previously learned information. Despite extensive research on memory recall, comprehensive investigations that explore the combined impact of colour, perceived positive reinforcement, and gender on the memory abilities of adolescents are scarce. Since improving and retaining human memory has been a challenge that scientists have faced for many years (Patel, 2020), the present study investigated the effects of colour, perceived positive reinforcement, and gender on adolescents' recall.

Empirical Review

Colour and Recall

Colour refers to the visual perception of the quality of an object based on the light reflected by that object. Colour serves as a powerful information channel for the human cognitive system and may play a significant role in improving the recall of information in learning and educational settings, marketing, communication, or even sports; delivering a certain message; and decorating for art purposes (Olurinola & Tayo, 2015; Dzulkifli & Mustafar, 2013). Colour can increase the likelihood of environmental stimuli being encoded, stored, and retrieved from the brain (Olurinola & Tayo, 2015). Studies have suggested that colours can improve a person's ability to remember word definitions or word lists (Stitt & Pula, 2013) and positively affect people's memory and the clinical population (dementia and autistic individuals) (Krahn, 2018). Colours have been proven to be effective in reducing the reading challenges of patients with dyslexia (Wilkins, 2003). In 2016, some researchers explored the impact of colours on students' immediate and delayed retention of vocabulary and suggested that colours have a more significant effect on students' recall (Rogahang et al., 2016). Similarly, Singg and Mull (2017) studied the effect of colour on students' recall of information from 117 young college students at American Southwestern University. They revealed that the colour of the learning materials can impact the recall rate. More recently, a study conducted by Khan and Liu (2020) in China demonstrated that colour affects human working memory. This study supported the argument that colour as an environmental stimulus may strongly influence human memory.

However, other studies have argued that colours affect the retrieval of information (Patel, 2020; Fear, 2016). Haynes (2017) investigated the effects of text colour on attention and short-term recall memory using 117 college students at Harding University in Searcy, Arkansas. The results revealed that the colour of the text has no significant effect on the recall of short-term memory. More recently, a study further demonstrated that colour has no significant effect on improving memory recall (Johnson, 2023). Researchers have investigated colour over the years as a factor that can improve the recall of information among university students. However, there is still a paucity of literature on whether colours can improve the memory of secondary school students, and to the best of the researcher's knowledge, there is a dearth of literature on the impact of coloured papers on the memory recall of adolescents, as we observed that adolescents appear to remember materials when the information is written in coloured papers (blue and yellow) rather than when it is written in simple white paper (control group).

Perceived Positive Reinforcement and Recall

Positive reinforcement has been conceptualized as a factor that shapes and directs learning, recall, problem-solving, and behaviour in general (Onyishi et al., 2019). Positive reinforcement is the type of reinforcement in which the frequency of a response is likely to increase when it is followed by a rewarding stimulus. It entails adding a positive stimulus when a desirable response is elicited, which increases the probability that the response will be repeated in the future. Positive reinforcement simply involves strengthening a desired behaviour through reward. For example, suppose that a teacher praises a student each time she completes homework. In that case, the student will be more likely to repeat this behaviour in the future, thus strengthening

the behaviour of completing homework. Positive reinforcement can be further classified into primary and secondary reinforcers, which focus on a distinction between inborn, unlearned, and learned aspects of behaviour. Primary reinforcement involves the use of reinforcers that are innately satisfying; that is, they do not require any learning on the organism's part to make them pleasurable (for example, food, water, and sexual satisfaction). In contrast, secondary reinforcement obtains its positive value via experience. Secondary reinforcers are learned. It includes praise, gifts, eye contact, etc.

The perception of a reward (positive reinforcer) can enhance children's ability to remember certain information more quickly and more clearly. Information associated with a higher reward value captures more attention and can be more easily recalled than information with little or no rewarding experience (Anderson, 2013). Stanek et al. (2019) demonstrated that anticipating rewards may facilitate memory formation. Over the years, several studies have agreed that rewards have a more significant influence on improving memory (Manga et al., 2020; Ern et al., 2019; Mefoh et al., 2016), as individuals appear to retrieve stimuli linked with rewarding experiences more effectively than those related to little or no rewarding experience. However, van den Berg et al. (2023) reported no association between reward and memory.

