2019

The Effects of Retrieval Strategy on a Collaborative Reconstruction Task

Amanda M. Bullock
University of Mississippi

THE EFFECTS OF RETRIEVAL STRATEGY ON A COLLABORATIVE RECONSTRUCTION TASK

Amanda M. Bullock

A thesis submitted to the faculty of The University of Mississippi in partial fulfillment of the requirements of the Sally McDonnell Barksdale Honors College.

Oxford

May 2019

Approved by:

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Advisor: Dr. Matthew Reysen

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Reader: Dr. Michael T. Allen

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Reader: Dr. Rebekah Smith

ACKNOWLEDGMENTS

First and foremost, I would like to thank my advisor, Dr. Matthew Reysen, for his patience and tremendous help over the past two years. He has given me all the tools to be successful in the completion of my thesis and I truly could not have done it without him. I would also like to thank my second and third readers, Dr. Michael Allen and Dr. Rebekah Smith, for taking time out of their schedules to read and review my work. I extend my gratitude to both the Sally McDonnell Barksdale Honors College and the department of Psychology for allowing me to conduct this research and giving me a platform from which to present my hard work. Lastly, I am deeply grateful to my family and friends who have shown me nothing but support, patience, and love.

ABSTRACT

The purpose of the present experiment was to explore the effects of using various retrieval strategies on a collaborative reconstruction task. More specifically, we sought to determine the extent to which the Retrieval Strategy Disruption Hypothesis (RSD) could explain the effects of collaborative inhibition on such tasks. Collaborative inhibition is observed when collaborative group performance is lower than the pooled performance of an identical number of individuals working alone (nominal groups). The RSD hypothesis suggests that one group member's output disrupts another group member's idiosyncratic retrieval strategy leading to poorer performance relative to individuals working alone. In the present study, participants were asked to reconstruct an eight-item list of common nouns either individually (later used to form nominal groups), with a partner employing a turn-taking strategy (turn-taking groups), or with a partner employing a turn-taking strategy while recalling the words in the order in which they were originally presented (restricted groups). We observed equivalent performance in the nominal and restricted groups and statistically poorer performance in the turn-taking groups. These results are discussed with respect to the Retrieval Strategy Disruption Hypothesis.

TABLE OF CONTENTS

INTRODUCTION

Memory research has historically focused on individual memory performance rather than how people work together to remember information. However, recently, there has been an increased interest in the manner in which people remember in groups. In the present study, we examined the effects of different reconstruction strategies on collaborative reconstruction performance. The Retrieval Strategy Disruption (RSD) Hypothesis predicts that the less a participant's idiosyncratic retrieval strategy is disrupted by their partner's output, the better memory performance will be. Thus, some strategies, like engaging in a free-for-all recall strategy, should be more disruptive than others (for example, engaging in a turn-taking strategy in which participants remember words in the order in which they were originally presented). More specifically, the RSD hypothesis predicts that, to the extent that partners with different retrieval strategies disrupt each other's preferred order of output, their overall performance will suffer. In the present study, we aim to explore how performance in a collaborative turn-taking strategy and a collaborative sequential turn-taking strategy compare to the performance of nominal groups (the pooled non-redundant output of two or more individuals working alone). As noted above, a number of recent studies have explored the manner in which collaborating to remember information influences memory performance (e.g., Andersson, Danielsson, Dahlström, & Emilsson, 2011). Several of these efforts are discussed below.

As noted above, there has been an increase in interest in collaborative memory in recent years. For example, researchers have examined the effects of collaboration on memory performance for recall of word lists (Dahltsröm et al., 2011), stories (Weldon & Bellinger, 1997), and pictures (Weldon & Bellinger, 1997). They have also investigated factors that may influence

the manner in which people work together to recollect information, such as pairing people with friends as opposed to strangers (Anderson & Rönnberg, 1996).

