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Effect of Color on License Plate Recall

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EFFECT OF COLOR ON LICENSE PLATE RECALL

A Master's Thesis

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In Partial Fulfillment

Of the Requirements for the Degree

Master of Science, Psychology

By

Hannah R. Johnson

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ABSTRACT

Accurate and quick license plate recall is important for identification purposes, especially in emergency situations, such as hit-and-runs. Previous research has shown that there are particular patterns of license plate designs that are easier to recall, such as a higher digit to letter ratio. Missouri license plate patterns (AB1-C2D) somewhat diverge from what research suggests works best for recall. The current study sought to determine if including color into license plate designs would improve recall. There were 48 undergraduate students from Missouri State University who participated in the experiment. Participants saw 100 timed trials of license plate stimuli, where they saw the stimuli for half a second, waited six seconds, then had 10 seconds to recall the license plate stimulus they saw. Participants randomly saw one of two formats for the license plate stimuli; either the digits in the stimuli would be in color or the stimuli would be in all-black text. The hypothesis that the inclusion of color would improve recall was not supported, as there were no significant differences in recall between the two groups based on format. While color may be useful, future research should continue to look for additional ways to improve designs that would be easy to implement.

KEYWORDS: license plates, memory recall, license plate design, color effects

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INTRODUCTION

How often do people notice license plates? For most people, they see at least one license plate every day, if not many more than that. However, how many people can recall a license plate, except maybe their own? Do people know their particular state's license plate pattern? All license plates must have similar requirements to meet for state-specific compliance. Typically, there is reference to the state name, the expiration date, and an alphanumeric string. The number and ratio of letters and digits differs by state, though these alphanumeric strings usually contain six or seven characters total. For the state of Missouri specifically, all standard license plates must include the full or abbreviated name of the state, the slogan "Show-Me-State", the registration expiration date, and an arrangement of digits and/or letters as assigned by the director of revenue. According to the Missouri Revised Statutes, the plate should also be fully reflective with a common color scheme and design for each type of license plate (301.130, RSMo). Currently for Missouri license plate alphanumeric strings, there are four letters and two digits split into two even chunks (AB1-C2D). The number of characters and the alternation between letters and digits are both important as they affect the number of possible variations, so that all license plates within each state are unique.

Knowing all this information is not usually that important, except for when it is. Being able to recall an unfamiliar license plate for an emergency situation, like a hit-and-run, then becomes essential. During these situations, there are many factors that can be distracting and make it more difficult to recall a license plate, especially as the person probably only saw the plate for a few seconds at most. Ignoring these distractions, relying solely on one's working memory may not be enough to be able to recall the license plate. One's working memory can

only hold approximately four items at a time (Cowan, 2010). There may be some strain on working memory as the typical license plate has at least six characters on it. However, license plate number characters can be chunked, and often are by design, which can reduce the burden on working memory. Even if chunking is helpful, this would require someone to be able to focus on the license plate itself and not on the other distractions present, as well as make the decision to try to remember the license plate number they saw in that moment.

These situational factors cannot be controlled, but license plate patterns can be, and being able to quickly recall a license plate in order to identify cars is one of their main purposes. License plates must also show compliance with registration laws, which require a variety of information to be present, including specific patterns specific to the state the car is registered in (Baerwald et al., 1960). License plate designs have to meet both of these purposes, and while the design of the plate may not be able to change much due to these requirements, there is still a need to discover what changes can be made or what strategies can be used to improve license plate recall. In the following studies, the impact of character type, character combinations, recall strategies, etc. on memory performance are discussed.

