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The Effect of Incidental Conversation on Memory for Focal Colors

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In this research report we present findings from an experiment on memory for color that isolates the source of a discrepancy in results between Lucy and Shweder (1979) and Garro (1986). We find that memory for "focal" colors is affected by whether or not conversation is permitted during the memory task. When conversation is permitted during the memory task, as in our original procedure, focal and nonfocal colors are remembered equally well. When conversation is not permitted, as in Garro's procedure, memory for focals improves, while memory for nonfocals remains unchanged. A second set of results analyzing

subjects' self-reports of their memory strategies explores the strategies that may lie behind these differences. We find that subjects report using verbal memory strategies of various types more than any other strategy, whether or not conversation is permitted, but that a variety of other strategies are also commonly used.

Background

In 1972, Heider presented a series of studies challenging past research on Whorf's linguistic relativity hypothesis and supporting the view that focal colors[1] were *inherently* more memorable than nonfocal colors regardless of language and culture. In 1979, we criticized Heider's research on the grounds that her stimulus array was biased in favor of focal colors. Using a "fair" array,[2] we found that the focal and nonfocal colors were remembered equally well and that a language-based measure—high communication accuracy—provided a good, independent predictor of memory performance. In 1986, Garro tried to replicate our 1979 short-term memory task several times but found that the focal colors were remembered more accurately than the nonfocal colors.

A direct comparison of Garro's second experiment (1986:131, Table 1)[3] with our third experiment (1979:592, Table 4, "Short-term memory")[4] revealed that subjects in *both* studies correctly remembered about 53% of the nonfocals. It also made clear that the difference in the two sets of results resided entirely in the focals: our subjects correctly remembered only 62.5% of the focals, Garro's subjects correctly remembered 81.94% of them. This latter score reflects an extraordinarily high recognition rate and compares favorably with the accuracy rate in our (1979:591) perceptual matching task (82.2% for nonfocals, 89.4% for focals). In this perceptual matching task, no memory demands at all were placed on subjects: they merely had to match a visually present color chip with its mate in the array. This comparison suggested that something in Garro's procedure enhanced memory for focal colors or, inversely, that something in the Lucy-Shweder procedure inhibited memory of focal colors. A notable difference between the two studies, mentioned by Garro (1986:132) but not manipulated experimentally, was that we had permitted conversation during the experiment whereas she had not.[5] In the present study, we test directly the hypothesis that the difference in the Lucy-Shweder and the Garro results stems from this difference in experimental procedure.

Replication of Memory Experiments

Two versions of a recognition memory task were administered. One version followed the original Lucy-Shweder procedures: conversation was permitted during the time-filler period between seeing a color and attempting to locate its mate in an array of colors. The second version was identical except that it followed Garro's procedure: silence was enforced during the time-filler period.

Experimenter and Subjects

To preclude the possibility that the results were due to experimenter bias, we employed a female college student to administer the task who had no background in research on color vision or memory. She was instructed in detail on how to perform the experiment. She knew that we were testing to see whether the presence or absence of conversation would affect color memory. However, she did not know anything about "focal" colors or about the specific hypothesis, namely that memory for the focal colors might differ in the two experimental conditions.

The experimenter recruited twenty University of Chicago students (ten men and ten women) with an average age of 23.4 years to participate in the study. Potential subjects were questioned to assure that they were native speakers of American English and were not color-blind.

Methods

Subjects were divided into two groups of ten with five men and five women each. Both groups then performed color recognition memory tasks which differed with

respect to whether or not conversation was permitted during the filler period.

Subjects sat at a table with the experimenter. Multiple sources of bright incandescent light were used to illuminate the table. The experimental task was introduced as follows:

> This experimental task is part of a larger study of memory for color. The experimental task takes about 30 minutes. I will be happy to answer questions about the experiment at the end.

Subjects were then given specific instruction in the task with slightly different protocols in the No Conversation (NC) and Conversation (C) conditions:

> [NC & C] I will show each color sample for 5 seconds. [A practice chip was shown at this point.] We will then wait for 30 seconds.
> [NC] *You may use this filler time to remember the color in whatever manner you prefer.* [Cf. Garro 1986:130.]
> [C] *It is O.K. to talk during this filler time but not about the experiment itself.* [Cf. Lucy and Shweder 1979:591.]
> [NC & C] After waiting the 30 seconds I will ask you to identify the color you saw in a large array of colors. [The array of colors was shown at this point.] Identify the correct chip for me by pointing to the color or by telling me the location number. [The location numbers along the border of the array were indicated at this point.] Do not touch the chips themselves.