Gender and Recall

Gender appears to be a sensitive issue in the field of experimental and cognitive psychology. Most controversies in psychology cannot be fully understood without including gender. For years, there has been much debate on whether there are gender variations in memory recall. Motivated by this controversy, Levy (1972, 1978) proposed that sex differences in cognitive ability arise from sex differences in hemispheric asymmetry; thus, males have a more asymmetric brain organization in which the left hemisphere is responsible for verbal processing and the right hemisphere is responsible for spatial processing. In females, the brain could be more "bilateral", that is, both the left and the right hemispheres are responsible for verbal processing. As a result, the more asymmetric the male brain is, the greater the degree of spatial skills, and the more bilateral the female brain is, the greater the degree of verbal ability (Hirnstein et al., 2019). In support of these findings, Geschwind (1979) emphasized that left hemisphere dominance for verbal functions is attained earlier in females, which in turn does not permit spatial processing to be bilateral in females, as it is in males. The left dominance of females thus explains why females likely perform better on various language-related tasks, such as the recall of words. Similarly, some researchers have reported that gender differences could exist in the recall of memory, as females appear to recall more words than males do (Graves et al., 2017; Mefoh et al., 2016; Gunn, 2014).

Additionally, Torres et al. (2006) reviewed scientific evidence on gender differences in cognitive functions and revealed that women score higher than men do in terms of verbal fluency, verbal memory, and verbal learning. This female's superiority in verbal ability may be associated with their proportionally large Broca and Wernicke areas of the brain that are responsible for speech production and comprehension. However, studies (Schroeder, 2005; Mefoh, 2005, 2010; Tlhabano et al., 2013; Mooney, 2016; Young et al., 2017; Onyishi et al., 2019; Martinez, 2020) have revealed no gender difference in memory recall. This study also examined whether there are gender differences in adolescents' recall of words. On the basis of the relevant literature reviewed, it is hypothesized that participants in coloured-paper conditions will recall more information/words than participants in simple white-paper conditions; participants in the perceived positive reinforcement condition will recall more information/words than participants in the nonperceived positive reinforcement condition; and there will be significant gender differences in adolescents' recall.

METHOD

Sample

The sample consisted of one hundred and ninety-two (192) (96 males and 96 females) blind junior secondary school students randomly drawn from Ajouna Secondary School, Obukpa, and Model Secondary School, both in Nsukka L.G.A., Enugu state, Nigeria. The age range of the participants was between 10 and 14 years. A

stratified random sampling method was adopted in the selection of participants from the population of five hundred eighteen (518) students because the researcher needed equal representation from both genders. Male (208) and female (310) students were divided into different strata, and from each stratum, 96 participants were selected through a simple random sampling technique. This simple sampling technique involves randomly selecting the participants from the population of interest. With this type of sampling, everyone is given an equal chance of being selected.

Instruments

The instruments used for this study include the following:

The first prose passage and first prose assessment test: The first prose passage was extracted from the 40th page of The Arrow of God (Achebe, 1964), and it was used in this study. The first prose assessment test was developed from the first prose passage, and it was utilized as a pretest. It consists of six items and was administered to the participants to test for verbal intelligence, in which the scores were employed to match the participants into different groups. The first prose passage and first prose assessment test were both printed on simple white A4 paper.

The second prose passage and second prose assessment test: The second prose passage was self-developed, and it was printed on A4 coloured papers, such as yellow (64 copies), blue (64 copies), and simple white papers (64 copies). The second prose assessment test, used as a posttest, was generated from the second prose passage by the first author. It was printed on simple white paper.

The stimulus instruments were chosen by asking four literature-in-English language teachers from the above-mentioned secondary school and six Master of Arts students who specialize in the oral literature-in-English language at the University of Nigeria, Nsukka (UNN), to rate the 4 prose passages based on "which is most interesting". The first and second prose passages were the most preferred among the prose passages. The first and second prose assessment tests were further subjected to validity and reliability tests. The face and content validity of the tests were verified by requesting the teachers and Master of Arts students to determine the appropriateness of the items to measure participants' memory after 4-minute retention intervals. Furthermore, they were requested to assess the tests separately and to express their feelings in percentages. The judges' rankings for the pretest items ranged from 85% to 90%, and those for the posttest ranged from 85% to 98%, yielding means of 86% and 90%, respectively. These findings suggest that the assessment tests could measure the retention capacity of adolescents in junior secondary school.

Additionally, a simple mathematics task involving two stopwatches, pens, and packets of sweets and biscuits was used for the study. The simple mathematics task served as a distractor task, the stopwatches were utilized for timing the participants, and the sweets and biscuits were distributed to the participants as an appreciation.

Pilot Study

A pilot study was conducted using 50 volunteer JSS 1 students from City Comprehensive Secondary School, Nsukka. The ages of the students ranged from 10-14 years, with a mean age of 12.8 years. The students were given the first and second prose passages to study for 4 minutes. They were then given three simple calculations, which they solved within two minutes before being presented with the different tests. If a participant answered an item correctly, he/she received a score of 1, but if he/she answered incorrectly, he/she received a score of 0. The sum of all the items answered correctly represents the participants' test scores on either the first assessment test or the second assessment test. The analyses of the pilot study yielded a Cronbach's alpha for the first prose assessment test = .88 and the second prose assessment test = .77. These results indicated that the test results were relatively high and thus reliable.