According to the Retrieval Disruption Hypothesis, listening to a partner's memory output disrupts one's own idiosyncratic retrieval strategy (Dahlström, 2011). Basden, Basden, Bryner, and Thomas (1997) sought to determine if RSD can lead to collaborative inhibition when participants study categorized lists of words and subsequently attempt to remember them together. They found that collaboration inhibited performance more in groups presented with large categories and when category names were provided to participants at the point of test. However, collaborative recall was observed to be equivalent to nominal group performance when the task involved recalling non-overlapping parts of lists and when participants were instructed to organize their recall output by category. In a follow up study, it was found that collaboration benefits individual recall performance on a later test when participants had initially worked together to remember lists of items (Basden, Basden, Henry, 2000). Both these studies, and most studies that examine similar phenomena, employed a turn taking strategy, in which participants took turns responding with no constraints on the order in which they remembered items from the lists. Thus, it is possible that these results were contingent on participants adopting an asynchronous collaborative strategy as opposed to a shared strategy.

Although most studies examining collaborative inhibition have focused on word lists, it has also been investigated using both pictures and stories. For example, Weldon and Bellinger (1997) found that nominal groups recalled more pictures and words than collaborative groups. Similar results were observed when nominal and collaborative groups were compared with respect to their ability to recall elements of stories. Additionally, it was noted that there was a tendency for collaborating groups to rely heavily on one member's recall when performing the

task. In other words, it seemed as if the group member who was most confident in their memory of the story recalled as much as they could, and then other group members worked to fill in any missing details. This strategy is different than the turn-taking strategy enforced in several of the studies mention above (Bellinger & Weldon, 1997).

One factor that might influence participants' ability to work together to remember information is the extent to which those individuals are familiar with one another. Several studies have examined differences in collaborative memory performance between friends and strangers . For example, Takahashi (2007) found that groups of friends and groups of non-friends both produced fewer false memories than comparable nominal groups. Additional research has revealed that spouses tend to generate fewer memory errors when recalling shopping lists and on recognition tests than nominal groups (Lam, Linardatos, Perunovic, Ross & Spencer, 2004). There was also a higher level of certainty reported when spouses collaborated on the recognition of a city landmark from a photograph before they claimed they recognized the landmark in the recognition task (Lam et al., 2004). More collaboration between spouses led to more certainty that they could correctly identify the landmark. Similarly, in another experiment, it was shown that collaborating groups of friends performed better on memory tests than did collaborating groups of strangers (Andersson & Rönnberg, 1996). Most of these studies employed the standard turn-taking paradigm in which one group member recalls an item, followed by another, in the absence of restrictions on the order in which those items are remembered.

Another factor that has been identified as a contributor to the extent that collaborative inhibition occurs is decreased group productivity. For example, one study examined production blocking (the tendency for one group member to stop other group members from sharing their ideas) in collaborative group recall as opposed to a nominal group condition. They found that

most of the group productivity loss was due to productive blocking (Diehl & Stroebe, 1987). Similarly, Ekeocha and Brennan (2008) found that this loss of productivity in groups is seen in both face-to-face groups and electronic groups who interact via a computer interface. Further they noted that the underlying causes of this loss vary as a function of the manner in which the groups interact (self-filtering in electronic groups, group-filtering in face-to-face groups). Again, these studies employ a standard turn-taking set of instructions.

As noted above, collaborative inhibition is a robust phenomenon that has been observed in a variety of situations using a number of different types of stimuli. Wright and Klump (2004) ran an experiment designed to hone in on the underlying mechanism driving the effect. More specifically, they sought to determine whether group members' varying retrieval strategies were driving the effect or if it was due to other factors. They concluded that the reduced recall output as a function of working with another person to remember information was caused primarily by interference from other group member's recall output. Similar results have been reported by other research teams (Finlay, Hitch, & Meudell, 2000).