To assure that the subject understood the procedure, a second practice chip was then administered. Then the 24 stimulus chips used both in our original study and by Garro were presented one at a time in a randomized order.

For subjects in the No Conversation condition, the experimenter refused to engage in conversation during the filler period. For subjects in the Conversation condition, the experimenter actively initiated conversation. To minimize the possible influence of differences in the actual content of the conversations, the experimenter confined the conversations to the general topic of what the students intended to do during the summer and/or what courses they were planning to take during the coming year.

Although the experimenter had discouraged conversation about the task itself, any comments about the task made by the subject during its administration were noted. And at the end of the series of 24 chips, a series of follow-up questions were asked. These ancillary data are discussed below.

Results

Each subject's selections in the recognition task were scored as correct or incorrect depending on whether they selected the duplicate of the target in the array of alternates. Table 1 shows the results of the current experiment along with those of Garro (1986) and of Lucy and Shweder (1979). The results confirm that *the presence or absence of conversation during the filler period substantially affects memory of the focal color chips* although it has no apparent effect on memory for the nonfocal color chips. The differences in memory for the focal colors under the two conditions are statistically significant ($t_{18} = 1.91$, one tailed $p < .05$). It seems likely, therefore, that the difference in experimental procedure accounts for the difference between the Garro and Lucy-Shweder results.[6]

Discussion

It appears that memory for focal colors is dramatically affected by the presence or absence of conversation during the filler interval, yet memory for nonfocal colors is unaffected. The reason for this effect remains unclear. In line with her interest in visual imagery, Garro (1986:133–134) speculated that focals might enjoy an advantage in nonverbal—especially visual—encoding. Yet her speculation encounters a difficulty in accounting for the present results. As Garro noted (1986:135, n. 4), research on short term memory indicates that conversation should interfere *less* with visual memory than with verbal memory, that is, conversation should interfere less with a presumed visually based focal memory than with a nonvisually based nonfocal memory.[7] An alternative possibility that is consistent both with the earlier psychological research on memory and with the

Table 1
Accuracy scores (percentage correct) in recognition memory experiments.

	Experimental condition						
			Current experiment				
Chip type	Garro[a]		No Conversation		Conversation		Lucy and Shweder[b]
Focal	81.94%	=	80.00%	>	65.00%	=	62.5%
Nonfocal	53.24%	=	51.25%	=	51.88%	=	53.7%
t_{22}	4.11		2.59		1.25		1.01
two tailed p	<.001		<.02		(n.s.)		(n.s.)

[a]Results from Experiment 2 in Garro (1986:131, Table 1).
[b]Results from Experiment 3 in Lucy and Shweder (1979:592, Table 4, "Short-term memory"). The raw scores in Lucy and Shweder have been converted to percentages here for the purposes of comparison.

specific data at hand is that memory for focals is differentially enhanced by the use of some special verbal strategy and that the strategy is fragile and easily disrupted by conversation. Such a special verbal strategy might involve, for example, the use in memory of highly abstract descriptors (e.g., "pure yellow") not readily available in English for nonfocal colors.[8]

Garro did not consider this latter possibility. Instead, she made use of the introspective comments of her informants to suggest that conversation might, in fact, disrupt a presumed visual memory strategy:

> My informants stated that it was more difficult to keep a picture of the color in their mind than a description of it. Informants using this strategy said they needed to keep their eyes closed and minds clear, and that any extraneous interference would lead to losing the visual image. [1986:135, n. 4]

Garro did not indicate how many of her subjects made such remarks or whether they pertained exclusively to remembering focals. If one were to try to explain the current results in this way, one would have to establish that focals can profit more than nonfocals from visualization and also that conversation interferes with this visualization. In support of this position, Garro (following Rosch 1978) did argue that focal categories are "easier to learn, are processed more quickly, and serve as cognitive reference points" and that they may be better remembered because they match "stored representations and can be more easily encoded and retrieved" (1986:133). The argument is not convincing to us because one might just as well speculate that it should be the nonfocals—difficult to learn, store, and process—that should be helped by the advantageous memory conditions (i.e., those without conversation—where one can sit with one's "eyes closed" and "mind clear"). At the moment we lack the information necessary to sort out in detail the possible relationships between memory strategies and interference conditions that might account for the current findings. A second set of findings, however, suggests that verbal memory strategies play a significant role in color memory and should not be underestimated.