LITERATURE REVIEW

In Ford and Derr (1939), the character composition of license plates was examined to see what combinations were easier to recall. One hundred fifty-four undergraduate students in two groups were exposed to 60 plates total. The plates ranged from all five numeric characters to all five letter characters, with ten total plates for each type. Each group was shown five of the ten exposure plates where they were each projected for five seconds before a five-minute rest. After the rest, participants would mark on a sheet given all the plates whether this is plate they have seen before or not. The other five plates not originally shown would be considered lure plates. Scoring was based on successfully recognizing plates, with total success being a score of 10 points, and partial success being the number of errors minus the total number correct. They found that there were no temporal effects for the positioning of characters, that only numeric plates were easier to recognize than only letter plates, however, mixtures of both produce the best recognition performance. They also found that combinations of four digits and one letter were easier to recognize than combinations of 2 and 3 (Ford & Derr, 1939). This study shows that there are particular patterns and designs that improve recall which should be considered.

MacKinnon et al. (1990) explored techniques to improve eyewitness's ability to recall license plates across two experiments. For Experiment 1, 151 undergraduate students were shown nine slides depicting an event of a man putting a television in his car, with the plate being "1MJT407." After watching the slides, they were asked to give a full description of what they saw, then the interviewer either used cognitive or standard questioning strategies before asking the participant to recall the plate. Cognitive strategies consisted of getting the participant to reconstruct the context of what was around the license plate, while standard strategies were

gathered using techniques of several detectives that consisted of asking questions such as what colors were present or how many characters of each type were on the license plate. They found that cognitive questioning led to the best recall. Of errors made, they found that letters adjacent on the alphabet to those on plate were chosen more, as well as letters that look alike. Experiment 2, consisting of 108 undergraduate students, repeated the same procedure using the plate "640VYE", which is only six characters instead of the original seven. The results of this second experiment were similar to the first, including errors of adjacent letters chosen (MacKinnon et al., 1990). This study shows that the letters used themselves can cause issues with recall, as seen with the errors of adjacent letters and similar looking letters, which is another factor that should be thought of when designing license plates.

There has been additional studies that also investigate the impact of cognitive strategies to improve eyewitness recall. Emmett et al. (2006) examined the effect of mental context reinstatement (MCR) and virtual recreation of plates through Virtual License Plate (VLP) on remembering plate and event details. MCR asks participants to place themselves mentally back in the situation and describe both what they saw and what they felt during the event. VLP allows the license plate shape, color, border, surrounding car, and characters to be customized to match the target car. In the first experiment, 104 undergraduate students were placed in one of four groups: no use of MCR or VLP, use of MCR but no VLP, use of VLP but no MCR, and use of both MCR and VLP. They watched a short video depicting an event where children, separated from the rest of the group, were led to a car by strangers saying they could help. After watching the video and completing a five-minute distractor task, participants either went straight to a recall questionnaire, where they were asked to recall the plate and then recall details about the event, or were asked to mentally place themselves in the situation before answering the questionnaire

(MCR). Those who had access to the VLP would also use it during this time. They found that the condition in which participants used MCR and the VLP had the best performance, for both remembering the plate and event details. The use of MCR only, however, was more effective than the use of VLP only. The second experiment used the same procedure, except that the condition of using VLP only was dropped, as well as a different video was shown. There were 48 undergraduate students in this study who watched a video about a detective interviewing someone about a theft, with a minibus plate being shown. They found the same results as in Experiment 1, where the use of both MCR and VLP was most effective for both remembering plates and events, but the use of MCR only was also more effective than no MCR or VLP. Similar to the previous study, there are strategies for improving recall, and finding additional strategies or ways to improve recall would be helpful.

License plate composition was also examined by Schraagen and van Dongen (2005), who looked at patterns of characters on plates. Forty-eight participants were shown a series of 20 license plates that varied in number of alternations between letters and digits, as well as the ratio of letters to digits and equal or unequal character group. The number of alternations ranged between 0 and 4, and the letter to digit ratios were either 6:0, 5:1, 4:2, or 3:3. After seeing each plate, participants could write down what they saw, and then had to enter it into the computer. Participants were also asked which three plate designs were easiest to remember, and which three were the most difficult to remember. They found that plates with fewer alternations were easier to remember, as well as plates with lower letter to digit ratios and character groups of equal sizes, unless there was a low letter to digit ratio. The number of alternations had the biggest impact on memory performance. They also found that objective memory performance matched to the subjective ratings participants gave on plate designs. This study provides

evidence on what kind of patterns improve recall best, so additional research on small ways to change the pattern or make it more noticeable may further improve recall.