In the present experiment, we were particularly interested on the influence of reconstruction instructions on participants' ability to work together to reconstruct the order of a previously presented list of words. When participants are asked to recall a list of words in serial order, starting at position 1, there is well known tendency for items that appear early in the list to be especially well remembered (e.g., Grenfell-Essam, Tan, Ward, 2010). In addition, when participants are allowed to remember a list of items in any order they choose, they often recall items towards the end of the list first, followed by items that were presented at the beginning of the list. Furthermore, the ideal order of output for any given participant might differ and, when working together, the possibility for output interference is always present.

Dahlström et al. (2011) ran a study examining the effect of different recall strategies on collaborative recall performance. They had participants recall a sixty-word list both collaboratively and individually to examine if collaborative inhibition is due to RSD. The results were consistent with a retrieval strategy disruption account, in that the use of different recall strategies by different group members led to more forgetting than when group members relied on similar strategies (Dahlström et al., 2011). One factor that was not examined, and that we are interested in determining, is whether requiring participants to use similar retrieval strategies might improve performance relative to other turn-taking groups.

In the present study, we want to determine how reconstruction instructions influence participants' ability to work together to place a list of words back into the order in which they were originally presented. It is possible that the turn-taking strategy employed by most researchers in this area might lead to different results than a potentially more synchronous strategy in which participants adopt a serial reconstruction approach. In addition, very little work has been conducted on collaborative reconstruction tasks. We hope to add to the broader literature on collaborative memory by observing how working with others might influence one's ability to reorder a list of words.

In one similar study, Serra and Nairne (2000) looked at the effects of part-set cuing (giving items from the list back again to participants) on reconstruction ability. Their results demonstrated that participants often do not solely rely on position information to reconstruct word lists. Participants may also rely on interitem associative information to assist reconstruction (i.e. using the items in serial position one and two to remember the item in serial position three). They further concluded that their results were consistent with the idea that RSD is likely responsible for reduced reconstruction performance in the presence of cues from the original list.

Although collaborative inhibition and part-set cuing effects represent different retrieval phenomena, they are similar in the sense that items from the list present at the point of test can disrupt participants' recall, recognition, and reconstruction performance.

In the present experiment, participants studied an eight-item list of words either alone or in collaborative pairs. They then attempted to reconstruct the list order by themselves (which subsequently allowed for nominal group formation) or with a partner. In one collaborative condition, participants could place any item in any position they believed to be correct (the commonly used 'turn-taking' strategy), or were required to reconstruct the items in the order in which they were originally presented (a 'restricted' condition). We hypothesized that working with a partner employing a sequential turn-taking strategy would improve performance, relative to participants in the turn-taking condition, by reducing the potential for retrieval strategy disruption. In addition, we predicted that performance in the nominal groups would outpace the performance of those in the restricted groups, because members of nominal groups would not be disrupted by output from their group member. Such an observation would provide support for the Retrieval Strategy Disruption Hypothesis, in the sense that retrieval disruption would be identified as a primary mechanism driving collaborative inhibition in reconstruction tasks. In other words, the greater the potential for retrieval strategy disruption, the worse the reconstruction performance was predicted to be.

METHODS

Participants

A total of 156 undergraduate psychology students enrolled at the University of Mississippi participated in this study in return for partial course credit. Participants arrived at the lab individually or in pairs and the test sessions lasted about 15 minutes. These 156 participants were used to form 78 pairs in one of three experimental conditions described below.

Design

A mixed design was employed with instructional condition (nominal, turn-taking, restricted turn-taking) as a between-subjects factor and serial position (1 – 8) as a within-subjects factor. The primary dependent variable in the present experiment was the participants' ability to correctly reconstruct the list items that they studied.

Materials

Consistent with previous work in this area (Serra & Nairne, 2000) participants studied an 8-item list consisting of nouns which ranged in length from 4 to 6 letters. These 8 words were drawn from Clark and Paivio's (2004) word norms and were rated comparably in terms of imagery, concreteness, and meaningfulness. So that participants were not able to anticipate the manner in which they would be asked to recall the items, unlike previous studies that have examined reconstruction in a similar manner (e.g., Serra & Nairne, 2000), we opted to use a single study-test trial (as opposed to multiple trials) and introduced the instructional manipulation after the presentation of the list. Although this reduced the amount of data that we could collect and increased the possibility of ceiling effects, it prevented participants from altering their encoding strategies to make them more consistent with the instructional condition to which they were assigned. Personal computers were used to present all of the stimuli and all of the participants' responses were recorded on paper response forms.

Procedure

If two participants arrived at the lab together, they were randomly assigned to one of the two group conditions (turn-taking, restricted turn-taking). If a time slot had two participants scheduled but only one of them attended (or if only one participant signed up for a given time slot) they were assigned to the nominal group condition. All of the participants were informed that they were going to be presented with a list of words. Following the presentation of each list, they were told that they would then be presented with the words in a new random order. They were also informed that their job would be to put the words back into their original positions either alone or with the help of their partner.

At this point, the experimenter answered any questions that the participants had, and the list of items was presented. During the word list presentation, eight words were presented one at a time in the middle of a computer monitor at a rate of two seconds per word with an inter-stimulus interval of .5 seconds. After the presentation of the eighth item, the screen was cleared and participants were handed a sheet of paper with a number of double-digit addition and subtraction problems (e.g., 58 – 23) and they were asked to solve these problems for 60 s. Following this 60 s delay, the experimenter handed the participants a response sheet with a set of instructions at the top of the page. The instructions were as follows for the various conditions:

Nominal: Using the spaces below, please place the words back into their original list positions. Please do not leave any spaces blank.

Turn-Taking: Using the spaces below, please take turns with your group member (one response from you followed by a response from your group member) and place the words back into their original list positions. Please do not leave any spaces blank.

Restricted: Working from left to right and using the spaces below, please take turns with your group member (one response from you followed by a response from your group member) and place the words back into their original list positions. In other words, you should fill in the first space first, followed by the second, then the third – continuing until all of the spaces are filled. Please do not leave any spaces blank.

Beneath these instructions, eight items from the previously presented list were printed on the response sheet in a new random order. Underneath these items, eight lines were displayed. Participants were told to write the words printed beneath the instructions on the lines in the order in which the words were originally presented. In the group conditions, the participant who was asked to respond first wrote a response and then passed the sheet to their group member so that she could provide a response. This turn-taking continued until participants had placed a word in each of the eight positions. After reconstructing the list, participants were debriefed and thanked for their participation. The reconstruction test was self-paced.

RESULTS

The present experiment had two independent variables, one which was a within-subjects variable (serial position: 1 - 8), the other which was a between-subjects variable (instructional

condition: 'nominal', 'turn-taking', and 'restricted'). Nominal groups were created by combining two individual participants' non-redundant responses on the reconstruction tests. Individuals were assigned to nominal groups in the order that the individual participants completed the study. In other words, the first two individual participants to complete the study comprised the first nominal group, the second two individuals to complete the study made up the second nominal group, and so on until all of the nominal groups were formed. More specifically, if either of the two members of a nominal group correctly reconstructed the position of an item, that item was counted as correct for the nominal group. If the reconstructed the item correctly, it was scored as 1. If it was not reconstructed correctly, it was scored as 0. We used these scores to find the mean accuracy at each serial position according to each condition.

In the turn-taking groups, each participant in a pair was required to take turns responding, but they were allowed to put any item from any serial position (one through eight) in the order that they believed to be the correct order when it was their turn to respond. So, for example, a participant responding first would be able to place the eighth item in a list in the position that they believed to be correct on their first reconstruction attempt. Finally, in the restricted condition, participants worked in pairs and were required to take turns and, in addition, were required to reconstruct the items in the order in which they were presented until all eight items had been placed in positions. If the pair reconstructed a word in its correct serial position, it was scored as 1 and if it was incorrect, it was scored as 0.

We hypothesized that participants' performance would be best in the nominal condition because participants would be free to reconstruct the lists using their own preferred idiosyncratic retrieval strategies. We expected performance to be intermediate in the 'restricted' condition, because although it may not represent their preferred strategy, participants would at least be

forced to adopt a common strategy. Finally, we expected performance to be worst in the turn-taking condition because participants would be free to reconstruct items in a manner that could disrupt their partner's idiosyncratic retrieval strategy. A 3 (instructional condition) X 8 (serial position) repeated measures ANOVA was conducted to determine to extent to which instructional condition influenced reconstruction ability as a function of serial position. Instructional condition was entered as a between-subjects factor whereas serial position was entered as a within-subjects factor. As expected, we observed a main effect for serial position $F(7, 525) = 12.62$, $p < .0001$. Thus, overall, participants were more likely to correctly reconstruct words in some positions in the list than in others. In addition, a main effect was observed for instructional condition, $F(2, 75) = 4.55$, $p < .05$. This result suggests that the manner in which participants were instructed to reconstruct the lists influenced their ability to place the items in their correct positions. The interaction between serial position and instructional condition was not statistically significant, $F(14, 525) = 1.61$, $p > .05$.

The main effect for serial position was expected and likely resulted from the well-documented serial position effect, or the tendency for participants to reconstruct items towards the beginning and ends of lists better than items positioned in the middle of lists. To determine whether this expected pattern of results was generally consistent with the results we obtained, we collapsed across instructional conditions and compared the average reconstruction accuracy in the first two positions (1 and 2, $M = .86$) with the second two positions (3 and 4, $M = .60$) using a paired samples t-test. The result of this comparison was statistically significant, $t(77) = 5.20$, $p < .0001$. Thus, participants were more likely to correctly reconstruct the first two words in the list than the second two words. Next, we compared the average performance in the second two positions (3 and 4) with the next two positions (5 and 6, $M = .44$). This result was also

statistically significant, $t(77) = 3.41$, $p < .005$. Consist with expectations, reconstruction performance was relatively poor for the items in the middle of the serial position curve. Finally, we compared participants' performance for items in the fifth and sixth positions with the final two positions (7 and 8, M = .54). The results indicated that performance improved in the expected direction but that the difference was not statistically significant, $t(77) = 1.63$, $p = .10$. Thus, overall, participants tended to reconstruct items more accurately towards the beginning and ends of the list relative to items positioned in the middle of the list.

To determine the extent to which instructional condition influenced reconstruction ability, we conducted three independent samples t-tests comparing overall reconstruction accuracy in each of the three instructional conditions. The results of those tests indicated that, as predicted, participants reconstructed the list items more accurately in the nominal condition (M = .68) than in the turn-taking condition (M = .51), $t(50) = 3.52$, $p < .005$. In addition, as predicted, participants in the restricted condition (M = .64) more were likely to accurately reconstruct the words than participants in the turn-taking condition, $t(51) = 2.01$, $p < .05$. However, contrary to expectations, participants' reconstruction accuracy was statistically equivalent in the nominal and restricted conditions, $t(49) = 0.53$, $p > .05$. Thus, overall, these data suggest that allowing participants working in collaborative pairs to reconstruct items in any order they chose was disruptive to reconstruction ability relative to both the nominal and restricted conditions.

DISCUSSION

Overall, the results obtained in the present study are consistent with the retrieval strategy disruption hypothesis. In other words, the more likely it was that one group member's output could interfere with another's reconstruction efforts, the worse participants performed. We

hypothesized that participants in the restricted groups and the nominal groups would both outperform the turn-taking groups and our results were consistent with this prediction. More specifically, we expected better performance in the restricted groups than in the turn-taking groups because we hypothesized that adopting a similar strategy would reduce retrieval strategy disruption. However, inconsistent with predictions, we observed equivalent performance in nominal groups and restricted groups. Thus, it is possible that participants working alone may have adopted a similar serial reconstruction strategy. It is also possible that the ability to rely on a partner to avoid potential mistakes may have overcome any retrieval strategy disruption which occurred while adopting a shared strategy.

One potential concern with using a single study-test trial was that participants may find the task too easy to complete. In other words, it is possible that ceiling effects may have limited our ability to determine whether the instructional manipulation influenced participants' reconstruction ability. However, the low number of items correctly reconstructed (especially for items positioned towards the middle of the list), reduced any such concerns. In fact, given the relatively poor performance across conditions, it is possible that employing multiple study test trials may have reduced performance further as participants became fatigued or proactive interference from earlier trials accrued. In future experiments, it would be interesting to determine how different sets of instructions might influence performance over multiple study-test trials. Such a manipulation would also allow for a determination of whether participants can adjust their reconstruction strategy to become consistent with current task demands. In other words, if they know they will be using the same retrieval strategy each time they get a new list, they may adopt a strategy of, for example, only focusing on every other word in the list. It

would also be possible to manipulate reconstruction instructions within subjects so that participants could not anticipate what would be asked of them at the point of test.

There are several aspects of the current study that may limit our ability to interpret the observed results. First, establishing a significant number of collaborating groups proved much more difficult than anticipated. We had hoped to include at least thirty groups per condition and, while we got close, we did not quite reach that number, perhaps reducing the likelihood of observing statistically significant results. Furthermore, this dearth of participants forced us to make a difficult choice and eliminate a fourth condition we had hoped to include in the experimental design. In that condition, participants would have engaged in a collaborative reconstruction task that did not involve turn-taking. In other words, participants in collaborative groups would have been free to complete the reconstruction task in any manner that they chose. It would be interesting to examine how such a group might compare with those included in the present study. Finally, this experiment was completed by volunteers currently enrolled in an undergraduate psychology class. Because of this, the age range of the participants was primarily constrained to young adults. It would be interesting to determine whether such effects could be observed in either older or younger adults.

Overall, the results of the present experiment are consistent with predictions generated from the RSD hypothesis. As the likelihood of strategy disruption increased, reconstruction performance decreased. Thus, the retrieval cues generated one at a time by a partner seemed to act in a similar manner to the part-set cues presented all at once to participants prior to reconstruction attempts in previous studies. This result adds to the literature on collaborative inhibition by suggesting that working with others can not only disrupt performance on recall and recognition tasks, but also during reconstruction tasks. Furthermore, these results suggest that

the manner in which participants are instructed to complete such tasks can have an impact on participants' reconstruction performance.

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Figure 1

Reconstructive accuracy as a function of instructional condition

Serial Position	Condition	Mean	Standard Deviation
One	Nominal	0.9200	0.27689
	Turn-taking	0.9630	0.19245
	Restricted	0.8846	0.32581
	Total	0.9231	0.26819
Two	Nominal	0.9200	0.27689
	Turn-taking	0.6296	0.49210
	Restricted	0.8462	0.36795
	Total	0.7949	0.40641
Three	Nominal	0.8000	0.40825
	Turn-taking	0.5556	0.50637
	Restricted	0.6154	0.49614
	Total	0.6538	0.47882
Four	Nominal	0.7200	0.45826
	Turn-taking	0.4074	0.50071

Figure 1: A comparison of the mean reconstructive accuracies as a function of the instructional conditions. The error bars represent standard error.

	Restricted	0.5000	0.50990
	Total	0.5385	0.50175
Five	Nominal	0.6000	0.50000
	Turn-taking	0.2963	0.46532
	Restricted	0.4615	0.50839
	Total	0.4487	0.50058
Six	Nominal	0.5600	0.50662
	Turn-taking	0.2593	0.44658
	Restricted	0.4615	0.50839
	Total	0.4231	0.49725
Seven	Nominal	0.4400	0.50662
	Turn-taking	0.4074	0.50071
	Restricted	0.6923	0.47068
	Total	0.5128	0.50307
Eight	Nominal	0.4800	0.50990
	Turn-taking	0.5556	0.50637
	Restricted	0.6538	0.48516
	Total	0.5641	0.49908

Table 1

Proportion correct for each serial position as a function of instructional condition.