Analysis of Memory Strategies

Our original study (1979) primarily provided quantitative behavioral evidence for the use of verbal encoding as an aid to color memory. Some informal qualitative material on subjects' memory strategies was also provided by analyzing subjects' *incidental remarks* about how they approached the task (1979:593–594). We identified the following strategies: verbal description (sometimes supplemented by visualization), pure visualization (very rare), object matching to an object stored

in memory, and object matching to an object present in the experimental context (Lucy and Shweder 1979:593–594). We concluded that

> the subjects appear to utilize a "standard" (a verbal code, a remembered object, a present object) to encode in memory the bulk of the information [about the color]. Then they only need to actively store the much smaller quantity of information necessary to distinguish the color at hand from the standard. [1979:595]

Garro (1986:130–133) explored subjects' strategies more systematically by asking *follow-up questions* about what types of strategy they used to remember the chips. She found the same basic strategies: verbal, visual, and mixed (e.g., "green like my mother's sweater"). Garro did not provide detailed information about what her subjects reported, except that the mixed strategy was "by far the most common strategy in my experiments" (1986:133).

In conducting the memory experiment reported above, we replicated both earlier procedures: we noted down *incidental remarks* made by subjects during the course of the experiment as we had done in our original experiment, and afterward we asked subjects specific *follow-up questions* about their strategies in the memory task. Our goal was to assess the relative weight subjects put on various memory strategies in this task.

Results: Incidental Remarks

Subjects in the Conversation condition made roughly twice as many incidental remarks overall (124 versus 62, F (1, 16) = 8.45, $p < .001$; there were no significant sex differences or interaction effects so the data for both sexes are combined for the analyses that follow). The remarks were scored qualitatively into the following four types: task analyses, evaluations, difficulty and confidence judgments, and strategy reports.[9] It is the latter that are relevant in the present discussion.

Strategy reports, in which subjects reported or otherwise gave verbal evidence that they were using a specific memory strategy, made up half of the remarks. Subjects mentioned four strategies: verbal labeling, matching with an object present in the room, matching with an object in memory (i.e., absent from the room), and visualizing. These match the strategies identified in our original study. Table 2 shows the distribution of these incidental remarks concerning strategy among these four categories. If we compare the number of subjects giving evidence of the use of one of these strategies, the numbers and the rank order remain quite close under both experimental conditions. Notice that verbal strategies were the most commonly mentioned under either measure (i.e., number of subjects or number of mentions) and that visualization was the least commonly mentioned under either condition. There was particularly pronounced evidence of verbal strategies in the Conversation condition.

Results: Follow-up Questions

Subjects were asked these specific follow-up questions in the order indicated:

1. How did you try to remember the colors; what strategies did you use?
2. Did you visualize the color?
3. Did you use a verbal label or name?
4. Did you associate with an object in memory?
5. Did you associate with an object in the room?
6. Did you use some combination of these?
7. What strategy did you use most?
8. Did you find anything especially difficult about the task?

In response to the first, open-ended question, "How did you try to remember the colors; what strategies did you use?" subjects reported essentially the same array of four strategies that we have already encountered in their incidental remarks. Responses were therefore coded in the same way as the incidental remarks, although a few responses had to be classified as "Other." Table 3 shows both the absolute number of subjects mentioning each type of strategy and a weighted score showing the proportion of responses falling into each category when the responses of each subject were weighted equally. (Each subject was given a score of one and it was distributed among the strategies he or she mentioned.)

Table 2
Distribution of incidental remarks having to do with memory strategies: number of subjects mentioning each strategy and absolute number of mentions of each strategy.

Strategy	Experimental conditions		
	No conversation	Conversation	Total
	Number of Subjects[a,b]		
Verbal labeling	5	8	13
Matching, present object	4	4	8
Matching, absent object	1	3	4
Visualizing	1	2	3
	Number of Mentions[b]		
Verbal labeling	9	29	38
Matching, present object	8	4	12
Matching, absent object	3	9	12
Visualizing	1	2	3

[a]There were 10 subjects in each experimental condition.
[b]Because a given subject could report more than one strategy, totals bear no reliable relationship to the sample size.

Table 3
Distribution of follow-up questions having to do with memory strategies: number of subjects mentioning each strategy and weighted scores of number of mentions of each strategy.

Strategy	Experimental conditions		
	No conversation	Conversation	Total
	Number of Subjects[a,b]		
Verbal labeling	7	5	12
Matching, present object	5	3	8
Matching, absent object	2	5	7
Visualizing	6	4	10
Other	2	0	2
	Weighted Scores[b]		
Verbal labeling	3.33	3.16	6.50
Matching, present object	2.50	1.83	4.33
Matching, absent object	0.83	2.67	3.50
Visualizing	2.50	2.33	4.83
Other	0.83	0.00	0.83

[a]There were 10 subjects in each experimental condition.
[b]Each subject was given a value of 1 and this point value was divided equally among the various strategies mentioned.