A pilot study was also conducted using sixty (60) different students (without colour blindness) from the same school between the ages of 10–14 years to select the colours for the study. The participants were randomly

assigned to four groups, with the second prose passage printed on four coloured-papers (yellow, green, blue, and red) recommended by the above judges. The participants in different coloured-paper groups studied the second prose for 4 minutes, after which the materials were taken from them, and they were further given 3 simple calculations, which they solved for two minutes before they were given the second prose assessment test to recall what they had studied. Yellow and blue coloured-papers yielded the best recall (average word recall: yellow=5.33, green=3.40, blue=5.27, and red=3.73). Thus, yellow and blue were preselected for the experiment.

Procedure

A letter of introduction was issued by the Head, Department of Psychology, Faculty of the Social Social Sciences, University of Nigeria, Nsukka, and given to each of the principals of the above schools. The purpose of the study was explained in each of the letters. The principals, in turn, introduced the first author to the Vice-Principals of Academics, who requested assisting the researchers in realizing the research objective. Afterward, an appointment was given to the researchers for the study to take place. Before the beginning of the first study session, the first author and four research assistants selected 192 students (96 males and 96 females) from the population via a stratified random sampling method. To ensure that the participants were not colour-blind, every participant was presented with a range of coloured samples and asked to identify and name the colours that matched the selected test samples. This task was performed via inspection.

The first variable, colour, was manipulated into three conditions: yellow, blue, and simple white coloured-paper conditions. To control for intelligence, the participants were further subjected to a pretest before they were matched into different levels of colour. They were presented with the first prose passage, which they were instructed to study for four minutes, after which it was collected. The first prose assessment test, which lasted for three minutes before it was retrieved, was given to the students. The result of the first assessment prose test was utilized to match the participants into the three colour conditions. Thus, the participants occupying the first, second, and third ranks (on the basis of the results of the pretest) were randomly assigned to the conditions. This process was repeated for the pair occupying the fourth, fifth, and sixth ranks. Sixty-four participants (32 males and 32 females) were randomly assigned to each of the conditions—yellow, blue, and simple white-coloured paper conditions. To manipulate the second independent variable, perceived positive reinforcement, ninety-six (96) participants (48 males and 48 females) each were randomly selected from the three existing conditions (yellow, blue, and simple white coloured-paper conditions) and assigned to the perceived reinforcement condition (group A) and the nonperceived reinforcement condition (group B). This assignment was performed through a stratified random sampling technique. When the two groups (A & B) were seated in different classrooms, group A was informed that “gift items would be given to those who performed well and that nothing would be said to group B.

The second prose passage printed in yellow, blue, and simple white-coloured papers was then administered to the groups individually. Those in the yellow-coloured paper condition received the second prose passage printed in yellow, the same as those in the other conditions. The participants in the yellow and blue-coloured paper conditions were in the experimental group, whereas those in the simple white-coloured paper condition were in the control group. The participants were then instructed to “read the passage carefully for four minutes”. When the four minutes elapsed, the prose passages were collected from all, and a simple mathematical task printed on simple white paper was administered to the participants, which lasted for three minutes before it was retrieved from the participants. The second prose assessment test (posttest) was then given to the participants, and after 3 minutes, the first author, with the aid of the research assistants, collected the sheets of paper. Finally, the first author debriefed the participants, and then, sweets and biscuits were offered to the participants as a form of appreciation.

Design/Statistics

This study employed a 3x2x2 factorial design. This design was utilized not only to investigate the main effects of the three individual independent variables simultaneously but also to detect interactions among variables.

Three-way analysis of variance (ANOVA) was utilized in the data analysis to determine if there was an interaction effect between the three factors on the continuous variable.

Table 1. Schematic Illustration of the Design

Perceived Positive reinforcement(B)					
Non-Perceived Positive Reinforcement (b_1)			Perceived Positive reinforcement (b_2)		
	Gender				
Colour (A)	Male (c_1)	Female(c_1)	Male (c_2)	Female (c_2)	Total
Yellow coloured-Paper (a_1)	16	16	16	16	64
Blue coloured-paper (A2)	16	16	16	16	64
Simple white coloured-paper(a_3)	16	16	16	16	64
Total	48	48	48	48	192

RESULTS

Table 2. Table of Means (M) and Standard Deviation (SD) for Colour, Perceived Positive Reinforcement, and Gender on Adolescents' recall.