Cohen et al. (2014) suggested that the use of symbols in license plate design would make for better recall. Besides seeing how symbols affect recall, they also examined recall delay and viewing orientation. In Experiment 1, participants were shown a brief video of a car and were asked to recall the car color and license plate. Before viewing, they were told to pay attention to the license plate and car color, that they may see a normal or mirror image, and that the plate may consist of letters, digits, and/or symbols. The plates used in the videos had either six characters, five characters, or four characters with a symbol. They were also warned that the exposure would be for a very short period of time. The exposure video would be either one, two, or three seconds, and would be followed by a 10-15 second filler segment of someone driving and listening to blues music. After viewing the video, they would have to type "822" to simulate calling 911, and then were asked to recall the plate and car color by selecting radio buttons next to response options (A-Z, 0-9, and all symbols) and then again for the list of car colors (white, black, red, or blue). They found that recall was not affected by the inclusion of symbols, but that longer exposure helped recall, and mirror-images were harder to recall. In Experiment 2, participants followed a similar procedure as Experiment 1, except that the number of plates was reduced and used the same variation for each plate condition (M6C83R or T62XR7), but again changed the number of characters (6, 5, or 4 and a symbol) and the position of the symbol (1, 2, and 4). They viewed each plate with a study-test delay of 15 seconds and only used black cars, but did use plates appearing normal or mirrored. They found that that the results of Experiment 1 were replicated, and there was no advantage in using symbols, recall was worse for symbols than characters in the left-most positions but better in normal view, and later positions were

remembered worse than earlier positions, especially for six characters. However, recall across the two plate conditions varied, which suggests that some characters may be easier to remember than others. The use of the symbol in the license plate design in this study was also not helpful, but there may be other ways for license plate design to improve recall.

Current Study

The prior research shows that there are specific patterns, as well as strategies, that make license plates easier to recall. However, the current license plate pattern for Missouri (AB1-C2D) seems to sometimes follow and sometimes diverge from what prior research recommends. There are alternations between digits and letters, which typically make recall more difficult. The chunking into two groups of three is more helpful than all characters in one chunk. However, the higher ratio of letters to digits and their alternation negatively impacts recall. Finding a way to further improve license plate recall without drastically changing the designs may be easier to implement. One way that has been tested in a pilot study has been by manipulating character color.

In a pilot study, one aspect that was manipulated to try to improve recall was the color of the license plate characters. Seventy-seven undergraduate students at Missouri State University were exposed to 100 sample license plates that matched the pattern for Missouri. One group of participants saw only black characters (not color-coordinated), while the other group saw black letters and red digits (color-coordinated). Each participant only saw the license plate for half a second and had to wait for six seconds before having ten seconds to recall as many characters as they could in the correct order. There was no statistically significant difference in the average scores between groups, so the inclusion of red digits was not helpful in improving recall.

Based on the results of the pilot study, the difference in color may not have made much of an impact on recall. However, manipulating color a different way may have had more effect. In the current study, letters would remain black, but instead of using only red for the digits, specific colors would be selected. As suggested by Witthoft and Winawer (2013), people may associate specific letters and digits with specific colors, many times aligning with color schemes used in children's toys, such as refrigerator magnets. The color of each digit in the color group followed a rainbow pattern, which as shown in the article, is the same pattern that would typically be used in children's toys.

The purpose of the current study was to examine if a color-coordinated design led to better recall then an all-black text design. This study used a similar design as the pilot study, although, was updated to be done online, as opposed to pen-and-paper. An additional factor of license plate exposure was included in the current study. Acknowledging that certain strategies can improve recall, some participants were also exposed to an example license plate before beginning the study to see if prior exposure would improve recall.