As Table 3 shows, verbal labeling is the most frequently mentioned strategy under both measures for both conditions. It appears that visualizing was a slightly more common strategy under the No Conversation condition, but the trend is not strong. Perhaps the surest conclusion here is that subjects used a variety of strategies for remembering the colors. This is confirmed by the question, "Did you use some combination of these [strategies]?" All 20 subjects responded affirmatively to this question.

The more direct questions about specific strategies (questions 2–5) produced much the same pattern of results as the

open-ended question. All 20 subjects reported using verbal labels at least part of the time, 18 out of 20 reported using matching with an object present, 18 out of 20 reported visualizing, and 16 out of 20 reported matching with an object in memory. When asked "What strategy did you use most?" a majority of subjects (11/20) indicated that they used verbal labels most, but a significant minority indicated that they used other methods the most: matching with a present object (4/20), matching with an absent object (2/20), visualizing (3/20). The same pattern of results obtained for both conditions.

The final question was "Did you find anything especially difficult about the task?" The majority of comments concerned the color stimuli themselves. Nine subjects complained that chips were perceptually very close to each other; typically they remarked that there were many "shades" of the same color. Also, eight subjects complained that certain chips, or types of chips, were harder: five of these eight subjects specifically mentioned the blues and three of these five also specifically mentioned greens. Aside from these comments about the colors, the most frequently mentioned difficulty had to do with conversation. Four subjects in the Conversation condition mentioned that the conversation was distracting. However, three subjects in the No Conversation condition mentioned that not talking (or keeping quiet) was a problem, and a fourth mentioned that "thoughts or 'mental' conversation" disrupted his memory.

Discussion

It seems likely that subjects use multiple strategies in remembering colors under these task conditions. Incidental remarks and the follow-up questions (open-ended and specific) suggest that verbal strategies represent the most common memory strategy. By contrast, visualization is not a dominant strategy although it clearly does play some role. These generalizations hold for *both* experimental conditions. These self-report measures do not suggest differences in strategy for the two groups.

Conclusion

The major result of our study is that enforced silence enhances memory for focal colors but not for nonfocal colors or, alternatively, that conversation differentially interferes with memory for focal colors. If this finding proves robust, then the discrepancy between Garro (1986) and Lucy and Shweder (1979) can be accounted for by differences in details of experimental design. In particular, the elimination of conversation in Garro's procedure appears to have helped subjects remember focal colors.

More evidence is needed before we can fully explain this result. One possibility is that memory for focals can profit by a concentrated effort at visualization and that enforced silence helps this effort. A second possibility is that memory for focals can profit by special verbal encoding, but that verbal conversation results in interference. We do not feel that the data presently available provide decisive support for either claim.

More generally, detailed analysis of subjects' remarks shows that regardless of experimental condition all subjects report using multiple strategies. Some use of visualization is reported by most subjects—especially when they are directly asked about it. Yet there is no notable difference in this regard between the Conversation and No Conversation conditions. Interestingly, just as many subjects complained about the absence of conversation as complained about its presence! It should also be noted that the highly context-sensitive strategy of matching a color chip with a nearby object was just as important as visualization and that verbal strategies were the most frequently mentioned in all the self-report measures.

Finally, the replication of both sets of previous results is in itself noteworthy—especially in light of the remarkable similarity of the new results to the original findings. We conclude that verbal strategies form an important component of color memory, that under special conditions such as enforced silence focals are better remembered than nonfocals, but that the specific reasons for this advan-

tage remain unclear. We also note that nothing in the present study alters the major conclusions of our original study (Lucy and Shweder 1979), namely, that during the previous decade the role of language and verbal strategies in color memory had been prematurely dismissed.

Notes

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[1]Focal colors are those most frequently chosen from a specific array of commercially produced color samples as best exemplars of the basic color terms of English and other languages.

