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The Effects of Color Preference on Word List Recall

By

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An Honors Thesis Submitted in Partial Fulfillment
Of the Requirements for Graduation from the
Western Oregon University Honors Program

Dr. Joel Alexander,
Thesis Advisor

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Abstract

The current study hypothesized that the group allowed to choose a color from a list will recall more words from a word recall list than the group that is assigned the color black. 50 non-colorblind participants (9 male) with a mean age of 22.5 (SD= 6.40) were recruited from a University subject pool, and offered extra credit in a psychology class in exchange for their participation in this study. The word list (20 five-letter words) was gathered from braingle.com, a site with numerous memory lists and activities. The independent variable, color, was manipulated between black and a color selected by the participant. The dependent variable was the number of words from the list that the participant could recall. If a significant positive relationship is found between preferential color and the number of words recalled, it would indicate that using a preferential color for studying may yield better tests scores as compared to those who study in the standard black color. The results calculated with a 2 sex x 2 group factorial design revealed no significant difference between the experiment and control groups.

Keywords: Color, recall, color preference, short term memory

The Effects of Color Preference on Word List Recall

Memory is used every day in various different ways. For example, when we meet someone new and few moments later we have to recall their name to add them on Facebook, or other social media account, so that our friend count is over 100 and we look popular. A more complex use of memory is when finals are coming up and we have to do our best to remember all of the stuff the professor droned on about all semester long, when we were making lists of better things we could be doing than listening to a boring lecture about something that happened before we were even born. But who cares, right? We have all heard the saying that “C’s get degrees” in college, so just pay enough attention to get a C and after that you can start your career. After you get your diploma who cares about your grades, right? Many will say “WRONG.”

It is said employers are now looking at college transcripts before making a decision about who they are going to hire (Koeppel, 2006). With that comes the stress, now more than ever, of doing well in classes. The GPA of potential employees may be the deciding factor on who gets the job; C’s may get degrees but will they get you the job or the career you have dreamed of? Along with this added pressure to perform well in class, comes the added pressure to find an edge in class, thus much new research is now being done into the area of improving memory recall.

Short term memory capacity

The most notable research done on the topic of short term memory, is probably that of Miller (1956), where among other things he concluded that the capacity for short term memory was about seven plus or minus two. This theory is known today either by “the theory of seven plus or minus two”, or by “Miller’s constant”, as he was largely

credited with finding this numerical theory of the average person's short term memory capacity. Solso (1988) has agreed with Miller's theory by analyzing others research and in summary stating:

Using dots, beans, nonsense syllables, numbers, words, and letters, experiments of this type have been conducted throughout this century, with consistent results: immediate memory seems to be limited to about 7 units (p. 149).

This theory has undergone much additional research of people trying to more accurately describe the theory by adding decimal points to the theory, however Miller's Constant is still the most widely known numerical value for short term memory.

Another theory that has been argues is that each individual has their own personal limit to the number of units that can be held in their short term memory (Fukuda, Awh, and Vogel, 2010). The difference in the number of units each individual can hold in short term memory, in this theory, comes from the individual's variation in executive attention processes. Basically, because each individual has a different attention span, or level of attentiveness, the number of units they can store in short term memory is also different (Engle, 2002).

Improving short term memory capacity

Along with the research trying to improve the accuracy of Miller's Constant, there came much research into how to expand the capacity of short term memory. One of the more notable strategies for improving short term memory is chunking. Solso (1988) noticed a pattern, along with Miller (1956), that only seven unrelated letters will fill the short term memory, however many more letters can be recalled in the form of seven words. Going further with this one can assume that 7 short sentences can also be

remembered, which is many more letters. The trick in the “chucking method” is that the chunks have to be big enough in order to increase the memory, however, small enough that the original pieces making up the chunk are not lost (Baddeley, 1990, 1994).

One of the lesser known strategies for improving short term memory is color. Research has begun to reveal that perhaps another avenue to increase memory is to color code notes or even just use color in your notes and flashcards, opposed to simple black and white notes and cards. Studies have shown various colors can improve memory recall (Fuller & Sulsky, 1995), or a person’s ability to remember word definitions or word lists presented (Stitt & Pula, 2013). This could help give students the academic edge they need in order to score the grades potential employers are looking for; if nothing else it may just help boost the knowledge base of the people studying in color.