METHODS

Participants

This study (IRB-FY2022-295) was approved by the Missouri State University Institutional Review Board on December 10, 2021. It was determined to be exempt from further review as it met the exemption criteria and risk was minimal, as noted in the Appendix. Participants (n = 48) were undergraduates from Missouri State University who were enrolled in PSY 121. They were recruited through the PSY 121 student research pool using SONA and received research credit for participating. The pilot study mentioned previously was, in part, used to determine how many participants were needed.

The average age of the participants was 19.29 years old (SD = 2.28). Twenty-seven (56.25%) participants identified as female, 20 (41.67%) participants identified as male, and 1 (2.08%) participant preferred not to disclose their gender. See Table 1 on the next page for all demographic descriptive statistics and frequencies.

Materials

License Plate Stimuli. The experiment was made up of 100 trials. Each trial had its own unique license plate stimulus. All license plate stimuli consisted of six characters following the Missouri license plate design (AB1-C2D). For example, the first trial was “CJ3-W2T”. The digits “zero” and “one” were not used in any of the stimuli, as well as the letters “O” and “I”, due to their similarity to each other, respectively. In the all-black text condition, all characters (both letters and digits) were black. In the color condition, all digits were in a specific color. The color scheme was as follows: “twos” were red, “threes” were orange, “fours” were green, “fives” were

blue, “sixes” were purple, “sevens” were dark red, “eights” were dark orange, and “nines” were dark green. Using the first trial’s stimuli again as an example, the “three” would be orange, and the ”two” would be red, while all other characters would remain black.

Table 1. Descriptive Statistics and Frequencies for Demographics and Driving History

Demographics	Option	*%*	*n*	*M*	*SD*	*SE*
Age	-	-	48	19.29	2.28	.33
Gender	Female	56.25	27	-	-	-
	Male	41.67	20	-	-	-
	Prefer Not to Say	2.08	1	-	-	-
Years Lived in Missouri	-	-	47	14.72	7.16	1.05
Hours Driven Each Week	-	-	47	4.47	6.21	.91
Age License Received	-	-	45	16.13	.46	.07
State Received License	Missouri	82.22	37	-	-	-
	Illinois	6.67	3	-	-	-
	Kansas	4.44	2	-	-	-
	Georgia	2.22	1	-	-	-
	Nebraska	2.22	1	-	-	-
	Pennsylvania	2.22	1	-	-	-
	Not Reported	6.25	3	-	-	-

Procedure

A room with computers was utilized for this experiment. Participants completed the experiment through Qualtrics, which was already loaded for them before they entered the room. Participants entered the room and sat at the computers, with at least one space in between each participant when possible, and were instructed to not start the survey until the experimenter said so. Once all participants were seated, the informed consent was read aloud as participants followed along, and they were told what to expect during the experiment. Participants were then asked if they had any questions before starting the experiment and any questions they had were answered.

Each participant was randomly assigned through Qualtrics to be in the all-black text condition (n = 24) or the color condition (n =24). Additionally, the experiment was designed to randomly assign half of participants to be exposed to an example of a potential license plate before starting the experiment and the other half would not see it.[1] All participants were shown an example trial. Before participants started the example trial, they were told they could enter their responses either with a dash or not, and in all capital letters or not, as long as they tried to keep these consistent throughout. This was set up similar to the experimental trials. The example stimulus, however, was "000-000", so that participants did not see the license plate stimuli pattern beforehand. Participants would first see the example stimulus for half a second, then would be told to wait for six seconds on a blank page, then would have ten seconds to be able to type the license plate stimulus into a text-box. After the example trial, participants were reminded of the instructions before beginning the experiment proper.