Independent variables	**Levels**	**M**	**SD**	**N**
Colour	Yellow coloured-paper	3.98	2.10	64
	Blue coloured-paper	4.17	2.08	64
	Simple white coloured-paper	4.08	2.08	64
Perceived Positive Reinforcement	NPPR	3.46	2.27	96
	PPR	4.70	1.60	96
Gender	Male	3.59	2.13	96
	Female	4.56	1.86	96

Table 2 shows that participants in the yellow coloured-paper condition, blue coloured-paper condition, and simple white coloured-paper condition had similar mean recall scores. The participants in the perceived positive reinforcement condition had a higher mean score on recall than the participants in the nonperceived positive reinforcement condition. Additionally, female participants had higher mean scores on recall than the male participants.

Table 3. ANOVA Summary Table for Colour, Perceived Positive Reinforcement, and Gender on Adolescents' Recall.

Source	**Sum of squares**	**Df**	**Mean square**	**F**	**Effect size**
Colour	1.13	2	.56	.15	.00
Perceived positive reinforcement	73.76	1	73.76	20.22**	.10
Gender	45.05	1	45.05	12.35**	.06
Perceived positive reinforcement X Gender	1.51	1	1.51	.41	.00
Perceived positive reinforcement X Colour	.67	2	.33	.09	.01
Gender X Colour	3.13	2	1.56	.43	.00
Colour X Gender X Perceived positive reinforcement	24.04	2	12.02	3.30*	.04
Error	656.56	180	3.30		
Total	805.83	191			
Note: ** p <.001, *p<.05					

ISSN No. 2454-6186 | DOI: 10.47772/IJRISS | Volume IX Issue IX September 2025

Table 3 shows that colour did not significantly affect recall: F (2, 180) = .15, p=.05. These results fail to support the first hypothesis. Thus, H1 was not confirmed in this study. The results also revealed that the participants in the perceived positive reinforcement condition recalled more information/words than the participants in the nonperceived positive reinforcement condition: F (1, 180) = 20.22, p<.001. This result supported the second hypothesis. Thus, H2 was confirmed. Additionally, the results also indicated that the gender difference was statistically significant: F (1, 180) = 12.35, p<.001. This result supported the third hypothesis. Finally, the last table further indicates that there was an interaction effect of colour, gender, and perceived positive reinforcement on adolescents' recall: F (1, 180) = 3.30, p<.05.

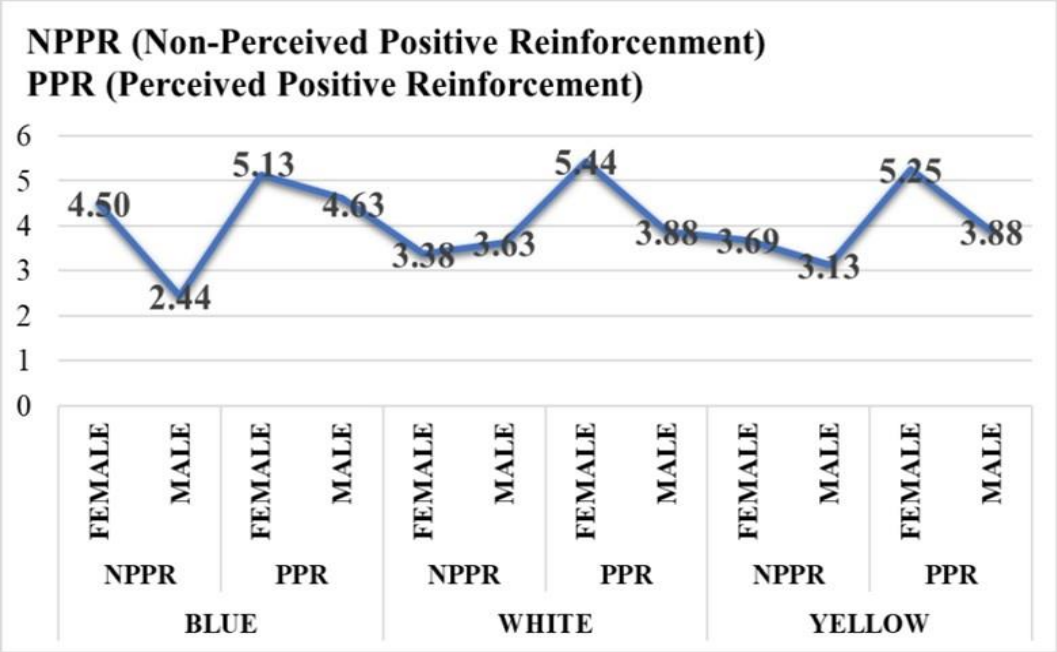

Figure 2: Graphical illustration of the interaction effects of colour, perceived positive reinforcement, and gender on recall.

The following observations can be drawn from the above graph: In the blue colour condition, under nonperceived positive reinforcement, the female participants recalled more information (4.50) than their male counterparts (2.44); under the perceived positive reinforcement group, the female participants recalled more information (5.13) than their male counterparts (4.63). In the white colour condition, under the nonperceived positive reinforcement group, there was a contrast, as male participants recalled more information (3.63) than their counterparts (3.38). However, in the perceived positive reinforcement group, the recall of female participants was greater (5.44) than that of male participants (3.88). In the yellow colour condition under the nonperceived positive reinforcement group, the female participants recalled more information/words (3.69) than the male participants (3.13); under the perceived positive reinforcement group, the female participants still recalled more information/words (5.25) than their counterparts (3.88).

DISCUSSION

The empirical study investigated the effects of colour, perceived positive reinforcement, and gender on adolescents' recall. The result obtained from results of the present study revealed that colour has no statistically significant effect on adolescents' recall. Considering this result, H1 was not confirmed. This present study is inconsistent with most of the previous studies reviewed in the literature. However, it collaborates with and lends support to the studies of Richman (2005), Fear (2016), Haynes (2017), and Patel (2020), which indicated that colour has no significant effect on recall. One possibility could be that the simple white-paper colour on which the second prose assessment test was printed served as a cue, thus giving the participants in the control group (simple white coloured-paper) an advantage over others (the yellow and blue coloured-paper group). This finding could also be attributed to individual differences in colour perception, as it is possible that the participants in blue- and yellow-coloured paper conditions were overwhelmed by the materials.

The results of this study supported H2, as participants in the perceived positive reinforcement condition recalled more information/words than did participants in the nonperceived positive reinforcement condition. This result is consistent with previous studies (including Manga et al., 2020; Ern et al., 2019; Onyishi et al., 2019; Stanek et al., Mefoh et al., 2016), which reported that perceived positive reinforcement could highly improve recall. Sattar et al. (2019) reported that perceived positive reinforcement has a significant effect on the recall rate, as the temptation of rewarding of marks reinforcement has a significant influence on short-term memory. Positive reinforcement can elicit positive emotions, such as excitement, happiness, or satisfaction, which are known to enhance cognitive processes, including memory (Yin, 2019). Dahl et al. (2015) additionally argued that these emotions can increase an individual's attention span, improve cognitive flexibility, and update and increase the cognitive maps of people. When students experience positive emotions, their cognitive processing tends to be more efficient, leading to better encoding and recall of information. Additionally, the study of Nielson and Bryant (2005) revealed that reward anticipation has a significant effect on recall. However, the findings of the present study are inconsistent with those of van den Berg et al. (2023), who reported that potential monetary rewards do not affect visual working memory. There is a possibility that the potential monetary reward is simply not an effective reinforcement to enhance memory recall. Perceived positive reinforcement can enhance children's and adolescents' motivation to engage in a task and put forth more effort. The perception of positive reinforcement by students can facilitate encouragement and motivation to perform well, resulting in improved recall. It can direct participants' attention more effectively towards the task at hand. When individuals expect positive feedback or reinforcement, they may become more attentive and focused on the information being presented, which can facilitate encoding and subsequent recall. Similarly, the perception of a reward can increase adolescents' confidence in their ability to complete a task and reduce their anxiety about it.

Furthermore, the results provided support for H3, as female participants performed better than male participants in the recall task. This result contradicts some age-long, popular postulations that gender has no significant effect on recall (see Simotas, 1996; Schroeder, 2005; Bridge, 2006; Mefoh, 2005,2010; Tlhabano et al.,2013; Mooney,2016; Young et al.,2017; Onyishi et al., 2019; Martinez, 2020). Mefoh (2005) asserts that the magnitude of gender differences in cognitive ability is gradually becoming a fine line, sometimes even non-existent, as females have been encouraged to engage in activities formerly reserved for males and vice versa, which has led to a narrowing of the gender gap. Onyishi et al. (2019) reported that females do not differ significantly from their male counterparts, nor do males differ significantly from females in terms of recall. Martinez's (2020) study suggested that, in reality, there are no gender variations in memory recall among students.