[2]What constitutes a "fair" array is a matter of judgment and is always relative to the hypothesis at issue. We argued that Heider's array was "unfair" from the point of view of assessing *memory* effects because the focals had a distinct advantage in *perceptual* search times (i.e., even under conditions simulating "perfect" memory with probe chip and target chip both in view). No memory effects independent of perceptual differences could be established under such conditions. Some critics have questioned whether in altering the array we have not in fact removed the "focality" effect, which they seem to conceive of in terms of just such a local perceptual advantage. This is a misunderstanding of the idea of focality, which has to do with the inherent perceptual salience of a color. From a theoretical point of view, it is important to distinguish between *discriminability in an array* (which has to do with how much a color is like or perceptually "close to" its neighbors) and *inherent salience* (which has to do with the intrinsic perceptual properties of a color independent of its immediate neighbors). (See Kay and McDaniel 1978 for an attempt to establish a psychophysical basis for focal color *salience* in terms of visual thresholds *independent of any considerations of context.*) If the perceptual advantage of focals had solely to do with a greater perceptual distance from their immediate neighbors in an array, then focality would be reduced to a relatively minor phenomenon having to do with the perceptual characteristics of certain arrays. With such an attenuated concept of focality, the only way left to preserve some semblance of Heider's original claims about the inherent memorability of focal colors would be to argue that the Munsell-based Heider array represents a "fair" sample of the "color" space. The grounds for such an assertion would have to be made carefully either on psychophysical or sampling grounds. With regard to its psychophysical status, the perceptual distances on the horizontal and vertical axes are not equivalent, and the third axis (saturation) varies unsystematically. With regard to sampling, the array is taken only from the perimeter skin of the 3-D Munsell color space which would have to be justified. Furthermore, the Munsell array itself does not represent a "sample" of everyday encounters with color. And, finally, all this leaves aside some deeper questions about the status of "color" as a viable analytic category both in the Munsell system and more generally (see Lucy 1987:ch. 5).

[3]We use Garro's second experiment because it most closely matched the original Lucy-Shweder design. Her first and third experiments produced essentially identical results. Her fourth experiment involved Mexican Spanish-Tarascan bilinguals and produced substantially lower memory scores. Although the finding of lower memory scores on this task is probably reliable since comparable results have been found with other Mexican groups (Lucy 1981), we feel these latter data cannot be compared with the English results without more extensive discussion.

[4]The raw scores in Lucy and Shweder (1979) have been converted to percentages here for the purposes of comparison.

[5]Garro (1986:132) also suggested that, by chance, we might have made a Type II statistical error since our data showed some advantage for the focal colors in memory. This seems unlikely on three counts: (1) the slight (but not statistically significant) advantage held by the focals in memory can be readily accounted for by the slight perceptual bias that remained in the "fair" array (cf. Lucy and Shweder 1979:590–591, and note 2 of the present study), (2) the near identity of the nonfocal scores in the two studies suggests that the original numbers were reliable, and (3) the original results are replicated in the current study. Garro did not mention a third possible source of error: unwitting experimenter bias. This possibility is precluded in the present replication, which reproduces the original results using an experimenter unaware of the specific hypothesis.

[6]Since Lucy (1981) has found sex linked differences in memory strategies with focal colors in some cultural groups, a check was made for

sex differences. With the focals, both sexes showed a similar 20% decline in accuracy under the Conversation condition but women showed slightly superior ($t_{18} = 1.20$, n.s.) performance overall. With the nonfocals, the women did better under the No Conversation condition and the men did better under the Conversation condition.

[7]Garro has some reservations (which we share) about the relevance of this research to the task in question.

[8]Note that such a description depends less on specific experiences and more on a logic of relations within a set of criteria as to what constitutes "color."

[9]In "Task Analyses," subjects analyzed or evaluated the task parameters (20 remarks). For example, subjects remarked that the task got more difficult as it went along, that the lighting was bad, and so forth. In "Evaluations," subjects indicated that they liked or disliked a color or otherwise gave some positive or negative evaluation of it (30 remarks). In "Difficulty and Confidence Judgments," subjects indicated directly or indirectly that a particular item or group of items was especially difficult or easy (68 remarks). For example, subjects questioned whether all the colors were in the array, reported that they had forgotten a color, and so on. In "Strategy Reports," subjects reported or otherwise gave verbal evidence that they were using a specific memory strategy (68 remarks). The quantitative distribution of these four types of incidental remarks into the No Conversation (NC) and Conversation (C) conditions was as follows: Task Analyses (NC: 11; C: 9), Evaluations (NC: 8; C: 22), Difficulty and Confidence Judgments (NC: 18; C: 50), Strategy Reports (NC: 25; C: 43). As these numbers make clear, the kinds of remarks showing the greatest increase under the Conversation condition were the Evaluations and the Difficulty and Confidence Judgments—types of remarks not particularly of interest in the present study. Strategy Reports increase roughly in proportion to the overall increase in remarks under the Conversation condition.

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Anthropological Applications of Skeletal Lead Analysis

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More than 90% of lead absorbed by the body is stored in the skeleton, where its turnover rate in adults is extremely slow (Rabinowitz, Wetherill, and Kopple 1975). Within certain limits, useful information can be derived from a pragmatic assumption that skeletal lead content at