The experiment was set up so that each part of the trial was separated to different pages, with participants not being able to prematurely advance to the next page or go back a page. They

would first see a page that would say “first trial”, “next trial”, or “last trial” and would have to wait on that page until it automatically advanced after one second. They would then see a blank page for half a second. They would then be given the trial number and the license plate stimulus, which either had color-coordinated digits, or no color-coordinated digits. They would see this page for half a second. They would then be taken to a blank page for six seconds. Finally, they would be asked to recall the license plate and would have ten seconds before being advanced to the next page, and subsequently, the next trial. Participants would do this for all 100 trials.

After the 100 trials, participants were asked a series of demographic questions and questions regarding their driving history. Participants were asked to provide their age and gender. The questions relevant to their driving history were how long they have lived in Missouri, approximately how many hours they drive each week, what age they were when they received their driver’s license, and which state they received their license in. Additionally, participants were asked to provide a potential Missouri license plate by entering in a combination of digits and letters that could be real license plate. The only stipulation was that they could not write their own license plate or one that they know really exists. The space in which they entered the potential plate was a blank text box, just as it was for the experimental trials.

After completing the experiment and answering all demographic and driving history questions, participants were debriefed about the experiment. Any questions that the participants asked about the experiment were also answered. Participants were also told they could email the experimenter at any time after the experiment if they had any additional questions

RESULTS

Preliminary Analyses

Scoring. Each trial was worth a maximum of 12 points. If the participant had the correct character in the correct position, they would receive two points. If they had the correct character, but in the wrong position, they would receive one point. If they had no correct characters, they would receive no points. Each participant's total score across the 100 trials was averaged, which was the score used in analysis for each participant.

Data Screening. Prior to running the analysis, the average recall scores were screened for accuracy, missing values, outliers, and assumptions. Accuracy was assessed using descriptive statistics, and no issues were found. Three cases were removed for not completing the experiment. Outliers were assessed univariately by examining the standardized z-scores for the average score, and no outliers were found. Normality was assessed by examining Shapiro-Wilk's Test of Normality and was not violated ($p > .001$). Homogeneity was assessed using Levene's Test for Equality of Variances and was also not violated ($p > .001$).

Exposure Data. Additionally, of the 48 participants, there were $n = 27$ participants who were exposed to an example license prior to beginning and $n = 21$ participants who were not. However, as mentioned previously, due to an error in the example, the exposure example pattern did not match the trial patterns.

To determine if this data should be treated separately from the rest, an independent samples *t*-test was conducted to see if there were any initial differences in average memory recall between those who were exposed to the example prior and those who were not exposed to the sample prior. There was not a statistically significant difference between the groups, $t(46) = 1.20$,

p = .269. This suggests that prior exposure did not impact average recall, so the data does not need to be split by which exposure group participants were in.

Primary Analysis

An independent samples t-test was conducted to determine if there were significant differences in the average license plate recall score based on format (color group or all-black text group). There was not a statistically significant difference between the groups, $t(46) = -.80$, $p = .426$. License plate recall was slightly higher in the color group ($M = 10.04$, $SD = 1.38$) than the all-black text group ($M = 9.69$, $SD = 1.67$), but again, this was not a significant difference. Refer to Figure 1 for a depiction of the results. The results are similar to the pilot study, in that the inclusion of color-coordinated digits did not significantly improve license plate recall.