Regardless, this result is consistent with other previous studies (such as Graves et al., 2017; Mefoh et al., 2016; Gunn, 2014; Dewhurst et al., 2012; Baer et al., 2006; May & Hutt, 1974), which indicated that gender has a significant effect on recall, as females recalled more information/words than their counterparts (males). Additionally, Geschwind (1979) reported that left hemisphere dominance for verbal functions is attained earlier in females, which could explain why female adolescents performed better in terms of the recall of words/information

CONCLUSION

Implications of the Study

The findings of this research have many practical implications. Despite the unexpected result regarding the impact of colour on recall, the significant effects observed in perceived positive reinforcement and gender bring forth actionable considerations:

The finding that colour has no significant effect on adolescents' recall suggests that educators and instructional designers may not need to prioritize specific colour schemes when designing learning materials. This can simplify the process of creating educational resources, potentially reducing the costs associated with colour preferences. Another educational implication of this study is the large body of evidence (Manga et al., 2020;

Sattar et al., 2019; Onyishi et al., 2019; Stanek et al., 2018; Mefoh et al.,2016). The perception of reward plays a pivotal role in enhancing adolescents' ability to recall information across diverse learning materials. When a student expects to be rewarded for recalling information, this curiosity could facilitate his/her recall. Educators can implement targeted positive reinforcement techniques, such as praise and rewards, to enhance students' engagement and memory retention.

The observed gender differences in recall imply that educational strategies should be tailored to account for diverse learning preferences. For example, educators may consider implementing various instructional methods that accommodate both male and female students, acknowledging and capitalizing on their distinct strengths in information recall. Another area of practical application of this study is legal testimony; female adolescents who witness a crime scene may be able to accurately recall verbal information, which may be employed in investigating a suspect's underlying motives or intentions.

The interaction effect of colour, perceived positive reinforcement, and gender on recall suggests that a holistic approach is essential in designing intervention programs. Integrated strategies that consider the combined influence of these factors may be more effective in enhancing memory recall among adolescents.

In conclusion, this research provides actionable insights that can be applied across educational and professional domains. By tailoring strategies to leverage positive reinforcement and considering gender-specific learning tendencies, practitioners can create more effective and inclusive learning environments for adolescents. The intricate interaction effects highlighted in this study underscore the importance of adopting comprehensive and nuanced approaches in educational interventions.

Limitations of the study and suggestions for future research

This study has several limitations. First, most of the empirical studies reviewed in this study are based on Western cultures. These results prove that there is a problem in terms of the comparison of the results. Second, the sample size was relatively small. With only 16 participants (8 males and 8 females) in each of the 12 cells, it may not be easy to obtain significant results for the factors tested. For generalization, future studies on colour, perceived positive reinforcement, and gender in recall must, as a matter of necessity, increase the number of participants for the study. The simple white-paper colour on which the second prose assessment test was printed may have affected the outcome of the study. Researchers interested in this study should utilize the same coloured paper throughout their experiments. Additionally, future research should consider a psychological laboratory for experimental research instead of the classroom to avoid extraneous variables. It could also be interesting to explore the moderating and mediating roles of self-efficacy and emotions in the relationships among colour, perceived positive reinforcement, gender, and adolescents' recall.

REFERENCES

1. Achebe (1964). Arrow of God. London: Heinemann Educational Book Ltd.
2. Anderson B. A. (2013). A value-driven mechanism of attentional selection. Journal of vision, 13(3), 7. https://doi.org/10.1167/13.3.7
3. Badinlou, F., Kormi-Nouri, R., Mousavi Nasab, S. M., & Knopf, M. (2017). Developmental differences in episodic memory across school ages: evidence from enacted events performed by self and others. Memory (Hove, England), 25(1), 84–94. https://doi.org/10.1080/09658211.2015.1126607
4. Bower, G.H. (2000). A Brief History of Memory Research. The Oxford Handbook of Memory.
5. Bridge, D. J. (2006). Memory & Cognition: What difference does gender make? (Publication No. 655) [Undergraduate's thesis, Syracuse University]. Surface. https://surface.syr.edu/honors_capstone/655
6. Caruso, G., Perri, R., Lucia, F., Caltagirone, C., & Carlesimo, G.A. (2020). Recall and recognition in Alzheimer's disease and frontotemporal Dementia. Journal of Alzheimer's disease, 77(2), 655-666. https://doi.org/10.3233/JAD-200126.
7. Dahl, C. J., Lutz, A., & Davidson, R. J. (2015). Reconstructing and deconstructing the self: cognitive mechanisms in meditation practice. Trends in cognitive sciences, 19(9), 515–523. https://doi.org/10.1016/j.tics.2015.07.001