Color preferences

While everyone may have a different color preference it is important to note that the reasons for this may differ. For instance, according to Schloss, Hawthorne-Madell, Palmer (2015), one person’s favorite color may be blue because they had a favored blue stuffed animal as a child, while someone else may not like the color blue because they don’t like blueberries; each individual’s color preference is influenced by correspondingly colored items. Research has shown that color preferences are not stagnant, however they are shaped by events and experiences a person may have with colored items (Strauss, Schloss, & Palmer, 2013). There are many theories as to what causes these color preferences and makes them more pleasing to each person. For example Ou, Luo, Woodcock, and Wright (2004) have theorized that it comes from the emotional content of the colors; and Palmer, and Schloss (2010) have theorized that the color preference is

realized by a combination of liking and disliking emotions of corresponding colored ecological objects. However, the evidence in these cases is purely correlational, meaning there is no definitive answer as to what causes color preferences, only well researched theories. While the results in the above studies did show a positive relationship between the variables being tested, it is a purely correlational relationship; one cannot say that one variable definitively caused the other.

Another notable study in the area of color preference was conducted by Taylor, Schloss, Palmer, and Franklin (2013). In their study probing the difference in color preference between infants and adults they discovered, through data analysis that adults typically look at colors they like longer than colors that they do not like. In the situation with preferential color being used in a word list would it cause the participant to pay more attention to the words on the paper, or would it become too distracting because the participant may become too mesmerized by their favorite color that they forget that they are trying to remember these words? More research should be done into this phenomenon in order to answer the above questions.

Color and memory

This research has begun to reveal that perhaps one of the easiest avenues to increase memory is to color code notes or even just use color in your notes and flashcards, opposed to simple black and white notes and cards. Studies have shown various colors can improve memory recall (Fuller & Sulsky, 1995), or a person's ability to remember word definitions or word lists presented (Stitt & Pula, 2013). This could help give students the academic edge they need in order to score the grades potential

employers are looking for; if nothing else it may just help boost the knowledge base of the people studying in color.

Typically, a pre-test and post-test method (Stitt & Pula, 2013), or a word count recall (Kuhbander & Pekrun, 2013) method, is used to measure data on these variables. In a pre-test post-test method the participant is tested and then the stimulus is applied and then retested. This method in Stitt and Pula (2013) was used to test memory of vocabulary words and definitions. Context dependent memory theory is the theory that memory recall can be improved if the conditions in which the learning occurred is the same when the recalling is happening (Grant et. al., 1998). This being said, it is important that how preferential color effects memory is studied more extensively to improve the classroom. As Stitt and Pula (2013) show by conducting their study in the classroom and using common classroom techniques of pretest versus post test scores, and integrating their theory on how color may influence recall of word definition. In this case the researchers did find a positive correlation between higher test scores and being able to choose the color the participants studied in. If Stitt and Pula's (2013) results are able to be replicated among many different class rooms, it has the potential to change how students are studying for tests in their classes.

This topic is important because it could help make learning more efficient, which could then raise test scores, and this raising of test scores could raise funding for the school (Thompson, 2015). If there is a positive correlation between a preferred color of the text and memory, it could cause school books to be available in different colors, in order to improve memory. Moderate levels of arousal have also been linked to increased memory (Otani, Libkuman, Widner, & Graves, 2007).

Kuhbander and Pekrun, (2013) conducted a study testing word count recall with the colors red, green, and blue in different serial positions. In the word lists involved in the above study most words were black except one random word in a serial position or either 6, 7, 8, or 9, in a list of 27, which was in a color of either red, green, or blue. The participant then recalled the words, on paper, that they could remember and the number of colored words remembered was compared to the black words on the list that were remembered. The theory of context dependent memory is also important in this study. It is possible that part of the time the colored words were not being remembered because they were not recalling the words in the same color that they were seen, in the context dependent learning theory, if the participants had been recalling the words in the same color they saw them in then the color may have ‘jogged’ their memory and helped them remember the colored word. In order to avoid what may have been happening in this study, the current study had participants recall the words in the same color that they were viewed in.

Farley and Grant (1976) examined the relationship between color and black and white slide-show presentations. More specifically, they wanted to know whether color or black and white would affect memory differently. The researchers hypothesized that, over one week, the color presentation would have higher recall rates, of the information presented, for participants.