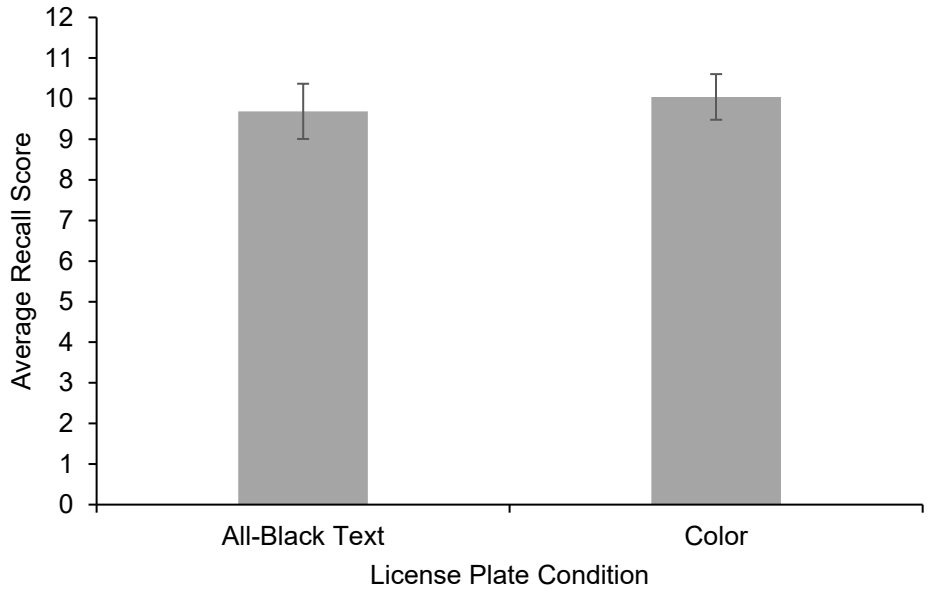

Figure 1. Average Recall Scores between the All-Black Text Condition and the Color Condition. *Note*. Error bars represent standard error.

Exploratory Analyses

A one-way ANOVA was completed to determine if participant performance changed throughout the 100-trial experiment. In order to do so, the 100 trials were broken down into four blocks for each participant; Block 1 used the total scores from trials 1 through 25, Block 2 used the total scores from trials 26 through 50, Block 3 used the total scores from trials 51 to 75, and Block 4 used the total scores from trials 76 to 100. An average of the total scores was computed for each block and for each participant. While scores did somewhat decrease across the four blocks when looking at the descriptive statistics, there was not a statistically significant difference in the average recall scores across blocks [$F(3, 188) = .33$, $p = .80$]. See Table 2 for all descriptive statistics.

Table 2. Exploratory Block Analysis Descriptive Statistics

Block	*M*	*SD*
1	10.01	1.54
2	9.95	1.54
3	9.79	1.70
4	9.72	1.78

Additionally, a series of one sample *t*-tests were conducted to determine if the average recall scores were significantly different from a perfect score of 12 points. This was completed using the average recall score from each of the four blocks, as well as the average recall score from the overall 100 trials. Each average score from each of the four blocks was significantly

lower than a perfect score of 12 points. The overall average recall score was also significantly lower than a perfect score of 12 points. See Table 3 for all one sample *t*-test results.

We also examined whether format had any effect on the likelihood of recalling a digit either in a digit position or in a letter position, regardless of whether the digit that was recalled was correct. For each participant, the number of times they recalled a digit in a digit position (position 3 and position 5) and the number of times they recalled a digit in a letter position (positions 1, 2, 4, and 6) was tallied. A 2 (Condition: All-Black Text vs. Color) x 2 (Position: Digit vs. Letter) mixed factors ANOVA showed no significant main effect for Condition [$F(1, 46) = 2.56$, $p = .117$] and no significant interaction between Condition and Position [$F(1,46) = 1.42$, $p = .239$]. See Table 4 on the next page for all descriptive statistics for position.

Table 3. Difference from Perfect Scores One Sample t-Test Results

Variable	*t*	*df*	*p*	*d*
Block 1	-8.96	47	< .001	-1.29
Block 2	-9.21	47	< .001	-1.33
Block 3	-9.02	47	< .001	-1.30
Block 4	-8.89	47	< .001	-1.28
Overall	-9.71	47	< .001	-1.40

The main driving history demographic we were interested in was the reported hours driven each week. A Pearson's *r* correlation was performed to determine if there was a statistically significant relationship between the average recall score and reported hours driven each week. There was one outlier for reported hours driven each week, so the analysis was

conducted with it included and it excluded. With the outlier included, there was no correlation between average recall scores and reported hours driven each [$r(45) = -.035$, $p = .813$, 95% CI (-.32, .25)]. With the outlier excluded, there was a negative relationship between the average recall score and reported hours driven each week [$r(44) = -.297$, $p = .045$, 95% CI (-.54, -.01)]. This would indicate that someone's average recall score decreased the more hours they reported driving each week See Figure 2 for a depiction of the relationship.