8. Dzulkifli, M. A., & Mustafar, M. F. (2013). The influence of colour on memory performance: a review. The Malaysian journal of medical sciences: MJMS, 20(2), 3–9.
9. Ern, L.Y., Ziyamdeen, F.S.M., Zeidi, S. bt M., Tamilselvan, N. a/p., & a/l Mohan, V. W. (2019). The effect of positive and negative reinforcement on stress, anxiety, confidence, mood and short-term memory among medical students. Journal of Social Sciences and Humanities, 5(3), 108-116. http://www.aiscience.org/journal/jssh
10. Fear, A. (2016). The effects of colour preference on word list recall (Publication No. 92) [Undergraduate's thesis, Western Oregon University]. Digital Commons. https://digitalcommons.wou.edu/honors_theses/92.
11. Geschwind, N. (1979). Asymmetries of the brain—new developments. Bulletin of the Orton Society, 29**,** 65–73.
12. Gunn, L. M. (2014). Gender differences associated with memory recall (Publication No. 578) [Undergraduate's thesis, University of Mississippi]. eGrove. https://egrove.olemiss.edu/hon_thesis/578
13. Haynes, E. (2017). The effect of text colour and text grouping on attention and short-term recall memory (Publication No. 4) [Undergraduate's thesis, Harding University]. Scholarworks. https://scholarworks.harding.edu/honors-research/4.
14. Johnson, H. R. (2023). Effect of color on licencelicense plate recall (Publication No. 3819) [Master's thesis, Missouri State University]. Bearworks. https://bearworks.missouristate.edu/theses/3819
15. Khan, J., & Liu, C. (2020). The impact of colours on human memory in learning English collocations: evidence from south Asian tertiary English as a second language (ESL) students. Asian-pacific journal of Second and Foreign Language Education, 5(7). https://doi.org/10.1186/s40862-020-00098-8
16. Krahn, E. (2018). Decomposing the effect of colour on memory: How red and blue affect memory differently (Publication No.1733) [Undergraduate's thesis, University of Colorado Boulder].CUScholar.https://scholar.colorado.edu/concern/undergraduate_honors_theses/rb68xc20k
17. Levy, J. (1972). Lateral specialization of the human brain: Behavioral manifestations and possible evolutionary basis. In J. A. J. Kiger (Ed.), The biology of behavior (pp. 159– 180). Corvallis, OR: Oregon State University Press.
18. Levy, J. (1978). Lateral differences in the human brain in cognition and behavioral control. In P. Buser, & A. Rougeul-Buser (Eds.), Cerebral correlates of conscious experience (pp. 285–298). New York, NY: North Holland Publishing Co.
19. Manga, A., Vakli, P., & Vidnyánszky, Z. (2020). The influence of anticipated monetary incentives on visual working memory performance in healthy younger and older adults. Scientific Reports, 10(8817). https://doi.org/10.1038/s41598-020-65723-5
20. Martinez, F.B. (2020). Gender differences in memory recall among college students [Undergraduate's thesis, California State University Stanislaus]. CSUStan. https://www.csustan.edu/sites/default/files/groups/University%20Honors%20Program/Journals_two/fernandob.pdf
21. McCormick, C., Barry, D. N., Jafarian, A., Barnes, G.R. & Maguir, E.A. (2020). Vm PFC drives hippocampal processing during autobiographical memory recall regardless of remoteness. Cerebral Cortex, 30 (11), 5972–5987. https://doi.org/10.1093/cercor/bhaa172
22. Mefoh, P.C. (2005). The effects of level of processing, context and gender on recall and recognition [Master's thesis, University of Nigeria, Nsukka]. Researchgate. https://www.researchgate.net/publication/317039381_Effects_of_levels_of_processing_Context_and_Gender_on_Recall_and_Recognition
23. Mefoh, P.C. (2010). The effects of level of imagery, interference, and gender on explicit and implicit memory [Doctoral thesis, University of Nigeria, Nsukka]. Researchgate. https://www.researchgate.net/publication/317039529_Effects_of_Imagery_Interference_and_Gender_on_Explicit_and_Implicit_memory
24. Mefoh, P.C., Unegbu, S. O., & Awo, L. O. (2016). Effects of perceived reward and practice on adolescents' arithmetic problem solving. Social Science Research, 3, 1-20.
25. Mooney, P. (2016). Adaptive memory: Measuring the effect of encoding strategies on word recall [Undergraduate's thesis, Dublin Business School]. eSource. https://esource.dbs.ie/handle/10788/3174