The 52 participants in this study were nursing students from the University of Wisconsin. Fifty of the students were female, and all were between 19-25 years old. The students were shown a 20 slide overview on the laboratory and its functions and characteristics, each slide was on the screen for 15 seconds. Half of the participants

viewed the slides in color, and the other half in black and white. The slides were shown at the same time in separate but identical rooms. After the slides were viewed, the students were given a multiple choice test (with four answers to choose from), made up of 20 questions (10 literal and 10 inferential questions) that the researchers put together. Each slide corresponded to one question on the test; however, the order in which the information appeared, on the test, was random. A week after the initial test, the students took the same test again and the order was, again, randomized. The researchers did not inform the students that they were going to be tested over it again, and did not require them to put their names on the new test, but rather they matched the new tests to the previous tests by the answers on a background questionnaire given with the new test (Farley & Grant, 1976).

Once the results were analyzed, it was clear there was a difference in the test scores between the colored and the black and white presentations. The results from the colored presentation tests showed 38.46% of the students improved their scores from the first test, 30.77% of the students achieved the same score, and 30.77% did worse than they did before. The black and white presentation showed significant change from the results of the colored presentation. The percentage of students with increased their scores on the black and white presentation was 23.08%, whereas 30.77% showed no deviation in scores, and 46.15% did worse on the second than the first test. These results supported the hypothesis that, over the one week, the color presentation would have higher information recall than the black and white presentation. The results of this study further evaluated learning with slide-show presentations, and whether colors do increase memory recall, which shows that, more research on this topic could improve the education system.

The results offer insight into how important color is for remembrance. It demonstrates that colorful presentations increase a student's memory more than black and white. The researchers stated that based on their research color presentations should be used instead of black and white whenever possible (Farley & Grant, 1976).

The current study's focus and methods are inspired by Stitt and Pula (2013) which studied the effect of color versus black on information recall. The researchers were studying whether colored ink on flash cards would lead to a higher learning rate or recall rate for vocabulary words compared to the standard black ink flash cards. They hypothesized that the class of students who were allowed to choose the color of ink on their cards would remember more vocabulary words and definitions than the class with the typical black ink flash cards.

Two heterogeneously grouped classes of 7th graders participated in this study. The control group was made up of 21 students, 11 females, one of which was African American. Twenty-three students (13 females) consisting of two African American students (one male and one female) made up the treatment group for this study. The groups were made so that they were statistically similar based on a pretest on the vocabulary terms they would be studying. The researchers used a pre-test and a post-test to measure improvement through the experiment. The control group for this study used the standard white flash card with black text. The treatment group was allowed to choose which color they used each day to write on their white flash cards, this means the set of completed cards for the treatment group could be multiple colors. Three or four blank white cards and words were given out each day during the 12 day period to make a total of 40 cards, and 40 vocabulary words and definitions to study using the cards. The study

took place over 12 days with 14 days between pre and post-tests. The students were given about five minutes of in-class time to study with a partner for the first ten to fifteen words, seven minutes to study 16 to 25 words, and were given ten minutes during the last two days when the last of the new flashcards were presented. In order to ensure that none of the students spent time outside of class or at home studying the cards, the students were instructed to leave them in the classroom at all times. Even though the students were given 40 words to study, only the 20 words that appeared on the pre-test were on the post-test.

Comparing the pre-test and post-test scores from this study confirmed that the treatment group had more improvement on the tests than the control group. The elevated test scores from the pre-test by the control group were attributed to studying the flash cards rather than the color black. However, the treatment group had test scores that were higher than the control group so some of their improvement can be attributed to the colors on their cards instead of black and white. These results confirmed the authors' original hypothesis that the students with colored text would recall more of the vocabulary definitions and ultimately do better on the post-test than the control group. The authors state that if the study is done again that they would more closely monitor which colors the treatment group uses to try to gain information on whether certain colors are better for learning and recall than others. Importantly, findings from this type of research could provide teachers with improved strategies for ensuring learning goals are met.