Table 4. Descriptive Statistics for Numbers Reported in Letter or Digit Position

Condition	In Letter Position		In Digit Position	
	M	*SD*	*M*	*SD*
Color	10.17	10.76	179.75	22.08
All-Black Text	12.04	14.31	169.71	26.48

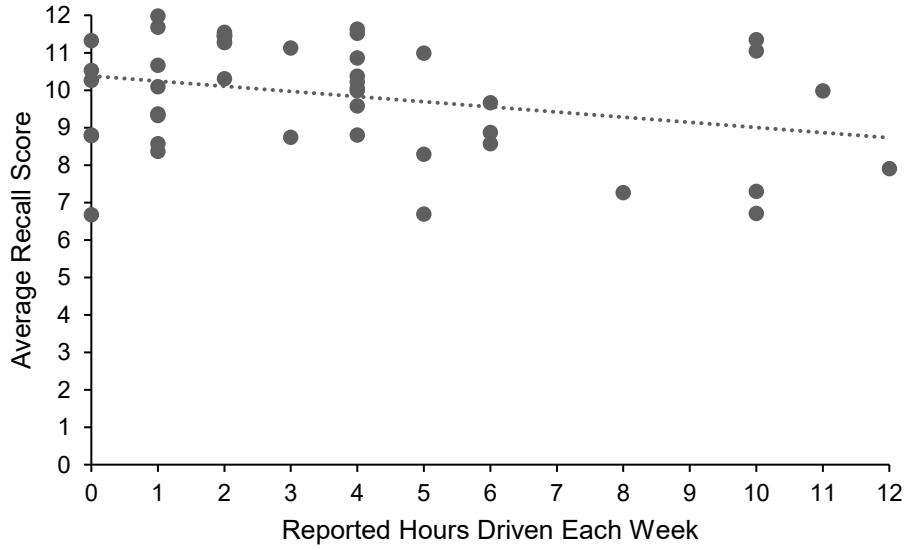

Figure 2. Relationship between Reported Hours Driven Each Week and Average Recall Score, Excluding the Outlier.

DISCUSSION

The purpose of this study was to examine if a color-coordinated license plate design would lead to better recall. The primary hypothesis was that the inclusion of color into license plate designs would improve memory recall, and this hypothesis was not supported. The all-black text condition had very similar average scores as the color condition average scores. The results of this experiment are similar to the pilot study, in which adding any color to the license plate stimuli did not increase memory recall. Based on the literature, the results could also correspond to Cohen et al. (2014), in which they found the inclusion of a symbol was not helpful. Color-coding license plates does not seem to be an effective way to improve memory recall, at least in this experimental context.

As mentioned in the exploratory analyses, the average recall scores for all four blocks and for the overall experiment were significantly lower than a perfect score of 12 points, regardless of condition. This may suggest that, in the context of this experiment, the license plates were somewhat difficult to recall, and thus, the task of recalling was not too easy. There was not a ceiling effect present, as all participants were not close to perfect scores no matter the condition. Additionally, performance on the task did not significantly improve or worsen throughout the experiment, nor was one block particularly more difficult than another. Both of these findings suggest that the difficulty of the task of recalling license plates and the difficulty of the overall experiment were not the cause of the lack of difference between the conditions.