26. Musliu, A., Berisha, B., Musaj, A., Latifi, D., & Peci, D. (2017). The Impact of Music in Memory. European Journal of Social Sciences Education and Research, 4 (4), 222-227. https://doi.org/10.26417/ejser.v10i2.p222-227
27. Naim, M., Katkov, M., Romani, S., & Tsodyks, M. (2020). Fundamental Law of Memory Recall. Physical Review Letters, 124(1). https://doi.org/10.1103/physrevlett.124.018101
28. National Bureau of Statistics. (September, 2019). WAEC Results Statistics (2016-2018).
29. Nielson, K. A., & Bryant, T. (2005). The effects of non-contingent extrinsic and intrinsic rewards on memory consolidation. Neurobiology of learning and memory, 84(1), 42–48. https://doi.org/10.1016/j.nlm.2005.03.004
30. Olurinola, O., & Tayo, O. (2015). Colour in Learning: It's effect on the retention rate of graduate students. Journal of Education and Practice, 6(14).
31. Onyishi, A. P., Mefoh, P., & Onyishi, A.C. (2019). Effects of Perceived Reinforcement, Gender and Locality on Children's Recall Ability. Researchgate https://www.researchgate.net/publication/334195037_Effects_of_Perceived_Reinforcement_Gender_and_Locality_on_Children's_Recall_Ability
32. Patel, S. (2020). The effect of colour, preference, and the interaction of colour and action of color and preference on short-term memory (Publication No.549) [Undergraduate's thesis, Butler University]. Digitalcommons. https://digitalcommons.butler.edu/ugtheses/549
33. Ragland, J.D., Liu, X., Williams, A., Carter, C., Niendam, T., Tully, L., & Ranganath, C. (2020). Use of testing to improve long-term memory recall in people with psychosis. Schizophrenia Bulletin, 46 (Suppl 1), S164. https://doi.org/10.1093/schbul/sbaa030.389
34. Rasch, B., & Born, J. (2013). About sleep's role in memory. Physiological reviews, 93(2), 681–766. https://doi.org/10.1152/physrev.00032.2012
35. Sattar, S., Hussain, R.Y., Shsujja, S., & Riaz, M.N. (2019,). Effect of perceived positive reinforcement on the short-term memory of the children. American Journal of Research,5-6. http://dx.doi.org/10.26739/2573-5616-2019-6-9
36. Schroeder, R. W. (2005). Colour's influence on short-term memory in each gender. The Journal of Undergraduate Research, 3(3).
37. Simotas, S. (1996). Effects of age and gender on perceptual and conceptual implicit memory. (Publication No. 4948) [Master's thesis, University of Montana]. Scholarworks. https://scholarworks.umt.edu/etd/4948
38. Singg, S., & Mull, C.W. (2017). Effect of colour on information retention by young men and women. Juniper Online Journal of Case Studies, 2 (4), 1-4. https://doi.org/10.19080/JOJCS.2017.02.555591.
39. Stanek, J. K., Dickerson, K. C., Chiew, K. S., Clement, N. J., & Adcock, R. A. (2019). Expected reward value and reward uncertainty have temporally dissociable effects on memory formation. Journal of cognitive neuroscience, 31(10), 1443–1454. https://doi.org/10.1162/jocn_a_01411
40. Stitt, J.L. & Pula, J.J. (2013). The impact of colour on vocabulary attainment with multi-ability seventh graders. Delta Kappa Gamma Bulletin, 79(4).
41. Susanti, S., Lestari, D. & Takidah, E. (2019). The influence of pressure, opportunity and rationalization on academic fraud of vocational student. Universal Journal of Educational Research, 7 (9), 1976-1982. https://doi.org/10.13189/ujer.2019.070918
42. Tlhabano, K. (2013). Effects of time interval, age and gender on perception and recall ability of Nigerian Federal Road Safety Corps (Frsc) plate numbering system using tachistoscope. Journal of Scientific Research and Reports, 2(1), 443–459. https://doi.org/10.9734/jsrr/2013/3628
43. Torres, A., Gómez-Gil, E., Vidal, A., Puig, O., Boget, T., & Salamero, M. (2006). Gender differences in cognitive functions and influence of sex hormones. Actas espanolas de psiquiatria, 34(6), 408–415.
44. van den Berg, R., Zou, Q., Li, Y., & Ma, W. J. (2023). No effect of monetary reward in a visual working memory task. PloS one, 18(1), e0280257. https://doi.org/10.1371/journal.pone.0280257 Wilkins, A.J. (2003). Reading through colour. Chichester (EG): Wiley
45. Yang, C., Potts, R., David R. & Shanks, D.R. (11 April, 2018). Enhancing learning and retrieval of new information: a review of the forward testing effect. Nature partner Journals: Science of Learning, 3(8). https://doi.org/10.1038/s41539-018-0024-y.

46. Yin J. (2019). Study on the Progress of Neural Mechanism of Positive Emotions. Translational neuroscience, 10, 93–98. https://doi.org/10.1515/tnsci-2019-0016
47. Young, K.D., Bodurka, J., & Drevets, W.C. (2017). Functional neuroimaging of sex differences in autobiographical memory recall in depression. Psychological Medicine, 47(15), 2640-2652. https://doi.org/10.1017/S003329171700112X