Limitation of Past Research

While much past research exists on the topic of how color effects memory, the results vary from color having no influence on memory, to color having a large influence on memory. Much of past research focuses on the aspect of how individual colors effect memory, or how short-term memory is effected by other factors and strategies. Very few studies exist where the researchers are allowing the participants to choose the most appealing color to study in prior to the recall test; such as Stitt and Pula (2013). If the positive correlation found in Stitt and Pula (2013) can be replicated to other age groups and using different recall materials, this could change how students study for exams. However, since Stitt and Pula's 2013 study was among the first to probe the relationship between preferential color and memory, much more research is needed to see if the results from that study are common enough to draw a conclusion about how the two areas of preferential color and memory are related, if they are related at all.

Current Study

The current study experimented with the preferential color of the participant and how choice of color versus assigning the color black to a participant affects the memory recall of the participant. The same word recall may be observed for two different colors in the experimental group because the current study is probing the relationship between a color choice and black, not a specific color and memory.

Based on the above research discussed, the current study is attempting to replicate the results of the above study by Stitt and Pula (2013), for college students using a word list and word count recall measure. For purposes of this study, memory is defined as it is

in an article review by Dzulkifli and Mustafar (2012), a mental process in which information is processed, stored, and later recalled.

For the purpose of time, the current study will use a word list instead of vocabulary flash cards, and the method of word count recall (counting the number of words remembered correctly) as seen in Kuhbander and Pekrun (2013). The hypothesis of the current study is that there will be a higher mean number of words recalled in the experimental condition (participants in this condition were allowed to choose the color of the word list), than that of the control condition, which were assigned the color black with no choice.

Method

Participants

Participants were recruited via a University subject pool. The posters instructed students to go to the university library, where they entered a private library room and completed the study alone with only the researcher and service dog in the room. The participants were placed randomly into either the control or experiment group, by rolling a die. The participant pool included 53 participants, 44 of which were females (9 males). The average age of participants was about 22.5 years old ($SD= 6.40$). The most common major was psychology with 47%, various health and medical majors represented 15% of the participants, criminal justice represented 13%, art majors represented about 8% of the participants, and the additional 17% was split between six other majors. 28 of the participants were randomly assigned, by roll of a dice, to the control group, the remaining 27 rolled the dice and we determined to make up the experiment group. None the participants had ever been diagnosed with any kind of color blindness. No participants in

the experiment group chose the color black for their preferential color. At the end of the research 49% of the participants had seen the color black, 16% purple, 11% pink, 11% blue, 8% green, 2% red, and 2% chose orange.

Procedure

Participants entered the private library study room and sat at a table. First they were asked if they were color-blind in order to ensure that they would receive the full effect of the color of the words they view. None of the participants indicated that they were ever diagnosed with any variety of color blindness. The participants were instructed to read and sign the informed consent form (Appendix A), which told the participants about the risks associated with the study and the main variables in the study, such as color and memory, in order to participate in the study. Next, the participant filled out a demographics survey (Appendix B) to gather basic information about the participants. Information such as age, major, gender, and year in school were inquired about on the demographics survey. After filling out the papers the participants rolled a standard 6 sided die. Participants that rolled an even number were placed in the experimental group and participants with odd numbers in the control group.

The control group then received a word recall list printed in black ink, times new roman font, font size 26, single spaced, and center aligned on a standard (8.5 by 11 inch) piece of white printer paper. The participants in the test group received the same list the only difference is that the list was printed in the color ink they chose from eight colors on a list. In order to ensure that there was a chance of black being selected for color preference it was included on the word color list, however, it was not selected by any participants in the experimental group. Everything else between the groups remain the

same. The participants were given one minute to study the list, after which they will be given one minute to recall as many words as they can from the list. One minute of recall time is an adequate amount, according to Richard Mohs, in his article about how the human memory works he indicates that short term memory can hold pieces of information for 20-30 seconds (Mohs, n.d.). Participants wrote the words they recalled on a standard (8.5 x 11 inch) piece of blank printer paper. The groups will use a color marker identical to the color of ink used on the list of recall words. The identical marker color is based on the research by Grant et. al. (1998) and his theory of context dependent memory. This acts a control because if everyone recalled with a standard black pen, an advantage may be present for those looking at the list in black. This advantage may be there because, as Grant et. al.'s (1998) research indicated if study and recall happen in the same state memory recall can be improved. All colors were recalled in a matching color in order to enact the theory of context dependent learning equally across both groups. After the minute is over participants were told to stop writing words, and were then debriefed. The debriefing consisted of explaining what the study was about, and answering any questions that the participant had. Lastly the participants were given a red extra credit slip, and then left the room.

Measures

Recall. Recall was measured by the number of words that the participant remembered and wrote down from the 20 item word list. The number of correct words written down was then compared between the control and test group. The word list is comprised of 20 five-letter words from an online word memory test at braingle.com

(2001). This list was chosen because it is made of simple words that the average person would know, and items they would be familiar with. See Appendix C for word list.

Color. The participants in the experiment group chose a color from a list of eight different colors. The colors in the list were blue, red, orange, purple, green, yellow, pink, and black. Appendix D is a list of the colors, in the font color the word list was given to them if the participant chose that color.

Design

The design for the present study was a 2sex (Male, Female) x 2 Group (Experimental, Control) factorial design. Age was a covariate and Word Count was the dependent variable.

Results

The mean word counts (± 1 S. E.) for subject sex and group are displayed in figure 1. There was no significant difference between Experimental and Control groups $F(1, 48)=.73$, $P=n.s.$ There was no significant difference between Sex of subject, $F(1, 48)=.288$, $p= n.s.$ There was no significant Group x sex interaction $F(1,48)= 1.02$, $p= n.s.$

Discussion

The hypothesis of the current study was that there would be a significantly higher mean number of words recalled in the experimental condition (participants in this condition were allowed to choose the color of the word list), than that of the control condition, (given the word list in the color black, with no choice). In general the results from the data collected in the current study do not support this hypothesis. The results calculated showed no significant difference between groups, even while taking gender into consideration.

The results of the current study in comparison to that of the study of the theory of Miller's constant (7 ± 2), shows that the mean number of words recalled in the current study is within the range theorized as "average" in Miller's 1956 article (see figure 1). One group did not significantly lie outside of the range of Miller's constant on either end of the range theorized by Miller (1956).

Farley and Grant (1976) found that color slide presentations remained in a participant's mind longer than the same presentation in black and white. In the current study a significant difference between viewing a word list in a preferential color or black was not shown to make a significant difference in the number of words recalled, whether it was more or less words recalled. The contrast in results of the current study and that of Farley and Grant (1976), could indicate that pictures in color or black and white may carry different lengths of time that they can remain in retrievable memory than simple words in a preferential color or black ink.

The study examined in this paper that is most closely related to the current study is Stitt and Pula (2013), which revealed that in two groups of 7th graders, those who studied flashcards in a color of their choosing, received higher scores than that of their pre-test on their post-test vocabulary quiz, more so than their counterparts who studied with black and white flashcards. However, the results from the current study contradict that of Stitt and Pula (2013), because while a preferred color was also compared to the standard of black ink, the current study did not yield any significant findings of one condition improving recall, more so than the other condition. Potential reasons for the difference in finding between the above studies and the current study can be found below.

Potential limitation to the current study include the number of participants more specifically the lack of males present in both conditions was low compared to the number of females that participated in the study. It is also possible that there was a difference in males between the two different groups, but because the number of males was so low and uneven in each group (6 in control group; 3 in experiment group), the difference went unnoticed.

Another type of limitation to this study was the age. The current study had a clear majority of college aged participants, when much of prior research, Stitt and Pula (2013) for example, focused mainly on younger children. Perhaps color is more intriguing or important at that younger age. This could account for not producing results similar to that of Stitt and Pula (2013).

That being said, future research in this area should focus on the assignment of each color and test the memory capacity's effect from a specific color. Research should also be done one if there is an age where studying in color no longer shows any advantages, and what that age is. Due to the results from Stitt and Pula (2013), among others compared to the results of the current study, it is possible that an above such age exists and future research should be dedicated to finding that age.

In closing, even though much research has been done into whether or not color can have an effect on memory, there are many areas that have not yet been adequately probed by researchers. In the coming years these areas need to be researched in order to gain a better understanding of the area of color and memory.

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Figure

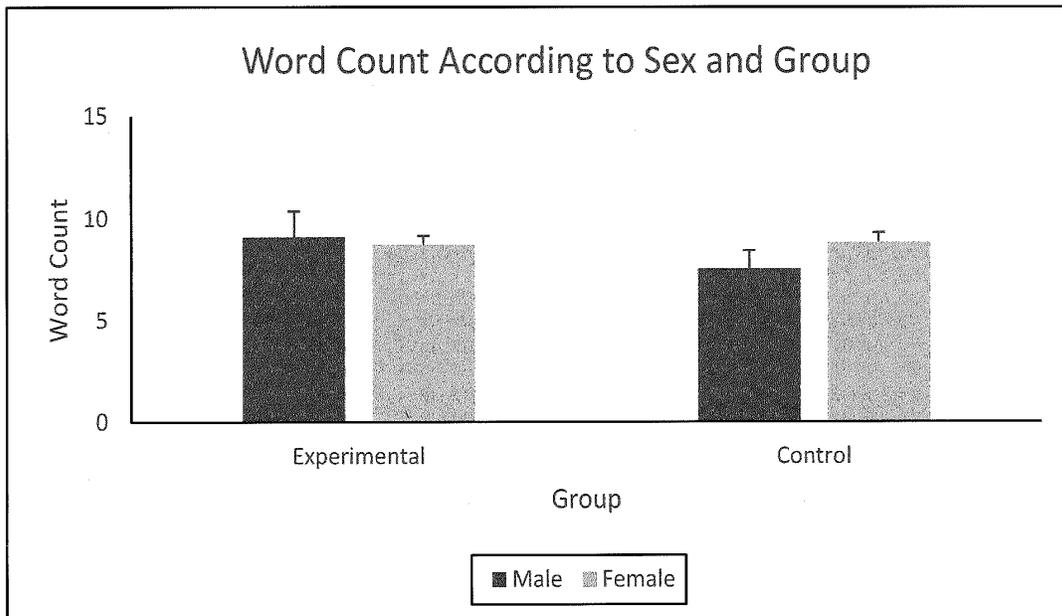


Figure 1. The mean scores (+1 S. E.) for the experimental and control groups

Appendix A

CONSENT FORM

Preferential color and word count recall

Western Oregon University and the Department of Psychological Sciences support the practice of protecting research participants' rights. Accordingly, this project was reviewed and approved by the WOU Institutional Review Board. The information in this consent form is provided so that you can decide whether you wish to participate in our study. It is important that you understand that your participation is considered voluntary. This means that even if you agree to participate you are free to withdraw from the experiment at any time, without penalty.

This study will probe the possibility of an influence of a preferential color on word count recall. For this study, you will be given a word list to study and then you will be asked to recall as many words from that list as possible.

Your responses will only be viewed by the researchers listed below and they will be kept in a secure location. This study poses no known risks to your health and your name will not be associated with the findings, however you may feel embarrassed or uncomfortable during participation. Remember that you can end your participation at any time if you feel uncomfortable. For participation in this research project, you will receive extra credit at the end of the session. Also, upon completion of your participation in this study you will be provided with a brief explanation of the question this study addresses. If you have any questions not addressed by this consent form, please do not hesitate to ask. You will receive a copy of this form, which you should keep for your records.

We thank you for your time.

Aubrey Fear: afear12@wou.edu

Joel Alexander, PhD
 Professor
 Todd 319, 503-838-8355
 alexanj@wou.edu

CONSENT STATEMENT:

I have read the above comments and agree to participate in this experiment. I understand that if I have any questions or concerns regarding this project I can contact the researchers listed above or the WOU Institutional Review Board at (503) 838-8271

 (Participant's signature)

 (date)

Appendix B
Demographics

1. What is your major? _____

2. What is your gender (circle one)? 1 Female 2 Male

3. What is your race (circle one)?

1 African American	4 Caucasian (White)
2 Native American/Alaskan Native	5 Asian
3 Native Hawaiian/Pacific Islander	6 Other _____

4. What is your ethnic background (circle one)?

1 Hispanic or Latino	2 Not Hispanic or Latino
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5. What is your age? _____

6. What year are you in school (circle one)?

1 Freshman	2 Sophomore	3 Junior	4 Senior
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7. Have you ever been diagnosed with any color blindness?

Yes	No
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Appendix C
worry
total
swiss
truly
catch
never
shade
march
armed
earth
salon
often
pause
virus
cliff
cried
lying
apply
uncle
mercy

Appendix D

Blue

Red

Orange

Purple

Green

Yellow

Pink

Black