The other aspect of license plate recall that we examined in this experiment was if prior exposure had any effect. While there was an error in the license plate example given, the results showed that there still was no significant difference in the results between conditions and at least

half of the participants were able to enter in a correct potential license plate format after the experiment had ended, with only one instance of the same positions being switched as in the prior exposure example. Likewise, our analysis of whether the format had any impact on participants' likelihood of recalling digits "out of position" (letter position) vs. "in position" (digit position) did not reveal any significant differences. This further suggested that the inclusion of color into license plate designs was not affecting participants' awareness of where digits regularly appeared in the license plates. The negative relationship found between reported hours driven each week and the average recall score may not necessarily indicate that prior exposure did have any effect, as it is possible that the relationship was a false positive found when exploring the data, especially as there was no relationship when including the outlier These results do vary from the literature if prior exposure can be seen as a strategy to improve recall. Both MacKinnon et al. (1990) and Emmett et al. (2006) found that different strategies improved recall, such as the way questions were asked or access to a virtual license plate. While other strategies seem to work better, the way prior exposure was included in the experiment does not.

Limitations

When considering memory for license plates in real life, the experiment is not the most realistic. One of the issues with recalling license plates in real-life scenarios is that, often, people are not solely focused on the plate, and instead are distracted by the event that is happening. In the experiment, participants only had to focus on the experiment and the flash of the license plate stimuli. Additionally, in real-life scenarios, people tend to need to be able to recall the license plate that they saw much longer after the fact than participants had to in the experiment, which was only six seconds later. It would be interesting to see if color has more effect for recall over

longer periods of time, as opposed to the experiment time. They also do not have a time limit for how long they have to recall the license plate, and may have access to strategies that improve their memory to recall license plates, such as described in Emmett et al. (2006). Future studies could address these issues by making the experiment more realistic and have participants view a scene or include other distractors while viewing the license plate stimuli.

Another limitation was one that affected the secondary hypothesis, that prior exposure to the correct license plate format would improve memory recall. The example license plate format contained an error in the prior exposure condition. Even if the results showed that there was no difference based on the prior exposure condition, it may have still affected a few participants that were in the prior exposure condition. It may have been more difficult to adjust to the license plate stimuli and correctly recall it, at least in the first few trials. If this factor of prior exposure was to be studied further, having participants actively memorize or acknowledge the correct format may have more impact, instead of passively being shown the format.

Implications

While the inclusion of color into license plate designs did not appear to be an effective way to improve memory in this experiment, there are still other aspects of the design that may be effective, as seen in the literature. Additional research should seek out the ways that license plate designs can be changed to improve recall and identifiability. It is important to find these changes as it affects real-life situations and can make identifying license plates easier. Being able to correctly recall at least part of a license plate can narrow down the list of potential matches, along with any information regarding the car make and/or model, so that the correct identification can be made. Beyond potential changes that can be made to license plate designs,

future research could also focus on finding strategies that improve recall. Making statewide changes to license plates may be a very difficult process to do, so by having strategies people can use to recall is easier to implement and help solve this recall issue in the short-term. It is worthwhile for future research to find these changes and strategies to help solve the issue with recalling license plates.

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APPENDIX. Human Subjects IRB Approval

Missouri State University

To:
Bogdan Kostic
Psychology
Hannah Johnson

Date: Dec 10, 2021 8:27:55 AM CST

RE: Notice of IRB Exemption
Study #: IRB-FY2022-295
Study Title: The Impact of Color Coding on License Plate Memorability

This submission has been reviewed by the Missouri State University Institutional Review Board (IRB) and was determined to be exempt from further review. However, any changes to any aspect of this study must be submitted, as a modification to the study, for IRB review as the changes may change this Exempt determination. Should any adverse event or unanticipated problem involving risks to subjects or others occur it must be reported immediately to the IRB.

This study was reviewed in accordance with federal regulations governing human subjects research, including those found at 45 CFR 46 (Common Rule), 45 CFR 164 (HIPAA), 21 CFR 50 & 56 (FDA), and 40 CFR 26 (EPA), where applicable.

Researchers Associated with this Project:
PI: Bogdan Kostic
Co-PI: Hannah Johnson
Primary Contact: Hannah Johnson
Other Investigators: