# THE EFFECTS OF PART SET CUING ON AUTOMATIC AND CONTROLLED PROCESSES

by

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Past studies of part set cue inhibition have provided little clue as to the possible relationship between this effect and controlled/conscious and automatic memory processes. In this study, an attempt to link directly the inhibitory effect of part set cues to conscious/controlled or automatic processes was attempted. Several different experimental methodologies were used across three different experiments to examine this issue. In Experiment 1, using the process dissociation procedure (Jacoby, 1991), part set cues were found to decrease estimates of controlled processes while estimates of automatic processes remained unaffected. In Experiment 2, the use of the independence remember/know procedure (Jacoby, Yonelinas, & Jennings, in press) produced similar results. Estimates of controlled memory were found to decrease in the presence of part set cues, and the automatic estimates were not influenced by the presence of part set cues. Furthermore, the claim that conscious processes were indeed manipulated independently of automatic processes was corroborated in both experiments by the use of marker variables known to effect conscious but not automatic processing. Both dividing attention (Experiment 1) and delay (Experiment 2) produced effects on conscious process estimates parallel to those produced by part set cues, thus strengthening the claim that conscious processes were being manipulated while

automatic processes were not. In the final experiment, a comparison of the effects of part set cues on explicit and implicit tests revealed the same pattern of performance as found in Experiments 1 and 2. That is, an inhibitory effect of part set cuing was found with an explicit cued recall test (i.e., a test relying on conscious memory processes) while such an inhibitory effect was absent on an implicit test of memory (i.e., a test relying on automatic memory processes). Furthermore, a levels of processing effect (cf. Craik & Lockhart, 1972) was obtained on the explicit test but not the implicit test, confirming that performance on the explicit test was utilizing conscious processing and that performance on the implicit test was not relying on conscious memory.

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TABLE OF CONTENTS

# CHAPTER I

# INTRODUCTION

Typically, memory research has shown that cues are beneficial to memory. For example, Tulving and Thomson (1971) have provided evidence that recall is enhanced when subjects are provided with cues that were present at the time the item was encoded. Numerous other researchers (Morris, Bransford and Franks, 1977; Tulving and Pearlstone, 1966) have given evidence of the beneficial effects of cues on recall. One effect, however, of cues on recall has received less attention-- namely, the inhibiting influence that cues can have on recall performance. This negative effect of cuing has been aptly named part set cuing inhibition (cf. Slamecka, 1968; Nickerson, 1984). Part set cuing inhibition is used to refer to a situation in which subjects are provided with a subset of items originally seen at study. Subjects are instructed to use these items as cues to help them remember the remainder of the study list. When performance in the partial cuing condition is compared to a situation in which subjects are not provided with cues, performance is found to be worse in the cued condition than in the uncued condition (Slamecka, 1968; Roediger, 1974; Rundus, 1973). This effect has been demonstrated with both related (Roediger, 1973; Watkins, 1975) and unrelated lists (Slamecka, 1968). This inhibitory effect of memory cues has been found with nonverbal materials such as pictures as well (Peynircioglu, 1987). This negative effect of retrieval cues contrasts sharply with studies demonstrating the positive effects of retrieval cues. While many different studies have demonstrated that part set cuing is a reliable phenomena (for a general review of the phenomenon see Nickerson, 1984), theoretical explanations of this phenomenon have not proved adequate in providing a satisfactory account of why cues should inhibit recall.

## Historical Background

In 1968, Slamecka presented the initial report of the part set cuing inhibition phenomenon. Across a series of six experiments, Slamecka found that the presentation of previously studied items inhibited recall of the remaining items when compared to recall in an uncued, free recall condition. Furthermore, this inhibitory effect was found to increase systematically as the amount of context (i.e., the number of previously studied items) increased. That is, inhibition was found to vary directly as a function of the amount of context provided. Furthermore, Slamecka found this inhibitory effect to be present when dealing with unrelated lists composed of either rare or common words. Slamecka, however, found that when words were associatively related to one concept, for example to the word butterfly, no inhibitory effect was found.

Others have found that presenting cues sometimes does facilitate performance under some circumstances. Wood (1969) found small effects of cuing only when related category items were blocked but not randomly presented at study. Lewis (1971) has also found that similar facilitatory effects occur when subjects are presented with one cue from each category with blocked but not random lists. Likewise, Slamecka (1972) has found evidence that facilitation can occur with blocked lists when one intralist cue is provided at recall, but he also found a decrease in recall with the use of four cues when compared to the use of one cue. Slamecka, however, pointed out that the facilitatory effect was mainly due to subject's accessing categories that would have been inaccessible without the provision of these cues. Support for this conclusion stemmed from the finding of greater category recall in the one cue condition than in the no cues condition and from the finding of equal items per category recalled (IPC) in both conditions. Consequently, cuing can have a positive effect in providing access to categories that would have otherwise remained inaccessible; but, once access to a category is gained, the provision of intralist cues (i.e., especially more than one intralist cue) can have an inhibitory effect on the recall of the remaining list items.

In other experiments (Rundus, 1973; Roediger, 1973), inhibition was shown to increase in a systematic fashion when more cues were provided at recall. For example, in a study by Rundus (1973), subjects were given from 0 to 4 cues for each category at recall. Rundus demonstrated that the proportion of the remaining list items recalled decreased as a function of the number of list items provided at study. That is, presentation of more cues resulted in greater inhibition. Furthermore, when both the category label and category instances were provided as cues, Roediger (1973) found that the amount of inhibition varied with both the number of list items provided and the size of the category.

Basden and Draper (1973) have also provided support for part list inhibition when both high and low frequency instances of a category are used. Basden and Draper, however, have shown that when many categories and high frequency items from those categories are provided as cues that some facilitation may be obtained. Similarly, Mueller and Watkins (1977) further extended the generality of the part set cuing inhibition effect. In a series of four experiments, Mueller and Watkins found inhibitory effects when rhyming sets of words were used, when subjects organized materials according to their own subjective sets, and when items were arranged as paired associates. However, despite the occasional finding of facilitation, the results of studies in which intralist cues (i.e., previously studied list items are provided as cues) are provided at test have displayed consistent inhibition in recall of the remainder of the list items. [1]

While the previously mentioned studies (e.g., Slamecka, 1968 & 1972; Rundus, 1973; Basden & Draper, 1973) focused on situations where previously studied items were presented as cues to aid retrieval, other studies have also observed this effect when items not previously seen were presented as an aid for recall. That is, part set cuing inhibition has also been found using extralist cues (i.e., extralist items refers to items that belong to a previously studied category, but the actual cue word itself was not presented during study). For example, Watkins (1975) found that cues from a categorized list can have an inhibitory effect even when they were not present at study. In this study, Watkins varied both the kind and amount of cues presented. Subjects received either 0, 2, or 4 cues. In the cued conditions, subjects received either intralist cues, extralist cues, or a combination of intralist and extralist cues. Watkins found that both intralist and extralist cues produced reliable inhibition. Moreover, the inhibitory effect increased with increasing numbers of items presented at retrieval regardless of whether the cues were intralist or extralist cues. Thus, Watkins found that extralist cues provided at recall inhibited cued recall performance to the same degree as did intralist cues that had been previously seen at study.

In contrast, Basden, Basden, and Galloway (1977) found no inhibitory effect when extralist cues were used but obtained the traditional finding when intralist cues were used. Basden et al. (1977), however, used a between subject design in which only intralist or extralist items were presented as cues. This lack of an inhibitory effect could possibly be due to the between list design used by Basden et al. (1973). In Watkins' (1974) study where an inhibitory effect of extralist cues were found, a mixed design was used.

Roediger, Stellon, and Tulving (1977) also conducted experiments with intralist and extralist cuing conditions. In Experiment 2 of the Roediger et al. study, the level of inhibition was roughly equivalent either when only intralist cues or both an equal number of intralist and extralist cues were provided at test; however, subjects that were given only extralist cues at test displayed less inhibition . For all three groups, recall performance was inferior to that obtained in the free recall control group. As a result, Roediger et al. demonstrated that extralist cues can be as inhibitory as intralist cues when an equal number of both intralist and extralist cues were provided but that the inhibitory effect of extralist cues was diminished when only extralist cues were provided. Although the extralist cuing inhibition was reduced relative to an intralist condition and a mixed condition, it should be noted here that performance was significantly different from the free recall group. In summary, extralist cues have been shown to inhibit recall in a manner similar to intralist cues when mixed or within subjects designs are used, but inhibition has been shown to be absent or reduced when a between subjects design is used.

Theoretical Explanations

Several explanations have been advanced to explain the inhibitory effects of part set cuing. Rundus (1973) and Roediger (1973) provided comparable explanations for the occurrence of part set cue inhibition. Due to the similar nature of their explanations, attention will be focused only on Rundus' theory . Rundus explained part set cuing inhibition by postulating that stronger list items block recall of weaker list items. In this model, items are associated directly to a higher order context cue (e.g., category exemplars to their category cues) in a hierarchical fashion. When told to retrieve previously presented items, subjects typically retrieve items that are most strongly associated with the provided retrieval cue. The act of retrieving an item from memory strengthens the connection between the item and the retrieval cue. A critical assumption for this theory is that items are retrieved from a memory system that uses sampling with replacement (i.e., a previously recalled item can be retrieved several times over the course of trying to remember items from a list). Since items are sampled with replacement, the strengthening that was acquired by an item on a previous recall attempt will make the item more likely to be recalled on subsequent retrieval attempts. Consequently, when items are presented as cues at study, this re-presentation of the items as cues strengthens the connection between the items and their context cues. The strengthening of items continues to occur each time that the items are retrieved. Since items are retrieved on the basis of the strength of association to their context cue and on the basis of sampling with replacement, items that have been retrieved once or twice are more likely to be retrieved again to the exclusion of items that have not already been retrieved due to the relatively lower activation of the unretrieved items. Retrieval processes then continue to occur until a certain criterion or number of retrieval trials have been attempted by the subject. In the part set cuing situation, the listed items are more likely to be retrieved repeatedly to the exclusion of retrieval of new items, and subjects are more likely to reach the criterial number of retrieval trials before all the items that were stored could be retrieved.

Rundus' (1973) theory can quite easily explain some findings in the part set cuing literature but has problems explaining other results. For example, the results of Rundus (1973) and Roediger (1973) are easily explained within this framework. In these studies, an increase in the number of list cues is found to decrease the retrieval probability of the remaining uncued items. This could easily be explained by Rundus' strengthening hypothesis. That is, the listing of more items results in a strengthening of the association between the provided cues and the context cue (e.g., a category cue). This strengthened association increases the probability that these listed items will be retrieved on later retrieval attempts. Consequently, the listed items become increasingly stronger over a number of retrieval attempts and are more likely to be retrieved. Consequently, the listed items can be viewed as blocking the retrieval of the relatively weaker unretrieved items because they are more highly activated and as a result are more retrievable than the unrecalled items. Roediger et al. (1977) also provide indirect support for this notion. When cumulative recall is plotted as a function of time allowed for recall, Roediger et al. found that part list cues reduce both the final level of target recall and the rate at which subjects achieve this final level of recall. This finding may be considered supportive of Rundus' (1973) theory in that any blocking of weaker items by stronger items should display itself in a reduction in rate of production of unrecalled list items. That is, retrieval of already strengthened items should occur at a higher rate than the relatively weaker uncued items. This should cause new items to be produced less frequently and at a slower rate.

Some findings are not reconcilable with Rundus' theory. For example, Marx (1988) failed to find inhibition when the part set cues were presented in another form (i.e., a recognition test) prior to the critical recall test and were not present when the recall test is given. Similar observations have been reported by other researchers (Basden et al., 1977). The finding that release from inhibition occurs when a free recall test follows the part list cuing preparation is counter to predictions derived from Rundus' (1973) theory. If this inhibition is due to the blocking of weaker items by stronger items, then one should expect to find this inhibition still in effect when the items are no longer present. This should be the case because the recent strengthening of the items with the part set cue preparation should still leave these items stronger relative to the previously unrecalled items. These items should be stronger unless they somehow rapidly lose the extra strengthening obtained during the part list cuing test. Consequently, despite the facility with which Rundus' theory can handle some of the data, it is quite deficient in explaining other data (but also see Park & Madigan, 1993).

Another explanation that is somewhat similar to Rundus' approach (1977) has been presented by Watkins and colleagues (Watkins, 1975; Mueller and Watkins, 1977). One early explanation provided by Watkins (1975) was a list length explanation. Basically, this position explained the detrimental effect of part set cuing as resulting from an increased mental list of items that must be retained by subjects. At study, subjects are given a list of items to be remembered. In conditions in which a subset of the cues is provided, Watkins theorized that subjects must add these items to the previously studied and retained list of items. After adding these new items to previously studied items, the likelihood of retrieving one of the cued items is increased because two of these items have been stored in memory while only one copy of the uncued items exists. Thus, recall of new items is impaired because it is more likely that subjects will retrieve one of the presented items when using the context cue. Consequently, part set cuing is explained as being due to the fact that if two copies of an item are present in memory then this increases the probability that one of these twice encoded items will be retrieved via the context cue to the exclusion of the items only encoded once.

The list length hypothesis espoused by Watkins (1975) was subsequently developed by Mueller and Watkins (1977). Mueller and Watkins hypothesized that part set cuing effects could be explained as an extension of cue overload (this notion is similar in many respects, but not identical, to the list length hypothesis; however, for the the present purposes, they will be treated as being essentially the same). That is, part set inhibitory effects would be due to a relative lack of effectiveness associated with a provided cue. A cue is rendered ineffective by storing more information than can be effectively retrieved with this retrieval cue. In the case of part set cues, the provided set of cues are encoded as a separate episodes under the same cue (e.g., a category cue) as the originally studied set of items. When trying to retrieve the original items, the new episode that has been paired with the original cue would interfere with the recall of the earlier learned information. Retrieval of the episode corresponding to the previously studied item or the new presentation of the item (i.e., as a part set cue) would impair the recall of the earlier learned information not presented as part set cues because two episodes exist for the part set cue items and only one exists for the uncued items. Consequently, a retrieval cue would be more likely to access items represented twice compared to items represented once. Hence, the cue would be less effective in reinstating items not presented as part set cues.

Support for this theory comes from work by Watkins (1975) and Mueller and Watkins (1977). The results of Rundus (1973) and Roediger (1973) can also be seen as supportive of this position if one assumes sampling from memory occurs with replacement and that subjects will invoke some sort of stopping rule concerning how many retrieval attempts will be made. However, both the results of Basden et al. (1973) in which extralist cues produce no inhibition and the results of Roediger et al. (1977) that show extralist cues are not as inhibitory as intralist cues are incompatible with this view. No provision is made within this theory for differential inhibitory influences of intralist and extralist cues, particularly for the cue overload hypothesis (i.e., this would be true because extralist cues would be assumed to be incorporated under the same cues as the earlier studied items and would be just as detrimental as intralist cues placed under these same context cues). Also, additional findings by Basden (1973) and Sloman, Bower, and Rohrer (1991) have shown that part set cuing can be lessened by reinstating the same strategy used at study when trying to recall items at test. Such findings limit the usefulness of Watkins and colleagues approach of the list length (Watkins, 1975) and the cue overload (Mueller and Watkins, 1977) hypotheses of part set cuing inhibition.

Another type of explanation that was put forth to explain part set cuing inhibition has concerned the ability of part set cues to invoke the use of suboptimal strategies for recall of previously studied items (Slamecka, 1968; Basden et al., 1977; Sloman, et al., 1991). The basic tenet of these approaches is that optimal recall performance is dependent on the subject's use of strategies developed at study during the test phase. For example, subjects are expected to form some type of strategy for remembering list items at study. When subjects are asked to recall previously studied items, they then make use of this earlier devised strategy to aid recall. Recall is expected to benefit more when the earlier strategy is invoked at test, and recall would be expected to be impaired if subjects deviated from this plan either by choice or experimental manipulation. In the case of part set cuing, subjects would be expected to perform worse when given a random set of cues. This would be the case because the experimenter imposed ordering of the cues would not be expected to map onto the subject's previously devised strategy. In fact, it is more likely that the experimenter's strategy will be different from any given subject's strategy. Incompatible strategy use would be more likely to occur in the part set cue condition but not in the whole (i.e., no cue) condition. The no cue condition would not provide any old items that could interfere with or cause subjects to deviate from their earlier developed strategy. Indeed, the lack of cues should encourage subjects to use the previously developed strategy at test since no strategy has been provided for them (i.e., except of course in the case where subjects are provided with only the category labels as aids). Consequently, performance should be higher in the whole or no cue condition relative to the part set condition to the extent that the part set condition encourages a retrieval strategy incompatible with that previously devised at encoding.

Basden (1973) provided evidence to support this position. In this study, recall was facilitated when the part set cues were every other item previously seen at study. According to the incompatible strategy theory, performance should be better in this condition than in a condition where a random set of items are provided as part set cues. The presentation of every other item from the list of studied items is more likely to cue subject's previously formed chunks of studied items. That is, the presentation of every other item is more likely to overlap with the subject's encoding strategy and result in the implementation of that strategy compared with the random presentation strategy used in most studies. Sloman et al. (1991) also provided evidence consistent with this viewpoint. When part list cues were presented in a fashion congruent with the method of presentation at study, Sloman et al. found less inhibition than when part list cues were incongruent with the initial list presentation. This finding occurred both in conditions in which congruency was varied as function of presentation order and as a function of meaning via idioms.

While the previously mentioned studies do support the incompatible strategy theory, results that show that extralist items produce reliable inhibition (Watkins ,1975; Roediger et al.,1977) seem incompatible with the theory. These results are problematic for this theory because it is not clear why items not previously seen by subjects should cause subjects to use a different strategy from that developed at study. That is, it should be relatively easy for subjects to read and ignore these new items and to implement their previously developed strategy. Furthermore, the finding of inhibition in the Sloman et al. (1991) study, no matter how attenuated, does not strongly support this thesis. This criticism is based on the idea that if all subjectively stored units are accessed by presenting every other item then one might expect performance to be at least equivalent to the control group. As this is not the case (cf., Sloman et al., 1991), one might expect something other than the subject's strategy to be affecting the inhibition. This speculation is supported by Sloman et al.'s finding that across all of their experiments that performance in the congruent condition was still below that of the control group. This finding weakens the claim that incompatible strategies between study and test can completely account for the inhibition phenomenon.

The three theories presented to account for part set cuing inhibition can explain some but not all of the observed instances of part set cuing inhibition. Indeed, in a more elaborate review of the part set cue inhibition phenomena, Nickerson (1984) has reached much the same conclusion. Since no theory presented here (or alternative theories presented in Nickerson, 1984) can account for the accumulated data, it might be best to look at other more general theories of memory and apply them to the part set cue arena. By applying a more general theory of memory to the part set cue paradigm, a better explanation of the phenomenon may be developed. One such general theory was presented by Jacoby and colleagues (Jacoby, 1991; Toth, Reingold, & Jacoby, in press; Jacoby, Lindsay, & Toth, 1992; Jacoby, Ste-Marie, & Toth, in press). This theoretical explanation conceptualizes memory tasks as being partly due to the effects of controlled (i.e., aware) and automatic (i.e., unaware ) uses of memory. The application of such a framework might prove useful in explaining the locus of the inhibition. That is, does the inhibitory influence of part set cues predominantly affect conscious or automatic uses of memory. Localization of the effect to either of these two processes would allow a better delineation of the effect and may help explain the previously described differences between intralist and extralist cue inhibition (e.g., intralist inhibition may be produced by different processes than extralist inhibition).

Past research has had little to say about the relation between part set cuing and controlled and automatic processes. Rundus' (1973) theory makes no claim as to whether the continued resampling of stronger items is attributable to either controlled or automatic processes. One might speculate that the continued resampling of relatively strong items that blocks the retrieval of weaker items is due to some automatic process. For example, continued access of the same old items on repeated retrieval attempts may occur in a generate-recognize fashion (cf., Kintsch, 1970; Jacoby & Hollingshead, 1990). Old items could be generated and then evaluated (i.e., a determination of whether the item is old, has been given previously as a response, etc.). If part set cues could be said to affect generation, then this theory could form the basis for a hypothesis that part set cues affect the automatic production of cues as candidates for recall. Alternatively, part set cues may block the conscious verification of items. Consequently, Rundus theory does not provide any strong basis for making a prediction as to the locus of the inhibitory effect.

Watkins and colleagues' (Watkins, 1975; Mueller & Watkins, 1977) theories of list length and cue overload also have made no direct link between controlled and automatic processes and part set cue inhibition. It is not clear from either theory whether it is more than a conscious "filing" problem or a problem of one cue automatically accessing the wrong items. By a conscious "filing" problem, it is meant that part set cues could add more items to files that have to be mentally searched in order to find the correct old item (i.e., in this case an item that is not one of the cues and has not previously been produced). If there are too many cues or files, one might expect the subject to consciously stop what might seem to be an unproductive search of memory. Both the search through memory and the decision to stop could be considered to be under conscious control. Alternatively, one could read Mueller and Watkins theory of cue overload to imply that part set cues inhibit correct generation of old items (it should be noted here that generation is used in a different sense than in the previous paragraph--generation here refers to a one step process of retrieval similar to the idea of encoding specificity, Tulving, 1983; cf. Ellis & Hunt, 1992, Chapter 6). That is, the "overloaded" cue may automatically access the wrong item. For example, the category cue may access the already listed part set cues or may continually access a previously given old item and, consequently, deny access to the desired old items. Thus, just as Rundus (1973) theory provided little concrete connections between part set cue inhibition and controlled and automatic processes, Watkins and colleagues also leave us with little more than speculation as to the locus of the effect.

Furthermore, those theories that attribute part set cue inhibition to a lack of overlap of strategies developed at encoding and implemented at recall (Slamecka, 1968; Basden, 1973; Sloman, et al., 1991) also have made no definitive predictions about the use of automatic or controlled processes. If the inhibitory effect is caused by the implementation of an ineffective strategy at retrieval, one might take this as evidence that the inhibition stems from poor use of controlled or conscious memory processes. That is, if the subject consciously chooses to implement a strategy that will not be maximally effective, then the inhibitory effect could be attributed to a less than optimal controlled use of memory via strategy choice. The association of strategy implementation, however, with conscious or controlled processes depends heavily on whether one views strategic behavior as inherently conscious or not. Indeed, Sloman et al. (1991) have cautioned against completely attributing the cause of part set cuing to either conscious or automatic processes. They do so because it is possible that strategy impairment could be due to a mismatch between the encoding and retrieval environment and, consequently, need not be a conscious choice to use a particular strategy. Therefore, this type of theory also does not provide any clear conceptual link to automatic and controlled processes.

Despite any straightforward theoretical link between part set cue inhibition and controlled and automatic processes, an empirical study by Basden, Basden, Church, and Beaupre (1991) does provide some insight into this issue. In Experiment 2, Basden et al. compared part set cuing across direct and indirect tests. Two direct tests were used, cued recall and a paired associate recall test. The indirect tests consisted of free association to word cues. Basden et al. found the standard finding of inhibition when cued (i.e., part set condition) and noncued recall conditions were compared. Cued here referred to the use of list member response items as cues. Specifically, half of the previously seen response items were used as cues and the other half consisted of previously unseen items. Uncued described the use of stimulus items as cues. This classification was true for both the direct paired associate and the indirect free association tasks. Performance on the direct paired associate task was found to be equivalent across cuing conditions, and performance on the indirect test of free association was found to be slightly but not significantly better for the cued condition than the uncued condition. If one focuses on a comparison between the standard group (i.e., free recall) and the indirect test, one might be inclined to conclude that part set cue inhibition primarily has its effect on the conscious processes of trying to retrieve past items; as indicated by the indirect test, part set cues seem to have little effect on the unintentional use of memory. This comparison could serve as a basis for claiming that part set cues do not inhibit unaware uses of memory but do inhibit aware uses of memory. This claim, however, is complicated by the finding of no inhibition with the direct paired associate task. As such, the previously mentioned hypothesis is made tentative at best. Basden et al.'s findings do, however, present the intriguing possibility that the inhibition produced by part set cues may be associated exclusively with either unaware or aware uses of memory and that part set cues may selectively affect one of these memory processes.

## Implications

One hypothesis that could be derived from this research is that the presentation of part list cues inhibits the automatic generation of potential target items. This inhibition could result from an increased activation of old items and could result in their being continually resampled (i.e,. if one assumes that the items that are most active will be the most likely retrieved items). One more subtle way that automatic processes may be inhibited by the presentation of part list cues is that conscious evaluation of part list cues could predispose the automatic processes to retrieve these items (Jacoby, 1991). Automatic processes could be considered to operate in a conditional manner (cf. Logan,1989; Bargh, 1989). That is, conscious evaluation could constrain any beneficial effect of automatic processing to focus on those items either presented as part set cues or items previously generated by the subject. Given the previously reviewed research, one might expect automatic inhibition of additional list items to cause the part set cue effect. Although Rundus (1973) and Watkins (Watkins, 1975; Mueller & Watkins, 1977) offer no clear evidence to support this hypothesis, both theories seem to imply this to be the case. For example, Rundus' theory that weaker items are blocked by stronger items can be viewed as suggesting that the problem is that of continued automatic retrieval of the wrong items. This conclusion would seem to be warranted because the test of recall is an intentional test and, if continued resampling were under conscious control, one would expect that subjects would be able to avoid this continued retrieval of items (unless this process required too much effort to be worth the cost of continued retrieval). Furthermore, if Watkins and colleagues' (Watkins, 1974; Mueller & Watkins, 1977) theories are expected to operate in a direct generation method as described previously, retrieval would be expected to be an automatic process of a retrieval cue directly accessing an item previously encoded with it. This direct access model could explain continued resampling as continually directly accessing the wrong item.

Alternatively, a second hypothesis that could be advanced is that part set cues inhibit performance by affecting controlled retrieval of the old items. For example, the incompatible strategy theory (Basden, 1973; Sloman, et al., 1991; also see Slamecka, 1968, and Nickerson, 1984) can be seen as implying that conscious implementation of the optimal strategy for recall may be hampered by the presentation of part set cues. That is, if part set cues cause subjects to deviate from the strategy that they have developed, then it is likely that part set cues may effect the conscious selection of the appropriate strategy to pursue at test. It should be noted that this link between conscious uses of memory and strategy implementation requires that adoption of a particular strategy be conscious. As noted previously, Sloman et al. (1991) have cautioned that this may be a suspect assumption in that strategy selection may not always have to be consciously chosen (for similar arguments in another field see Paris, 1988). Given this criticism, such a connection between conscious retrieval and part set cue inhibition would be very speculative at best; however, Basden et al. (1991) have found that when performance between a standard condition and an indirect test condition are compared that no inhibition occurs with the indirect test. In fact, performance with a cued indirect test was slightly but not significantly better than performance in the standard condition. This lack of inhibition suggests that part set inhibition may only occur in situations in which conscious recollection is used. Unfortunately, performance in another direct test condition, a direct associative test, also shows no inhibition. Once again a piece of evidence supportive of a conscious inhibition hypothesis is presented, but the evidence is weakened by a lack of inhibition in the second direct test. Consequently, any conclusion based on this evidence may be premature.

Rationale

Given the lack of knowledge regarding the locus of part set cue inhibition, there is a need for research examining whether the effect involves controlled or automatic processing. Past theories have made only suggestions as to which of these two processes are affected by part set cue inhibition. The one study (Basden et al., 1991) where data bearing on this issue have been provided suggested that the inhibition may be consciously mediated, but the lack of uniform inhibition across all direct tests makes a prediction that part set cues inhibit controlled processes speculative.

Recent research on automatic and controlled processes may prove useful in localizing the inhibitory effect of part set cuing to one of these processes. One current theory designed to separate the effects of automatic and controlled uses of memory has been presented by Jacoby and colleagues (Jacoby, 1991; Toth, Reingold, & Jacoby, in press). Jacoby's (1991) theoretical framework allows one to set up conditions so that controlled uses of memory are set in opposition to automatic uses of memory. For example, one may be told to use intentionally previously studied words to complete a task (e.g., a cued recall test in which subjects are told to remember all of the previously studied items). In this task, one may correctly remember items because one specifically remembers that an item occurred on a previous list or because an item automatically comes to mind and is given as a response. Since the two causes of correct performance cannot be discriminated in this condition alone, another condition must be implemented. The second condition to be implemented requires subjects to refrain from giving previously studied items as responses (i.e., subjects are told to exclude from use any items that they remember as having occurred on a previous study list). If subjects use any prior items on this test, their responses are treated as a failure of conscious memory for that item. Using the data from the test in which subjects are asked to include old items or the test in which subjects are instructed to exclude previously studied items will not by themselves allow an assessment of controlled or automatic processes. However, by implementing both tests within subjects and by applying formulae provided by Jacoby (1991), one can obtain an estimate of both controlled and automatic processes.

Using formulae provided by Jacoby and colleagues (Jacoby, 1991; Toth, Reingold, & Jacoby, in press), the inclusion condition can be described by the following equation:

$$\text{Inclusion} = C + A(1 - C)$$

In this formula, C would be performance due to controlled processing, and A would be performance due to automatic processing. This formula is used to describe a situation in which both automatic and controlled processes contribute to performance. Performance in the exclusion group is described using the following equation:

$$\text{Exclusion} = A(1 - C)$$

The exclusion equation is used to represent the situation in which automatic uses of memory occur in the absence of any conscious recollection of an old item.[2] In order to get an index of both automatic and controlled processing, one will need to combine the information in both formulae in the following manner:

$$C = \text{Inclusion} - \text{Exclusion}$$

This combining of the two formulae results in the amount of performance due to conscious processing.[3] In order to obtain the amount of performance due to automatic influences, one can rearrange the formulae into the following form:

$$A = \text{Exclusion}/\ (1 - C)$$

Consequently, the implementation of both inclusion and exclusion conditions will allow one to gain an assessment of the relative contributions of automatic and controlled processes to memory performance.

Likewise, Jacoby, Yonelinas, and Jennings (in press) have described a second means of obtaining estimates of controlled and automatic memory performance. This method is labelled the independence remember/know or IRK method. The IRK method is implemented within an intentional memory task. As subjects recall items, they are required to make judgements about these items. Subjects are instructed to rate each item as a remember, know, or new item. Remember responses are to be given to old items that are accompanied by recall of the contextual detail surrounding the previous occurrence of an item at study (e.g., one remembers an item and also recalls that the item was blurry during presentation, evoked a negative response, etc.). Know responses are to be given to items that are old items but little detail surrounding their occurrence can be remembered (i.e., these items are described analogous to seeing a familiar person on the street that one recognizes as a previous acquaintance but cannot place the person. That is, no memory of the initial meeting with this person, their name, etc., can be recovered). New responses are given to items that judged as not encountered previously at study. Jacoby et al. have found that items that are given a remember response correspond to the controlled estimates of memory obtained using the process dissociation procedure. Furthermore, by combining the know responses with the new responses mistakenly given to old items, an automatic estimate of memory performance can be obtained analogous to that obtained using the process dissociation procedure. So according to the IRK method, controlled contributions to memory performance are redefined as :

$$C = \text{Remember Responses}$$

Automatic contributions to memory performance are described by the following formula[4]:

$$A = \text{Know} + \text{Old Items Labelled New} / 1 - C$$

The IRK procedure has as its main advantage its ease of implementation compared to the more complicated process dissociation procedure. Furthermore, when results are obtained using this method, converging evidence is provided concerning the validity of Jacoby and colleagues (Jacoby, 1991; Jacoby, Yonelinas, and Jennings, in press) views of automatic and controlled processing. Specifically, evidence is provided that controlled and automatic processes make independent contributions to performance (an assumption of both the process dissociation and the IRK procedures).

This would be particularly relevant to a development of an explanation of part set cuing based on automatic and controlled processes because a different model of part set cuing would be needed if controlled and automatic processes are not found to be independent of each other within the context of part set cuing.

In Experiment 1, the process dissociation procedure of Jacoby (1991) was implemented within the context of part set cuing. A typical part set cuing procedure was used. In the whole cue condition, subjects were presented with only a category label and no intralist cues. For the part set cue condition, subjects received a category label and three intralist items as cues. Using the methodology developed by Jacoby (1991), subjects were further instructed to either include or exclude previously studied items within each cue condition (i.e., either uncued or cued conditions). The implementation of these two subconditions allowed for direct assessment of the effect of part set cues on both controlled and automatic uses of memory. This preparation was designed to provide an empirical link between part set cue inhibition and either of these two processes.

Additionally, attention was manipulated as a variable at study. That is, subjects studied items under conditions of divided or undivided attention. Attention was varied in order to assess performance in conditions in which controlled processing should be eliminated and automatic processing should be left relatively intact. This condition was important because it allowed an assessment of automatic processes in the absence of the controlled processes. If part set cue inhibition affected either one process or the other, then this variable would reflect this finding. For example, if inhibition were found to only affect conscious processing, then this variable should result in a condition in which no inhibition was observed (i.e.; the divided attention cued group). Or alternatively, if the effect of inhibition was located solely within the automatic use of memory, then dividing attention should not produce any lessened inhibition. The main goal of this first experiment was to make a more direct connection between part set cue inhibition and automatic and controlled processing.

A second experiment was conducted as a replication and extension of Experiment 1. In this second experiment, Jacoby, Yonelinas, and Jenning's (in press) IRK procedure was used to confirm the results of the first experiment. In this experiment, subjects were asked to study intentionally categorized items. The items were presented in a blocked format (i.e., all category exemplars occurred in succession before presentation of a new category) via slide projector. Subjects were instructed to copy these item into a booklet and to remember these items for a later test of memory. Subjects were further subdivided into two different groups. One group was given the memory test immediately following the study phase, and the second group was given a recall test two days later. During the test phase, both groups of subjects were instructed to recall all the previously seen items for each category seen at study. Subjects were informed that nine items should be listed for each test category. Some pages already had three of those old items listed. Subjects were informed that they could use these items as cues to help recall the remainder of the unlisted items and that these old items already listed counted towards the nine required items. If they could not remember all nine items, subjects were instructed to list new items to complete the required number of items. Furthermore, subjects were also told to make either a remember, know, or new judgement about each item produced. These ratings were to be made as each item was listed. Using these ratings and the IRK formulae, the relative contributions of automatic and controlled processes to performance were computed. This experiment was designed to replicate and extend the results obtained in the first experiment.

Finally, as a check to make sure that the results obtained using Jacoby and colleagues' (Jacoby, 1991; and Jacoby, Yonelinas, and Jennings, in press) paradigms generalized to other situations, a third experiment was conducted to manipulate tests proposed to measure automatic and controlled/conscious memory within the context of part set cue inhibition. This experiment consisted of two separate but related experiments: a test of explicit memory (cued recall), and a test of implicit memory (category production). In Experiment 3a, a traditional assessment of conscious or controlled processing was performed using an explicit test of cued recall. In addition, a levels of processing manipulation was applied to the part set cue paradigm as a marker variable. To vary encoding levels, three different study tasks were manipulated: intentional memory, sorting, and pleasantness rating study tasks. Past researchers (Hunt & Einstein,

1981) have found recall performance to vary as a function of these study tasks. Typically, levels effects are only obtained on explicit tests (Richardson-Klavehn & Bjork, 1988). Consequently, a levels effect should be obtained if conscious memory is involved. A second similar experiment was designed to assess the effects of a levels manipulation and the effects of part set cues on an implicit memory test. Implicit test performance is associated with the operation of automatic/unconscious uses of memory. Traditionally, levels effects are not obtained with implicit tests of memory (cf. Richardson-Klavehn & Bjork, 1988). Levels of processing was manipulated in Experiment 3b by using two different study tasks: sorting and pleasantness rating. The lack of a levels effect would confirm that automatic uses of memory are being assessed by this test. Although this latter claim has become contentious of late (Richardson-Klavehn & Bjork, 1988; Jacoby, 1991), research by Kelly, Pivetta, Matthews, and Hunt (1994) has indicated that category production meets the necessary requirement to be considered a process pure test (i.e., no levels of processing effect was found, and the only difference between the explicit analogue and the category production test was the absence of intentional memory instructions for the category production test). Consequently, an implicit memory test of category production was chosen for use in Experiment 3b. If both the levels effect and inhibition due to part set cues occur on the test of cued recall but are absent on an implicit test of category production, then a link between part set cue inhibition and conscious uses of memory would have been provided. If an inhibitory effect was found using both tests but the levels effect only occurred on the explicit test of memory, then the inhibition engendered by part set cues may be due the operation of automatic memory processes.

Consequently, the purpose of Experiments 3a and 3b was to replicate the results of Experiments 1 and 2 and to examine performance in a context similar to Basden, et al (1991) that demonstrated that part set cues did not negatively impact performance on an implicit test of memory. The levels of processing variable was used as a marker variable to indicate whether subjects were using conscious or automatic memory on each test. The levels of processing task was expected to influence performance on the explicit test of memory but not on the implicit memory test. Although the use of such tests seems contrary to Jacoby's view (1991; Jacoby et al., in press) that implicit and explicit tests are usually not exclusively associated with the pure operation of either automatic or controlled processes, Jacoby and colleagues have pointed out that the research from implicit tests often does dove-tail with those results obtained using either the process dissociation procedure or the IRK procedure. Furthermore, Jacoby et al. did not rule out the possibility of process pure tests, even though most tests are viewed as a combination of the two. Kelly et al.'s (1994) data have provided evidence that category production is a process pure task. Given this finding, the results of Experiment 3a and 3b should only further substantiate the results of Experiments 1 and 2.

In all, the three experiments are designed to provide evidence as to whether part set cue inhibition primarily affects controlled or automatic uses of memory. Within each of the three experiments, variables are manipulated that are known to affect either controlled or automatic processes. Secondarily, data concerning the operation of automatic and controlled processes within the context of part set cuing will be provided. That is, might a generate-recognize model or an independence model of controlled and automatic processing best characterize the operation of automatic and controlled memory processes within the part set cue paradigm. Furthermore, if a strong connection between part set cue inhibition and either controlled or automatic processes is found, then a more satisfactory theoretical account of the part set cuing phenomena may be developed. The development of such a framework could be instrumental in explaining the different conditions in which part set cuing does produce inhibition.

# CHAPTER II

# EXPERIMENT 1

## Method

*Subjects.* The subjects were 47 introductory psychology students from The University of North Carolina at Greensboro who received class credit for their participation. Subjects were run in groups of one to four subjects each.

*Design.* The three variables were cue type (cued or uncued), attention (divided or undivided), and test type (inclusion or exclusion). Both the cue type and test type variables were manipulated within subjects while the attention variable was manipulated between subjects.

*Materials.* Twenty categories were selected from the Battig and Montague (1969) word norms (e.g., VEHICLES, FLOWERS, INSECTS, etc.). For each category, six exemplars were chosen as target items for that category. Items were selected according to the following criteria: a) no items were selected from among the first three instances given for the chosen categories, and b) the six items for each category were chosen from among the items numbered 4-16 in the word norms.

All studied items were typed in a lowercase font on adhesive strips that were placed on the center of a 3 X 5 index card. All twenty categories were presented at study. These items were presented to subjects as a 120 item deck of cards (i.e., 20 six item categories). Subjects used a sheet of 120 numbered lines to register their ratings for each studied item. Five additional filler categories were also selected from the Battig and Montague norms for use as category production filler task. The respective filler categories were stapled into a five category booklet.

The set of twenty experimental categories were divided into two sets of ten categories each. These two sets of ten categories served equally often in the cued and uncued conditions. Each test booklet contained ten uncued (i.e., only the category labels were provided with no list items presented as cues) and ten cued categories (i.e., both the category label and three list items as cues). Two fixed presentation orders were used such that no more than two successive categories (i.e., cued or uncued) occurred in sequence. For all twenty categories, the six category exemplars were divided into two different cue sets of approximately equal frequency. The two cue sets alternated serving as either cues and as scoring items. For half of the pages within each test condition, the category labels were printed normally in all capitals (e.g., ANIMALS), and the remaining half were printed with the category label in all capitals flanked by *'s (e.g., *SPORTS*). The different print types were used to differentiate inclusion and exclusion categories. The category print type was balanced within and across conditions.

*Procedure.* Upon arrival at the experimental room, subjects were given a deck of cards and a worksheet containing 120 numbered lines. Subjects were instructed that they were to be given a deck of cards on which one word was printed on each card. Subjects were told that they were to rate each item as to how pleasant or unpleasant they thought the item was. They were instructed to rate each item on a 3 letter scale. A pleasant response was represented by the letter *p*, a neutral response by the letter *n*, and an unpleasant response by the letter *u*. Subjects were also provided with an example of pleasant and unpleasant words. If subjects were assigned to the undivided attention group, no further instructions were given.

Subjects in the divided attention groups were given further instructions. These subjects were told that they would also be asked to listen to a tape of random numbers while rating the items. In addition to rating each item, they also were to listen for the number 9. They were instructed to keep a running total of the number of times the number nine was presented during the rating task. When they were finished with the rating task, they were told to write down the number of times the number 9 was heard. In order to get an estimate of the time it takes a subject to complete the task (and get an estimate of the length of tape heard in order to get an estimate of performance on the secondary task), subjects were to raise their hand when finished. A record of the time each subject required to complete the task was kept for each subject. No mention was made to subjects as to the forthcoming memory test.

After finishing the study phase, subjects were given a category production task. The category labels used were similar to the kind of category labels presented at study (e.g., MOVIE TITLES). This task required subjects to write down six items or examples for each of the category labels listed on each page (one category presented one per page). This task served as a buffer task between study and recall. Subjects worked on this test for approximately 5 minutes.

At test, subjects received a twenty page booklet. Each page corresponded to a previously seen category at study (i.e., 20 six item categories). Ten of the pages contained only a category label (uncued condition), and the remaining ten pages contained both the corresponding category label and three previously (cued condition) seen items from that category. For both the uncued and cued conditions, five categories were printed in all capitals, and five categories were printed in all capitals flanked by *'s. If a category was printed in normal print, subjects were instructed to write the words that they previously studied. On pages on which list cues appeared with the category label, subjects were told to use the category label and list cues to help them remember the remaining old items. For those category labels flanked by *'s, subjects were instructed to list six items belonging to that category which were not been seen previously at study (i.e., list new items). On pages on which list cues appear with the category label, subjects were instructed to use these as aids to think of new list items. Subjects were presented with papers to remind them of the symbol coding (i.e., whether to include or exclude old items from use).

Finally, subjects were debriefed and thanked for their participation in the experiment.

## Results

Unless otherwise noted all results reported as significant are significant at the 0.05 level. For Experiment 1 and 2, the finding of a part set cue effect was critical to the analysis of automatic and controlled processes. Consequently, part set cue effects will be reported prior to the discussion of the theoretical estimates of automatic and controlled processes.

*Part Set Cue Effects.*

An initial analysis was performed on the whole cue group to make certain that the whole target set did not differ from the whole cue set. The whole target set were the items that corresponded to the scoring items for the part set cue group. The whole set cue group were the items that corresponded to the intralist cue items provided in as part set cues. The analysis was performed to insure that the two sets of whole scoring items did not differ. For the undivided inclusion group, the results of this analysis revealed no differences in recall between either set of items, $F(1,42)<1$ , $MSe = 0.04$. Similarly for the undivided exclusion group, no effect of cue set was found, $F(1,42)< 1$, $MSe = 0.02$. For the divided attention groups, again, no effect of cue set was found for either the inclusion, $F(1,48)< 1$, $MSe = 0.02$, or exclusion groups, $F(1,48)< 1$, $MSe = 0.01$. Given that the arbitrary designations of cue or target items did not differ across groups, subsequent analyses will report scores collapsed across these artificial labels for the whole cue group.

*Inclusion Test Scores.*

The inclusion test scores reflect the standard situation in which subjects recall as many of the previously seen items as possible. The means reported here reflect the total percentage of old items produced for each group (i.e., the part set and whole cue groups). Inclusion scores were analyzed as a function of attention (divided or undivided) and cue type (part set or whole cue). The results revealed a marginally significant effect of the attention variable, $F(1,45) = 3.44$, $MSe = 0.13$, $p = 0.07$, a main effect of cue type, $F(1,45) = 11.54$, $MSe = 0.11$, and no interaction between the two variables, $F(1,45) = 1.85$, $MSe = 0.02$. Consequently, these results revealed a marginal effect of divided versus whole attention across cue types; the respective means equal 0.43 and 0.51. Furthermore, the typical part set cue effect was found in that performance across part set cue conditions was inhibited relative to performance across whole cue conditions; the respective means equal 0.43 and 0.50 (see Table 1.).

*Exclusion test scores.*

The exclusion test scores reflected the number of old items that were incorrectly listed as new completions by subjects. That is, exclusion performance was the number of old items incorrectly used by subjects when purposively attempting to list only new items that had not been experienced at study. Exclusion test performance was also analyzed as a function of the attention and cue type variables. The results of the analysis revealed no effect of the attention variable, $F(1,45) < 1$, $MSe = 0.000005$, no effect of cue type, $F(1,45) < 1$, $MSe = 0.0003$, and no interaction, $F(1,45) = 1.15$, $MSe = 0.01$. The means for the divided and undivided attention groups when collapsed across cue types were identical, respective means 0.08 and 0.08. Similarly, the means for the part set and whole cue groups collapsed across the attention variable were nearly identical, respective means 0.07 and 0.08. Exclusion scores were found to remain constant across all conditions (see Table 1.).

Table 1. Inclusion and Exclusion Test Performance as Function of Cuing Condition and Attention.

| | Inclusion | | |
|---|---|---|---|
| | Whole Cue | Part Set Cues | *Mean* |
| Undivided | 0.53 | 0.49 | 0.51 |
| Divided | 0.48 | 0.38 | 0.43 |
| *Mean* | 0.50 | 0.43 | |
| | **Exclusion** | | |
| | Whole Cue | Part Set Cues | *Mean* |
| Undivided | 0.08 | 0.09 | 0.08 |
| Divided | 0.09 | 0.07 | 0.08 |
| *Mean* | 0.08 | 0.08 | |

*Conscious and Automatic Estimates*

The current purpose of this study was to assess any differences in the theoretical estimates of controlled and automatic uses of memory using the theoretical formulae of Jacoby (1991) as a function of cuing and attentional variables. The conscious estimate was computed by subtracting the exclusion test score from the inclusion test score for each subject. The conscious estimates of performance were analyzed similarly to the inclusion and exclusion test scores. These results revealed a marginally significant effect of dividing attention, $F(1, 45) = 3.18$, $MSe = 0.20$, $p = 0.08$, a main effect of cue type, $F(1,45) = 6.48$, $MSe = 0.09$, and no interaction, $F(1,45) < 1$, $MSe = 0.007$. The mean estimate of conscious memory as a function of the attentional variable displayed a trend toward reduced conscious estimates when collapsed across cue conditions, respective means 0.44 and 0.35 for undivided and divided attention. This decrease in conscious memory performance was supportive of the prediction that conscious estimates should be decreased by dividing subject's attention through the use of a secondary task, although the decrease did not actually reach significance. Conscious memory usage was also found to be impaired when examined as a function of cue type, mean for the whole cue groups 0.42 and mean for the part set cue groups 0.36 (means collapsed across the attention variable). Consequently, both variables were found to impair conscious processing (see Table 2.).

The automatic estimates of performance were computed by dividing the exclusion score of each subject by one minus their conscious estimate (i.e., exclusion/1-conscious estimate). The pattern of results here differed strikingly from the analysis of the conscious estimate of performance. No main effect of dividing attention, $F(1,45) < 1$, $MSe=0.003$, no main effect of cue type, $F(1,45) = 1.33$, $MSe = 0.01$, or interaction, $F(1,45) < 1$, $MSe = 0.01$, was found. Means collapsed across the cue variable were virtually the same, undivided mean 0.10 and divided mean 0.11. This was also true when the means for the cue groups were collapsed across the attentional variables, mean for the whole cue group=0.11 and mean for the part set cue group=0.09. Thus, the automatic component of memory performance was relatively insensitive to manipulations of attention and changes in the cuing environment (i.e., specifically changes in the cue environment over and above the provision of a category label cue--see Table 2.).

Table 2. Conscious and Automatic Estimates as Function of Cuing Condition and Attention.

| | Conscious | | |
|---|---|---|---|
| | Whole Cue | Part Set Cues | *Mean* |
| Undivided | 0.46 | 0.42 | 0.44 |
| Divided | 0.39 | 0.31 | 0.35 |
| *Mean* | 0.43 | 0.36 | |
| | **Automatic** | | |
| | Whole Cue | Part Set Cues | *Mean* |
| Undivided | 0.10 | 0.10 | 0.10 |
| Divided | 0.13 | 0.09 | 0.11 |
| *Mean* | 0.11 | 0.09 | |

## Discussion

In Experiment 1, the typical part set cuing effect was found using Jacoby's (1991) process dissociation procedure. The group that corresponded most clearly to past part set cuing cued recall experiments (cf. Nickerson, 1984) would be the inclusion test. The results of an analysis of the inclusion test revealed an inhibitory effect of part set cuing. This finding was expected given past research (Slamecka, 1968). The attentional manipulation of listening for a particular number and mentally keeping track of the number of times it occurred was found to affect performance also. However, the effect of dividing attention fell just short of significance. The lack of an effect of dividing attention here may have been due to the ease of the secondary task for some subjects[5]. A more difficult secondary task would probably be more successful at reducing performance in this experiment.

In contrast to the inclusion test, no inhibitory effect of part set cues was found with the exclusion test. Past examinations of the part set cuing phenomenon have not tested for its presence in this sort of test. In fact, this test differed greatly from past examinations of part set cuing in that it required subjects to avoid using previously studied items. In this condition, performance in the part set cue condition produced performance virtually identical to a whole cue condition. Furthermore, no effect of dividing attention was found for the exclusion test. One conclusion that can be drawn from this would be that part set cues and dividing attention seem to have little effect of the rate of exclusion test errors produced by subjects.

However, given the lack of previous research using part set cues and exclusion tests, it is not clear why part set cues have no effect on the production of exclusion errors.

However, by combining the results of the inclusion and exclusion tests according to Jacoby's (1991) process dissociation formulae, estimates of the relative contributions of conscious and automatic memory processes to performance were obtained. This analysis revealed that part set cuing's inhibitory effect was localized mainly on the estimates of conscious recollection. Specifically, the estimates of conscious recollection obtained in the part set cue condition was significantly lower than the estimates of conscious recolletion in the whole cue condition. Contrarily, automatic memory estimates were unaffected by the cue variable. In fact, the automatic memory estimates were almost identical across cuing conditions. These conclusions are further reinforced by the attentional manipulation. Dividing attention at study produced a trend toward decreased estimates of conscious recollection while producing no decrement in the automatic memory estimates. The findings of this experiment provided clear evidence of a dissociation between conscious and automatic memory estimates as a function of part set cuing. Conscious memory was found to be impaired by part set cues while automatic estimates were unaffected.

# CHAPTER III

# EXPERIMENT 2

In this experiment, Jacoby, Yonelinas, and Jennings' (in press) IRK procedure was used to replicate the results of Experiment 1 that part set cuing impairs controlled/conscious uses of memory but not automatic uses of memory. Jacoby et al. (in press) have found that the IRK procedure produces results similar to the results obtained using the process dissociation procedure. This procedure was used due to its ease of use and to provide more support for Jacoby's (1991; Jacoby, et al., in press) theoretical views. A delay between study and test was used as a further check that conscious uses of memory were, in fact, manipulated on the assumption that delay between study and test produces impairment in conscious but not automatic uses of memory (Hasher & Zacks, 1979).

## Method

*Subjects.* The subjects were 36 introductory psychology and cognitive psychology students from The University of North Carolina at Greensboro who received class credit for their participation. Subjects were run in groups of one to four subjects each.

*Design.* A 2 X 2 factorial design was implemented. Both cue type (cued or uncued) and delay variables (immediate test or delayed test--2 day delay) were manipulated. Cue type was manipulated within subjects while the delay was manipulated between subjects.

*Materials.* Thirty categories from the Battig and Montague (1969) norms were selected for use in this experiment. Nine exemplars from each category were chosen from each category. The selection criteria were the same as in the first experiment except that the selection criteria were lessened to allow selection of items from those numbered 4-20 in the word norms.

The thirty categories were divided into three sets of ten categories each. Two of the three category sets served as study and test categories. These three sets were rotated so that each of the three possible study combinations occurred as to-be-studied items. These studied items also comprised the categories presented at test. Half of these categories served in the cued condition and half in the uncued condition. Within each category, three separate cue sets were constructed of approximately equal frequency. Each of these cue sets were counterbalanced across subjects, so that each target set occurred as both a cuing set and as a target set.

All studied items were presented by overhead projector. Each slide consisted of a particular category label and the nine exemplars that belonged to that category. Two different test lists were constructed for presentation to subjects for each of the three possible study list combinations. For each combination, one presentation order was constructed, and the second test order was a reversal of this order. An input booklet was constructed that consisted of twenty blank pieces of paper on which subjects were to write the corresponding category members from the presented slides.

The test booklet was constructed so that an equal number of studied categories occurred in both the cued and uncued conditions. One other restriction was also implemented in the construction of the test booklet. No more than two cued or uncued categories occurred in succession. The test booklet contained all twenty categories.

*Procedure.* Subjects were instructed that they were to be presented with a series of category slides via overhead projector. They were told that their task was to copy all nine category items from that category onto their test booklet and to do whatever was necessary to help them remember these words for a later test of memory (i.e., subjects were not given a particular strategy). They were also instructed that they would be allotted approximately 45 sec per category. This intentional study task lasted approximately 20 min.

Following the study phase, subjects in the delay condition were allowed to leave and were told to return 2 days later at the same time for the test phase. In the immediate group, subjects proceeded to the test phase following a short break in which they completed credit forms. For both groups, the test phase was a cued recall test in which subjects were to write down the previously seen items. For the uncued categories, only the category label was presented to subjects, and they were to list all nine previously studied items from that category. With the cued categories, subjects were presented with three of the previously seen items and were instructed to list the remaining unlisted items. All subjects were required to list nine items below each category label (for the cued conditions, this number included the three listed items).

Subjects in both groups were also required to assign each word a remember, know, or new judgement. These judgements were to be made as each item was recalled. Subjects were told to give a remember judgement to items for which they have a specific conscious recollection of the previous occurrence of the item. For example, if they could remember that the item was at the top of a slide of items, was blurry at presentation, or brought to mind an unpleasant memory, then they were to give that item a remember rating. However, if they could not remember any contextual detail about the item's occurrence other than that they were confident that the item was a previously presented item, then they were to assign a know judgement to that item. Furthermore, a new response label was to be given to items that subjects listed in order to fulfil the instance requirement to produce nine category items, but they were sure that the items were not part of the originally studied list.

Finally, subjects were debriefed and thanked for their participation in the experiment.

## Results

### *Part Set Cue Effects*

In this experiment, subjects were only scored on the subset of six items that corresponded to the target items for the part set cue group (i.e., both the whole and part set groups were scored only on those subsets of items that were available to both groups for recall).

An overall analysis of recall collapsed across remember, know, and "old" new items (i.e., items that were seen at study but mistakenly called a new item by subjects) was performed in order to assess the potential inhibitory effects of part set cues (for a listing of the means of each of these separate components see Table 3). The overall mean performance as a function of delay and cue type is listed in Table 4. The analysis was performed as function of delay between study and test and cue type (whole or part set cue). The results revealed a main effect of delay on recall, $F$ (1,34) =25.17, $MSe$= 0.50, a main effect of cue type, $F(1,34)$ = 29.84, $MSe$=0.08, and no interaction between the two variables, $F$ (1, 34) $<$ 1, $MSe$= 0.0005. Delaying recall by two days served to reduce the overall level of recall from 0.59 to 0.42 (these means are collapsed across cue type). Thus, delay served to reduce recall levels as predicted. More importantly, an inhibitory effect of part set cues was found, mean for the whole cue group= 0.54 and mean for the part set cue group= 0.48 collapsed across the delay variable. Given the occurrence of the part set cue inhibitory effect, a more systematic analysis of its effect on conscious and automatic uses of memory can be performed used using the IRK procedure.

Table 3. Remember, Know, and Old New Responses as a Percentage of the Total Number of Correct Items

| | Remember | | |
|---|---|---|---|
| | Whole Cue | Part Set Cues | *Mean* |
| Immediate | 0.37 | 0.31 | 0.34 |
| 2 Day Delay | 0.21 | 0.19 | 0.20 |
| *Mean* | 0.29 | 0.25 | |

| | Know | | |
|---|---|---|---|
| | Whole Cue | Part Set Cues | *Mean* |
| Immediate | 0.13 | 0.11 | 0.12 |
| 2 Day Delay | 0.17 | 0.19 | 0.18 |
| *Mean* | 0.15 | 0.15 | |

| | Old New | | |
|---|---|---|---|
| | Whole Cue | Part Set Cues | *Mean* |
| Immediate | 0.09 | 0.09 | 0.09 |
| 2 Day Delay | 0.07 | 0.04 | 0.05 |
| *Mean* | 0.08 | 0.07 | |

Table 4. Cued Recall Performance Collapsed Across All Old Items (Remember, Know, and New).

| | Recall | | |
|---|---|---|---|
| | Whole Cue | Part Set Cues | *Mean* |
| Immediate | 0.61 | 0.55 | 0.58 |
| 2 Day Delay | 0.44 | 0.39 | 0.42 |
| *Mean* | 0.53 | 0.47 | |

*Conscious and Automatic Estimates*

Using the IRK procedure (Jacoby, et al., in press), the estimate of memory performance due to conscious processes would be the percentage of old items given a "remember" response by subjects. An analysis of conscious memory processes as a function of the delay and cue variables was performed. The means obtained for the estimates of conscious recollection are listed in Table 5. The results of this analysis revealed a main effect of the delay variable, $F(1,34) = 10.63$, $MSe = 0.49$, a main effect of the cue variable, $F(1, 34) = 14.97$, $MSe = 0.05$, and marginally significant interaction between these variables, $F(1, 34) = 3.99$, $MSe = 0.013$, $p = 0.054$. These results revealed that delay between study and test served to reduce the estimate of conscious recollection. When collapsed across cuing conditions, the mean for the immediate group was 0.37, and the mean for the delayed group was 0.20. The second result, namely the main effect of the cue type variable, displayed the typical part set cue effect with impaired performance observed in the part set cue group (mean 0.26) compared to the whole cue group (mean 0.31) when performance was collapsed across the delay variable.

Concerning the marginally significant interaction of the two variables, this finding mainly stemmed from low level of performance between the whole cue delayed group (mean 0.21) and the part set cue delayed group (mean 0.19). This difference represented a low level of recall for both cuing groups when recall was delayed by two days. Such a finding may be reflective of a decreased impact of part set cues on performance as conscious recall decreases. This sort of finding does not conflict with the idea that conscious memory is impaired by part set cues but may indicate that as conscious memory contributions decrease part set cues have a smaller population of items upon which to exert their inhibitory effect. With immediate testing, the negative impact of part set cues was found to be more pronounced, whole group mean 0.41 and part set group mean 0.33.

However, the application of the IRK procedure (Jacoby, et al., in press) produced a different pattern of findings with the automatic estimates of memory performance. According to this procedure, automatic estimates of performance are composed of the percentage of old items labelled as know and the new (i.e., the old items given as completions by subjects but mistakenly called new items) responses divided by one minus the contributions of conscious recollection (i.e., know + "old" new / 1 - C ). The means for estimates of automatic contributions to performance are listed in Table 5. When the contributions of automatic processes to performance were examined as a function of delay and cue type, the results revealed no effect of delay, $F(1, 34) = 2.59$, MSe =0.09, no effect of cue type, $\underline{F}(1,34) = 2.96$, $\underline{MS}$e =0.02, and no interaction of the two variables, $\underline{F}(1,34) < 1$, $\underline{MS}$e =0.001. Means for the part set and whole cue groups were not different when collapsed across delay, respective means 0.28 and 0.31. Furthermore, means for the the immediate (0.26) and delayed (0.33) groups were not statistically different either, although these means appeared to be different.

Table 5. Conscious and Automatic Estimates as a Function of Part Set Cuing and Delay.

| | Conscious | | |
| --- | --- | --- | --- |
| | Whole Cue | Part Set Cues | *Mean* |
| Immediate | 0.41 | 0.33 | 0.37 |
| 2 Day Delay | 0.21 | 0.19 | 0.20 |
| *Mean* | 0.31 | 0.26 | |

| | Automatic | | |
| --- | --- | --- | --- |
| | Whole Cue | Part Set Cues | *Mean* |
| Immediate | 0.36 | 0.32 | 0.33 |
| 2 Day Delay | 0.28 | 0.24 | 0.26 |
| *Mean* | 0.31 | 0.28 | |

## Discussion

The results of Experiment 2 replicated the results of Experiment 1 using a different procedure. Across both experiments part set cues were found to systematically decrease conscious contributions to memory performance while having no adverse effects on contributions of memory performance attributed to automatic uses of memory. Specifically, in Experiment 2, part set cues decreased conscious estimates of performance both with immediate testing as well as with delayed testing, albeit the inhibitory effect was found to be less with delayed testing as compared to immediate testing. Furthermore, part set cues were found to produce no detriment to estimates of automatic memory performance at either the immediate or delayed testing intervals.

The validity of conscious and unconscious estimates was examined by the effects of the delay variable on performance. Delay has been predicted to have a greater effect on conscious or controlled processes than on automatic processes (cf. Hasher & Zacks, 1979). These predicted effects were found to emerge within the current framework. Delay was found to hamper the ability to consciously recollect previously seen items while having no effect on the automatic contributions to memory performance. Such parallel effects of delay and cuing have provided converging evidence that conscious memory was being manipulated while automatic processes were not.

In summary, Experiments 1 and 2 provide empirical evidence that part set cues impair conscious uses of memory but do not affect automatic contributions to performance. Although previous experiments have provided tentative conclusions regarding part set cue inhibition and automatic (i.e., implicit) and conscious (i.e., explicit) memory processes (see Basden, et al., 1991), these two experiments are the first experiments to provide direct associations between part set cues, automatic processes, and conscious processes.

# CHAPTER IV

## EXPERIMENTS 3A & 3B

In the final two experiments, a different methodology from the Jacoby's (1991) process dissociation and Jacoby et al.'s (in press) IRK procedures was adopted. In Experiment 3a and 3b, implicit and explicit memory tests were used to assess automatic and controlled uses of memory, respectively. The main purpose for this experiment was to generalize the finding that part set cues affect only conscious but not automatic uses of memory to a different experimental paradigm. Such a change in methodology seems at odds with the theoretical position of Jacoby and colleagues (1991; Jacoby, et al, in press; Toth, et al., in press) that both implicit and explicit test performance represents a mixture of automatic and conscious processes, and as such, would be poor estimates of these processes because they are not process pure estimates of either conscious or automatic memory. However, the question of whether a test is process pure or not is an empirical question. Indeed, an implication of Jacoby and colleagues' (1991; Jacoby, et al, in press; Toth, et al., in press) view that controlled and automatic processes contribute independently to performance could be that it is possible to have tests on which only one process may be influencing performance. Recently, Kelly, et al. (1994) provided evidence that an implicit test of category production is a relatively process pure test of automatic memory processes (i.e., due to a lack of a levels effect, etc.). Category production was chosen as the implicit test to be used in this series of experiments because it has been found to be a process pure test of memory (Kelly, et al., 1994). Since it is a process pure test, it would not be subject to contamination by explicit memory processes. Thus, the use of this particular implicit test would circumvent criticisms made by Jacoby (1991) against the identification of implicit test performance with automatic uses of memory. In fact, given the process pure nature of the category production task, it was expected that the results of this test would coincide with the results of Experiments 1 and 2.

Concerning the use of an explicit test of recall, this test was used as a comparison condition against which to compare the effects of the levels of processing manipulation. Typically, levels effects have been found to occur on explicit but not implicit tests of memory (cf., Richardson-Klavehn & Bjork, 1988). While this test is likely to be contaminated by the operation of automatic memory processes, its purpose was mainly to show the existence of a levels effect on an explicit test and serve as comparison condition for the implicit test. That is, the use of cued recall was implemented to demonstrate a levels effect a test where performance is mainly due to conscious uses of memory and to serve as comparison condition for the implicit category production test where no levels effect was expected.

Concerning the negative effect of part set cues, a negative effect was expected to obtain with the explicit test, particularly given that test performance is due primarily to the operation of conscious processes. Given that category production is a relatively process pure estimate of automatic processing, part set cues were not expected to impair performance on the implicit test of category production. The purpose of this experiment was to show that an explicit test of cued recall was susceptible to part set cue effects when tested within the context of a levels of processing manipulation.

Although different in scope from the previous experiments, Experiments 3a & 3b attempted to demonstrate that part set cuing would again be shown to be associated with conscious but not with automatic memory processes using conventional assessments of conscious and unconscious/automatic processes via the explicit (Experiment 3a) and implicit (Experiment 3b) test paradigm.

## Experiment 3a

### Method

*Subjects.* The subjects were 54 introductory psychology students from The University of North Carolina at Greensboro who received class credit for their participation. Subjects were run in groups of one to four subjects each.

*Design.* A 2 X 3 factorial design was implemented. The two variables manipulated were cue type (cued or uncued) and study task (pleasantness rating, sorting, or intentional instructions). The cue type variable was a within subjects manipulation, and study task was a between subjects variable.

*Materials.* Fourteen categories were selected from the Battig and Montague (1969) word norms (e.g., VEHICLES, FLOWERS, INSECTS, etc.). For each category, six exemplars were chosen as target items for that category. Items were selected according to the following criteria: a) no items were selected from among the first three instances given for the chosen categories, and b) the six items for each category were chosen from among the items numbered 4-16 in the word norms.

All studied items were typed in a lowercase font on adhesive strips that were placed on the center of a 3 X 5 index card. All fourteen categories were presented at study. These items were presented to subjects as a 84 item deck of cards (i.e., 14 six item categories). The fourteen categories were divided into two sets of seven categories each. Each set served equally often in both the cued and uncued conditions. Within each set, the set of six items was divided into two sets of items of approximately equal frequency. Subjects used a sheet of numbered lines to register their ratings for each studied item.

The test booklet consisted of ten cued and ten uncued categories. The booklet was constructed with the restriction that no more than two cued or uncued categories could occur in succession.

*Procedure*. Upon arrival at the experimental room, subjects were assigned to one of three conditions: a) pleasantness rating, b) sorting, or c) intentional instructions. With all three groups, the category exemplars were presented in a blocked format at study. In the pleasantness rating condition, subjects were instructed to rate each category item as to how pleasant or unpleasant they thought the item was. They rated each item on a 3 letter scale. A pleasant response was represented by the letter *p*, a neutral response by the letter *n*, and an unpleasant response by the letter *u*. Subjects were provided with an example of pleasant and unpleasant words. For the sorting task, subjects were provided with category label cards and told to sort the category exemplars into their respective category. Both the pleasantness rating and sorting tasks were subject paced.

In the intentional study condition, subjects were instructed that they would be tested later on the presented items. They were instructed that they should do whatever was necessary to help them remember these words. Subjects were told that they would be allowed 1.5 sec to study each word. They were instructed that when an auditory cue --i.e., a beep-- occurred that they were to turn over the next card. In order to facilitate correct timing (i.e., viewing the card for 1.5 sec), each deck of cards contained a few blank cards so that subjects could become acquainted with how to perform this task.

Following the study task and completion of credit forms, subjects were given the test booklet. Subjects were told that they were to write the previously studied items below their respective category labels. Subjects were also told that some categories would have three of the previously studied items listed below the category label. For these categories , subjects were instructed to write down those items that were not present and that they could use the listed items to help them remember the remaining unlisted items.

Finally, subjects were debriefed and thanked for their participation in the experiment.

## Results

Part set cuing was examined in the context of an explicit cued recall task, presumed to assess conscious uses of memory. An analysis of recall performance was performed as a function of cue type (part set or whole cues) and orienting task (intentional memory instructions, sorting, and pleasantness rating). The means for these groups are listed in Table 6. Results from this analysis revealed a main effect of cue type, $\underline{F}$ $(1,51) = 23.84$, $\underline{MS}e = 0.21$, a main effect of study task, $\underline{F}$ $(2,51) = 16.33$, $\underline{MS}e = 0.34$, and no interaction, $F$ $(2,51) < 1$, $\underline{MS}e = 0.0009$. The main effect of cue type represented an inhibitory effect of part set cues when compared to whole cues averaged over study tasks, part set mean 0.34 and whole set mean 0.43. The main effect of study task was primarily due to a levels of processing effect with increasing performance across the three groups: sorting mean 0.30, intentional group mean 0.36, and pleasantness rating group 0.49.

Post hoc comparisons revealed a consistent part set cue inhibitory effect within each experimental group: sorting (whole mean 0.35 and part set mean 0.25); intentional instructions (whole mean 0.40 and part set mean 0.32); and pleasantness rating (whole mean 0.53 and part set mean 0.45), Tukey's LSD =0.075. Concerning performance among the three different study groups, performance summed across cuing conditions revealed no difference between the overall level of performance between the sorting (mean 0.30) and intentional memory (mean 0.36) groups; however, both groups were found to be significantly different from performance within the pleasantness rating group (mean 0.49), which produced the greatest overall level of performance among the three groups.

Table 6. Cued Recall Performance as a Function of Study Task and Cue Type

| | Whole Cue | Part Set Cue |
|---|---|---|
| Sorting | 0.35 | 0.25 |
| Intentional | 0.40 | 0.32 |
| Pleasantness Rating | 0.53 | 0.45 |

To summarize, a persistent inhibitory effect of part set cues was found across three different study task conditions. A levels of processing effect was also observed in that performance was also found to differ as a function of study task.

Experiment 3b

Given the results of Experiment 3a concerning the persistence of an inhibitory effect of part set cues even when explicit memory performance was varied as a function of a levels of processing manipulation, this experiment was designed to show that part set cues would not affect performance on an implicit test of memory. Consequently, a category production task that does not require the use of conscious recollection for its completion was selected. Kelly, et al. (1994) have found that category production is relatively insensitive to influences of conscious recollection as indexed by a levels manipulation. These researchers have found category production to be a relatively "process" pure task in that it mainly reflects the priming of automatic memory processes. Consequently, category production performance following either an incidental pleasantness rating or sorting orienting task was assessed in the presence of either a category label cue (whole cue condition) or three intralist cues (part set cue). Given the results of Experiments 1 and 2 and the work of Kelly et al.(1994), it was expected that part set cues would not have any effect on category production performance. Furthermore, it was predicted that no levels effect would be obtained with the category production test given its status as a relatively process pure task.

## Method

*Subjects.* The subjects were 26 introductory psychology students from The University of North Carolina at Greensboro who received class credit for their participation. Subjects were run in groups of one to six subjects each.

*Design.* A 2 X 2 factorial design was implemented. The type of cue type (cued or uncued) that was provided and the type of study task (pleasantness rating and sorting) that subjects performed were manipulated. The cue type variable was manipulated within subjects while the study task variable was manipulated between subjects.

*Materials.* The categorized items used in Experiment 2 were used in this experiment. One difference was that only twenty of the categories were used in this experiment. These twenty categories were subdivided into 2 groups of ten. Each group of ten categories served equally as often as target and baseline categories. Only one group of ten was seen in the study phase of this experiment.

Items were presented in the form of a ninety item deck of cards (i.e., nine exemplars from each of the selected ten categories). Subjects who performed the pleasantness rating task were given a numbered sheet of paper on which to place their rating. Subjects in the sorting group were given ten handwritten category labels corresponding to the ten deck categories. These category labels were to be used when sorting the items into their respective categories.

The test booklet for both conditions was of the same form. Five filler categories were placed at the beginning of each book to disguise the implicit nature of the test. The remainder of the booklet consisted of ten previously studied and ten baseline categories. This booklet was constructed so that no more that two categories from either the target or baseline condition occurred in succession. Furthermore, no more than either two cued or uncued categories were to be presented in succession.

A math problem solving test was constructed from problems selected from Mayer (1981). The purpose of the math test was to serve as a distractor task between the study phase and the category production test.

*Procedure*. Upon arrival at the experimental room, subjects were presented with a 90 item deck of cards. Subjects in the pleasantness rating group were told that they were to rate each item as to how pleasant or unpleasant they felt the item was. The three letter rating scale that was used in experiment 1 was also used in this experiment. Subjects in the sorting task were to sort the deck of items into their corresponding categories using the provided handwritten labels. No mention as to any forthcoming test was made to any subjects.

Next, subjects were given a math problem solving task. Subjects were told to solve as many of the six listed math problems as they could. They were allotted 8 min to work on this task. This task served as a distractor task interposed between study and test.

Following the math distractor task, subjects were given the category production task. Subjects were presented with the category production test booklet and instructed to list nine items for each of the categories listed. Subjects were informed that for some of the categories three items would be listed below the category label. For these categories, the three listed items would be counted toward the required nine items and, consequently, they would only have to list six items for these categories. No mention was made that some of the presented items had been seen earlier by subjects.

Finally, subjects were debriefed and thanked for their participation in the experiment.

## Results

### *Scoring*

Performance on the category production test was assessed by the computation of priming scores for each subject. Priming scores were the total percentage of old items produced for target categories minus the percentage of experimentally defined target items that were produced for the nonstudied categories (i.e., old items - target items).

### *Baseline Performance*

Before comparisons of performance between the sorting and pleasantness rating tasks can be performed, the baseline production of experimentally designated targets in the absence of study must be shown to be equivalent. If the baselines between the study task groups are found to differ, then any subsequent analysis would be compromised. An analysis of the nontarget baseline performance was performed as function of the orienting task and cue type variables. The means for these groups are listed in Table 7. The results of this analysis revealed no effect of orienting task, $F$ (1,24) < 1, MSe = 0.002, an effect of cue type, $F$ (1,24) = 7.01, MSe = 0.05, and no interaction, $F$ (1,24) = 1.40, MSe =0.01. The lack of an effect of orienting task reflected nearly identical means between our sorting (mean 0.24) and pleasantness rating groups (mean 0.25) when collapsed across our cuing variable. When collapsed across the study task variable, the finding of a significant effect of cue type was due to inferior performance within the part set cuing conditions (mean 0.22) compared to the whole cuing conditions (mean 0.28). This decrease in baseline performance in the part set cue groups was most likely due to the reduced number of chances of correctly producing an old item in the part set cuing conditions. That is, the part set cue group only had to produce six items while the whole group was required to produce nine items.

*Priming Scores*

The primary analysis in this experiment is focused on the priming scores produced by each subject. The priming scores were analyzed as a function of orienting task and cue type. The results produced no effect of our orienting task variable, $F$ (1,24) < 1, MSe =

0.001, no effect of cue type, F (1,24) < 1, MSe = 0.005, and no interaction of the two variables, F (1,24) < 1, MSe = 0.004. The lack of an effect of the study task variable was reflected in the virtually identical means for the sorting group, 0.10, and pleasantness rating group, 0.11. Similarly, the absence of an inhibitory effect of part set cues on priming scores was due to almost identical means for the part set cue group, 0.10, and the whole cue groups, 0.12. In fact, the priming scores across all four possible groups were nearly identical (see Table 8).

Table 7. Category Production Performance as a Function of Study Task and Cue Type (Baseline Performance in Parentheses).

| | Whole Cue | Part Set Cue |
|---|---|---|
| Sorting | 0. 37 (0.28) | 0.32 (0.19) |
| Pleasantness Rating | 0.38 (0.27) | 0.35 (0.24) |

Table 8. Priming Scores as a Function of Study Task and Cue Type

| | Whole Cue | Part Set Cue |
| --- | --- | --- |
| Sorting | 0.08 | 0.12 |
| Pleasantness Rating | 0.11 | 0.11 |

## Discussion

The combined results of Experiments 3a and 3b provide converging evidence that tests proposed to tap primarily conscious memory were susceptible to part set inhibitory effects while tests that do not presumably require conscious recollection were unaffected by the presence of part set cues. In Experiment 3a, an explicit memory test of cued recall was given to subjects. This experiment displayed the typical finding of a levels of processing effect usually found when explicit tests are used (cf. Richardson-Klavehn & Bjork,1988). The expected part set inhibitory effect was also observed with this group, replicating prior research (cf., Nickerson, 1984).

The results of Experiment 3b, however, were very different from those of Experiment 3a. The major difference between these experiments was the lack of any instruction to subjects to produce items previously seen at study. When an implicit test of category production was used, no levels of processing effect was observed. This finding replicated Kelly, et al.'s (1994) lack of a levels effect when a category production test is used and reaffirmed the status of the category production test as a relatively pure process task (i.e., a pure measure of automatic priming-- see Dunn & Kirsner, 1988, and Merickle & Reingold, 1991). The more interesting finding was the absence of a negative effect of part set cues on this test. Only one past study has examined part set cuing in the context of an implicit memory test (i.e., Basden, et al. 1991), and the results of this study were far from conclusive. Consequently, the overall pattern of findings from these two studies was that of a dissociation of performance on implicit and explicit tests as a function of part set cuing.

# CHAPTER V
# GENERAL DISCUSSION

The purpose of this study was to make a clear connection between the inhibitory effect of part set cues and either conscious or automatic uses of memory. The only relevant prior research on this topic was conducted by Basden, Basden, Church, and Beaupre (1991). The results of their prior work indicated that part set cues produced no reliable decrements in performance on an implicit, cued association test. This finding suggested that part set cues have no impact on indirect or implicit tests; however, the corresponding direct or explicit analogue in the Basden et al. study also failed to produce a negative impact of part set cuing. Consequently, no conclusive evidence that part set cuing was associated with an impairment of conscious memory was provided. Other researchers that have discussed part set cues and their potential relationship to either conscious or automatic processes have provided no hypotheses or conjectures linking the two areas. For example, Sloman, Bower, and Rohrer, (1991) speculated that the effect may be due to improper strategy use. This suggested that conscious processes may be involved given that strategic behavior often has been associated with conscious uses of memory. However, they cautioned that the identification of strategic with conscious memory processes may be presumptuous because strategies may not require conscious implementation (e.g., a well learned and often repeated strategy).

Given the relative ambiguity of the literature on this topic, the process dissociation procedure of Jacoby (1991) was selected in order to systematically partial out the relative contributions of controlled and automatic processing to performance in the part set cue paradigm. Jacoby's procedure is designed to separate performance into the estimated contributions of controlled/conscious and automatic memory processes. In Experiment 1, the typical negative effect of part set cues was found. When performance was analyzed using the process dissociation procedure, the conscious estimate of memory was found to decrease when part set cues were present relative to conscious estimates of performance within the whole cue condition. This finding, however, did not characterize the automatic estimates of performance. No effect of cuing conditions was found for the automatic estimate. Furthermore, dividing attention lowered the estimates of conscious processing while leaving the automatic estimates of performance unaffected. The fact that a variable, dividing attention, predicted to affect conscious uses of memory only reduced the conscious but not the automatic estimate of memory further validated the results obtained using the process dissociation procedure. The parallel effects of dividing attention and part set cuing provided converging evidence that conscious memory was indeed assessed by the process dissociation procedure. Furthermore, these results provided empirical evidence that part set cues impair conscious but not automatic uses of memory.

As a replication of Experiment 1, a second experiment was implemented using Jacoby, Yonelinas, and Jennings' (in press) IRK procedure. This procedure has previously produced results similar to the process dissociation procedure using a much simpler experimental design. A marker variable of delay was also selected to provide additional evidence that conscious processes were, indeed, being manipulated. This experiment produced results similar to the first experiment. Part set cues were found to impair performance, and this inhibitory effect was localized to the conscious estimates of performance while the automatic estimates of performance were relatively constant across both part set and whole cue conditions. Similarly, when recall was delayed, the conscious estimate of performance was lower than conscious estimates obtained after an immediate test of memory. When the effects of delay on automatic estimates were assessed, delay produced no impairment in performance. Consequently, the predicted negative effect of delay on the conscious but not the automatic estimates of memory further validated the assumption that the IRK procedure was assessing the independent contributions of conscious and automatic processes to memory. Again, inhibition engendered by part set cues was found to be localized to impairments in the utilization of conscious memory processes.

In a final experiment, a departure from Jacoby's (1991; Jacoby, et al., in press) methodology was adopted in order generalize from the previous two experiments using a different method. While the adopting of a "flawed" methodology (cf., Jacoby, 1991) may look like a radical departure from Jacoby's theoretical framework, two things must be noted. First, the main purpose of this study was to examine any possible links between automatic and controlled/conscious memory and part set cuing, a goal not tied to any specific procedure. Second, the procedures that were used in Experiment 3 would only be flawed to the extent that the implicit test is contaminated by conscious influences. That is, if part set cues do not affect automatic uses of memory and the automatic test is not contaminated by conscious uses of memory, then the procedures should produce a pattern of results similar to the first two experiments (i.e., no difference in performance across part set and whole cue conditions with the implicit category production test). Moreover, Jacoby's (1991; Jacoby, et al., in press) theoretical views do not hold that process pure tasks do not exist but that tests usually are a mixture of controlled and automatic processes. So whether a test is process pure or not would be an empirical question. Recently, Kelly et al. (1994) have shown that the test of category production is a relatively process pure test. Consequently, category production was chosen as the implicit memory test to be used in this experiment. Concerning the explicit test of cued recall, it was assumed that this test would predominantly reflect the operation of conscious processes (even though automatic processes could still contribute to performance, their contribution here would be expected to be equal in both cuing conditions given the results of Experiments 1 and 2).

The results of Experiments 3a and 3b revealed an inhibitory effect of part set cuing on an explicit test of cued recall while the implicit test of category production displayed no effect of part set cues. The assumption that category production would be a process pure test was confirmed by the lack of the levels of processing effect (i.e., the study task manipulation) on the implicit test. Toth, Reingold, and Jacoby (in press) have postulated that if a levels effect is found on an implicit test then the levels effect is likely due to contamination of the implicit test by conscious processing. No such contamination was found here, reflecting the claim that category production was a process pure task. In contrast to the findings of Experiment 3b, a levels effect was found with the explicit task of cued recall. The levels effect here presumably reflected the operation of conscious processing, given the intentional memory instructions. Consequently, even with a vastly different theoretical approach, part set cues were seen to primarily effect conscious uses of memory and to produce no effects on tests that did not require conscious uses of memory.

The results of this study have demonstrated that the inhibitory influence of part set cues on memory primarily impairs controlled or conscious processes. No evidence was found for an inhibitory effect of part set cues on automatic uses of memory. In Experiment 1, using the process dissociation procedure of Jacoby (1991), part set cues decreased estimates of controlled processes while estimates of automatic processes remained unaffected. Furthermore, the use of the IRK procedure (Jacoby, Yonelinas, & Jennings, in press) displayed similar results. The estimates of controlled memory were found to decrease in the presence of part set cues, and the automatic estimates were not influenced by the presence of part set cues. Furthermore, the claim that conscious processes were indeed manipulated independently of automatic processes was corroborated in both experiments by the use of marker variables known to effect conscious but not automatic processing. Both dividing attention and delay produced parallel effects on conscious process estimates to those produced by part set cues, thus, strengthening the claim that conscious processes were being manipulated while automatic processes were not . Finally, a comparison of the effects of part set cues on explicit and implicit tests revealed the same pattern of performance. That is, an inhibitory effect of part set cuing was found with an explicit memory test while such an inhibitory effect was absent on an implicit test of memory. A levels of processing effect (cf. Craik & Lockhart, 1972) was observed to occur on the explicit test and was absent on the implicit test, confirming that performance on the explicit test was utilizing conscious processing and that performance on the implicit test was not relying on conscious memory. In summary, across three different experimental methodologies, part set cues were found to impair controlled or conscious uses of memory but had no impact on automatic uses of memory.

One question that arises from this series of experiments was why was a clear dissociation of performance on explicit and implicit tests found as a function of part set cues when such an effect was not obtained by Basden et al. (1991)? By comparing the outcomes of Experiments 3a and 3b with the results of Basden et al., several methodological differences are apparent. First, Basden et al.'s tests of implicit and explicit memory were paired association and paired cued recall tests. This method was quite different from the present set of experiments. In Experiments 3a and 3b, cued category recall was the explicit test of memory, and category production was the implicit test of memory. This difference was likely the critical difference in the results obtained across these different studies. Typically, part set cues have their greatest impact on cued recall of categorized lists of items (cf. Nickerson, 1984). Even though part list cuing effects can occur with unrelated lists of items (Slamecka, 1968), most part set cue research has been performed with categorized lists of items. Consequently, the failure to use categorized units may have resulted in the failure to find a inhibitory effect with Basden et al.'s (1991) direct or explicit test of memory. Another possible difference would be that retrieval of a direct associate from memory may be quite different from retrieving a particular category member from a category of items. For example, the latter condition may be more susceptible to cue overload (Mueller & Watkins, 1977) than the former condition. Thus, it is likely that both reasons contribute the differing results between the present study and Basden et al.'s study.

Another more critical question is could the present results be accommodated by an existing theory of the part set cue phenomenon? Rundus' (1973) theory states that inhibition engendered by part set cues comes about by continued resampling of the items listed as part set cues. That is, the re-presentation of previously studied items boosts the activation of these items in memory making these items more likely to be reaccessed on later recall attempts. This theory makes no attempt to identify this resampling with either conscious or automatic processes. One might speculate, however, on how this resampling may occur as a function of conscious processes. The presentation of part set cues could interfere with consciously guided retrieval processes. That is, as items are retrieved in the presence of part set cues, the association between the part set cues and the retrieved items may continue to increase in strength. Consequently, with each conscious use of memory, one would be strengthening the association between the part set items and the recalled items, and this new association would be expected to make the association between the part set cues and the unrecalled items appear weaker by comparison. It could be that with each succeeding retrieval attempt the criterion for calling a retrieved item an old item becomes higher as the retrieved targets and the part set cues become more associated. Such an explanation goes beyond Rundus' initial ideas and would seem to invoke a conscious regulatory or comparison mechanism as the main route by which part set cues impair memory. Specifically, part set cues could result in an increase in activation of the association between cues and recalled targets. Conscious recall of items would occur until the criterion is set too high to recall the unremembered (unlisted) words due to their relatively weaker association with the part set cues. Consequently, this could cause recall to asymptote faster with part set cues than with whole cues.

Similarly, Mueller and Watkins (1977) theory of cue overload makes no specific conclusions as to whether part set cues predominantly affect conscious or automatic processes. Again, one can speculate as to how conscious processes may produce the part set cue effect. According to this theory, part set cues would become attached to the mental list of items previously studied. When recall of the unlisted items begins, part set cues enjoy the advantage of being represented more times on the list than items not presented as part set cues. As one selects items, the likelihood of retrieving an item that was a part set cue is greater than the unlisted items because it is represented twice in memory whereas the unlisted item is only represented once. Conscious processes might be expected to retrieve these twice presented items more often than the unlisted items. However, one would need to add another conscious process to explain why retrieval would stop and the unlisted items would not be produced. One solution would be to again postulate a regulatory process to stop recall. For example, as items are repeatedly retrieved, one might expect that a conscious regulatory mechanism might stop retrieval after a certain number of retrieval cycles have failed to produce any new items. Thus, conscious processes may abort retrieval before all the items are recalled.

Unlike the previous speculations concerning Rundus (1973) and Mueller and Watkins (1977) theories, the strategy disruption hypothesis (Basden, Basden, & Galloway, 1977; Sloman, Rohrer, & Bower, 1991) can be adapted to account for part set cuing effects without the postulation of a conscious regulatory mechanism.

According to the various forms of this hypothesis (cf., Nickerson, 1984), part set cuing results from the failure of subjects to use the strategy previously developed at study when tested later. When part set cues are presented, the cues selected by the experimenter do not necessarily correspond to the idiosyncratic organization of these items developed at study. Consequently, part set cues may lead subjects to deviate from their previously developed and most optimal strategy for recalling the unlisted items.

One way part set cues could impair conscious processes is that the listed items could serve to retrieve other undesired items. For example, if lion, elephant, and zebra are presented as cues, one could use these items to recall hippopotamus as another jungle animal. However, with the retrieval of hippopotamus, one may be more likely to continue thinking about jungle animals. The predisposition to continue to think about jungle animals may lead one to think of a jungle cat, like leopard, instead of the actually presented item lynx, a cat more likely found in the mountains. Conscious utilization of the presented and retrieved items could cause retrieval of good items in terms of categorical fit but items that are incorrect. Consequently, conscious retrieval processes could produce incorrect items but because these items fit the category they may be given as responses by subjects. Although a criterion may be needed here for an item to be considered as correct, the criterion alone is not the sole source of potential errors as in the previous theories (i.e., the criterion to stop recall). Within this theoretical adaptation, conscious processing can also fail to produce the correct items even though it would most likely produce suitable candidates.

Although these theories when modified can account for the present results, none seems to provide a satisfactory explanation of the findings. None of the theories, as described, says anything about the nature of the conscious and automatic processes involved in the part set cue situation. Consequently, a better approach to describing these results would involve explaining part set cues within the framework of Jacoby and colleagues (Jacoby, 1991; Jacoby, Yonelinas, & Jennings, in press). This theory postulates that controlled/conscious processes operate independently of automatic processes. Both processes contribute to performance, and they do not produce redundant information or produce information in a generate-recognize fashion (cf., Jacoby & Hollingshead, 1990; Kintsch, 1970). This framework eliminates some previously mentioned ways that conscious and automatic processes could affect part set cuing, mainly a generate-recognize possibility previously mentioned in the introduction. In Jacoby's (1991) theory, each cue serves to access directly a corresponding item. This item will often be the correct item, but this is not necessarily the case (i.e., it could directly access the wrong item). Furthermore, this view does allow for the output of one type of process to be utilized by the other process. For example, if a word "platypus" was automatically produced, the conscious process of retrieval could use this item to access other items related to platypus like Australia or monotreme. Note that this example does not operate like a generate-recognize model in which some things are produced automatically and then some of the items are consciously selected as old items. Rather the output of a particular process can be used as input to access other items not produced by the first process.

Data from the first two experiments provide evidence that with categorized lists of items controlled/conscious and automatic processes do operate independently of each other. Specifically, part set cues decreased the controlled/conscious estimates of performance found using Jacoby's (1991) process dissociation procedure and using Jacoby, Yonelinas, and Jennings' (in press) IRK procedure. Furthermore, as further evidence that conscious processes were being assessed by the conscious estimate, the conscious estimate of performance was shown to vary independently of automatic estimates in a manner consistent with theoretical views of conscious and automatic processes. Specifically, dividing attention (Experiment 1), a variable proposed to impair conscious memory, produced a parallel negative effect to part set cuing on the conscious estimate of performance but not the automatic estimate of performance. Similarly, delaying recall (Experiment 2) impaired performance attributed to conscious processes. Delay, however, produced no noticeable reduction in the automatic estimate of performance. Thus, both sets of experiments produced results that are incorporable within Jacoby's (1991; Jacoby, Yonelinas, & Jennings, in press) framework.

Given the results of Experiments 1 and 2, a likely conclusion, derived from the application of Jacoby's (1991) theoretical ideas, is that the independence assumption best characterizes the controlled and automatic processes occurring in the part set cue paradigm. It is important to note that this conclusion is derived mainly from part set cue effects with familiar categorized sets of items, so generalization to other unrelated material could produce different results. The proposal that these processes are independent serves to place certain constraints upon theorizing how part set cue effects occur.

Consequently, one possible explanation of the part set cue effect based on an independent operation of automatic and controlled processes is described as follows. This approach is similar to the strategy disruption hypothesis (cf., Nickerson, 1984; Sloman, et al., 1991) except it focuses more on retrieval processes. As automatic processes were found to be immune to inhibition across all three experiments, one facet of the current model would be that automatic processes make the same contribution to performance in both the whole and part set cue condition. Conscious processes were impaired by the presence of part set cues. Therefore, differences in conscious processing between the part and whole set cuing conditions are producing the inhibitory effect. Given the idea that only conscious processes are involved in producing the effect, why would conscious memory be hampered by cues? One way that conscious processes could be impaired by cues is that cues not only facilitate recall of the correct items, but they can also facilitate recall of irrelevant information. The part set cues could be used to recall some correct information, but the combination of cues provided may also predispose subjects to think of other items that are not appropriate for the current task. For example, if the category animals was presented with the following exemplars-- sheep, elephant, mouse, lion, goat, bear, then sheep, goat, and mouse are presented as part set cues. The subject may spontaneously remember elephant due to the presence of mouse, but the combination of the cues sheep, goat, and mouse when input into the conscious retrieval system may produce a farm scenario concept. If the retrieved idea of a farm was used as a conscious aid to retrieval in an effort to retrieve the remaining items, this concept would be detrimental to the retrieval of specific items from the animals category for a number of reasons. Farms may circumscribe or limit the search of categorical items to a portion of memory that does not contain the relevant items (this view of memory as sets of items borrows heavily from the ideas of Tversky, 1977, in which memory sets can be viewed as intersecting, overlapping, and nonoverlapping Venn diagrams of sets of items). This misdirection of the search would likely be more detrimental to items that were weakly associated to a particular set of cues. The concept of farm, goat, sheep, and mouse would be less associated to lion, bear or elephant than to dog, cow, or horse. Consequently, the process of retrieval would be more likely to directly access other irrelevant items. If this is the case, time spent recalling irrelevant items could allow other items to be lost from memory possibly due to interference from recalling incorrect items. Thus, consciously produced irrelevant items could produce forgetting of the earlier earlier seen correct items. If this is the case, then one would expect less opportunity for distraction within the whole condition given no cues are provided. The whole cue group would be expected to spend less time recalling incorrect items if left to use a previously developed recall strategy. That is, if subjects are given the opportunity to produce items in any order they wish, then they may be less likely to be distracted than when the cues are experimentally provided items. That is, the generation of cues by subjects may be less likely to go down irrelevant retrieval routes than an experimenter cued pathway because they may be more likely to engage in a similar type of recall strategy as that engaged at study.

Although similar to the strategy disruption hypothesis (cf., Sloman, et al., 1991; Basden et al., 1973), this explanation differs slightly. For example, the strategy disruption hypothesis would seem to predict that as recall increases the negative effect of part set cuing should decrease. The decrease in the inhibitory effects of part set cuing should occur because the match between study and test processing should be higher, since the overall level of recall increases. In Experiment 3a, no such decrease in the inhibitory effect of part set cuing was found as the overall level of recall was manipulated (i.e., the negative effect of part set cuing remained consistent). Others (i.e., Sloman et al., 1991) have also found that when recall is increased part set cue effects often remain even if recall is improved. So a pure implementation of the strategy disruption hypothesis would need to be modified to account for both the finding that part set cues primarily disrupt conscious processing and that improved recall does not lessen part set cue effects.

Moreover, the strategy disruption hypothesis does not make clear predictions concerning the effects of extralist cues on performance. One could read the strategy disruption hypothesis as predicting either no effects of extralist cues on cued recall performance or a negative effect of extralist cues on performance. For example, if the extralist cues are irrelevant, then one could ignore these items and recall items in a similar manner to the whole cue group. This should be possible given the present results that part set cues do not seem to influence automatic processing of information. That is, these results imply that processing is under conscious control so the choosing of cues to be input into the retrieval system is plausible. If no automatic influence is involved in the part set cue effect, then subjects should be able to disregard these irrelevant cues, and performance should be similar to that observed in the whole cue group. However, the strategy disruption hypothesis also would expect that anything that is disruptive to implementing a similar strategy to the strategy earlier developed at study would impede performance. Consequently, if performance is worse with extralist cues, then they must be disrupting performance.

Several researchers (Watkins, 1973; Matthews, & Hunt, 1994) have found that extralist cues do impair recall to the same degree as intralist part set cues. Since extralist cues do impair performance, the first hypothesis that extralist cues would not impair performance would not be supported (but see Basden and Draper, 1973). Secondly, if extralist cues do disrupt performance and they do not impact automatic processing of information, how do they impair performance? According to the current explanation, part set cues of any type must be causing subjects to adopt inappropriate retrieval strategies. Any cues, if they are used, could cause subjects to retrieve items that are not part of the set that they wish to access. What would be important about part set cues would be that they misdirect conscious retrieval attempt by directing the search of memory to similar but incorrect items. Consequently, the current proposal predicts that extralist cues may operate according to the same principle as intralist cues, a prediction not clearly made from earlier manifestations of the strategy disruption hypothesis (cf., Basden, et al., 1973; Sloman, et al., 1991). Another related prediction would be that extralist cues would exert their inhibitory effects on the conscious inhibitory processes and leave automatic processing unaffected. This remains an open empirical question for future research. It could well be the case that extralist cues do not work via the same mechanism as intralist cues (i.e., processes may not contribute independently to performance in this condition).

A final question that presents itself is why don't subjects continue to retrieve items until they get the correct items for each category. There are two possible answers to this question. One is that subjects invoke some sort of stopping rule as proposed by Rundus (1973). Specifically, subjects will retrieve items as long as they are producing correct items. If subjects continue to retrieve incorrect items on successive retrieval attempts, then they are likely to abort the memory search as the ratio of incorrect/inappropriate items to correct items increases. That is, as the number of unsuccessful retrieval attempts becomes greater than the number of successful retrieval attempts, subjects will be likely to terminate any further search of memory for correct items for that category. The actual number of unsuccessful retrieval attempts that will need to occur before aborting recall likely depends on a number of factors. Some factors would be the payoff for continuing to produce items, motivation of the subject, etc. Another related possibility is that subjects can often incorrectly generate acceptable items for a particular category and list those items. If this happens, another factor that would affect the time spent recalling words would be the number of items that subjects are required to produce. For example, if a subject is required to produce three out of six previously studied items and is given three of these items as cues, then the subject may recall two of the items and possibly list a third that is incorrect but that fits the category. This may cause a termination of any further recall attempts, and the third correct item may not be accessed. Consider the whole cue condition when six items are required. Here retrieval attempts would continue longer because more items are required. A consequence of this may be that subjects can correct their errors more easily because later retrieval attempts may produce items that cause the subject to realize some of the items already listed are incorrect. Consequently, a relative stopping rule combined with listing incorrect items is warranted to explain why conscious retrieval processes may be abandoned sooner than necessary.

The current model of part set cue can be summarized as follows. Part set cues primarily are predicted to impair conscious uses of memory and not to impact estimates of automatic memory usage. Data supportive of this position is found in all three experiments. In Experiments 1 & 2, controlled/conscious uses of memory decreased when conscious estimates in the part set cue condition were compared to conscious estimates in the whole cue condition. Automatic estimates did not differ as a function of cuing. Experiments 3a and 3b also provide evidence supportive of this view. An explicit test of cued recall, primarily a test of conscious memory[6], was shown to display the typical negative effect of part set cues. An implicit of test of category production, however, did not display any effects of part set cuing (i.e., the whole and part set cue conditions resulted in equivalent performance).[7] Second, performance within the context of part set cues is composed of automatic and controlled influences of memory that independently contribute to performance. This statement is derived directly from Jacoby's (1991) theoretical views of memory and received support from the data in Experiments 1 and 2 where the controlled/conscious estimates of memory were able to be manipulated independently of the automatic estimates of memory.

Furthermore, part set cues are viewed as potentially diverting conscious retrieval attempts to categorically suitable items that are not correct items within the context of the given test. This misdirection was not viewed as comparable to the strategy disruption hypothesis (Basden, et al., 1973; Sloman, et al., 1991).

Reasons for a distinction between the two proposals are due to implications of the strategy disruption hypothesis. The strategy disruption hypothesis stated that part set cues cause subjects to use an inappropriate strategy. Conversely, it would be expected that improved recall would be due to a good match between study and test strategies. This would predict that better recall should be accompanied by a decrease in the inhibitory effects of part set cuing. Such a finding was not observed in Experiment 3a. That is, recall was improved via study task variations, but a persistent effect of part set cuing was found across all three types of study tasks. This finding does not fit well with the strategy disruption hypothesis. Also, the strategy disruption hypothesis made no clear prediction concerning the effects of extralist part set cues on performance. The present explanation predicts that extralist cues should impair conscious processes to the same extent as intralist part set cues (i.e., the type of cues manipulated in this study). These predictions await future experimentation. A relative stopping rule is also proposed to account for discontinuing conscious searches of memory.

Consequently, some major changes from previous theories proposed by the current model were the adoption of Jacoby's (1991) assumptions concerning automatic and controlled processing. The most notable contribution of the present model was that part set cues are proposed to affect only the conscious memory processes and not any automatic contributions to memory. These processes were also found to be relatively independent of each other. The present model also predicts that extralist cues should impair performance in a similar manner to intralist cues if part set cues tend do divert conscious retrieval processes to incorrect but categorically appropriate items in memory. The tentative model could be best described as a conscious diversion model in that part set cues are hypothesized to divert conscious processes away from correct items because the provided cues circumscribe a different set of categorical items in the memory system that does not contain the correct items (see Tversky, 1977). This model is viewed as a conceptually similar to the strategy disruption hypothesis (Sloman et al., 1991; cf. Nickerson, 1984) in that both rely on differing cue environments to misdirect performance. However, the incorporation of Jacoby's ideas of controlled and automatic processing and predictions concerning extralist cues reinforce the dissimilarity of the two theories.

To summarize, the present study achieved its goal of localizing the effects of part set cuing to either conscious/controlled or automatic uses of memory. The results of all three experiments demonstrated that part set cues selectively impair conscious/controlled memory but not automatic memory. This was true across three different methodologies (i.e, Jacoby's, 1991, process dissociation procedure, Jacoby et al.'s, in press, IRK procedure, and the implicit/explicit methodology). These results were compared to existent theories of part set cuing. The current theories of part set cuing were found to be unsatisfactory in accounting for the current data. Consequently, an alternative misdirection model of part set cuing was proposed based on Jacoby's (1991; Jacoby, et al.'s, in preparation) ideas. This model viewed the part set cues as acting to bias subjects to search inappropriate subsets of the memory system. This would result in the production of categorically appropriate but incorrect items. Alternatively, this bias could cause retrieval processes to "dead end" in areas of the memory system in which no appropriate answers may be produced.

Whether this conceptualization of part set cuing is accurate awaits additional experimentation. However, one test of this theory concerns the mechanism of extralist cuing. As stated previously, this theory speculates that extralist part set cues operate via the same mechanism as intralist part set cues. This prediction will require further research. Independently of the proposed model of part set cuing, the major contribution of the current research has been to provide evidence that part set cues exert their deleterious effect on conscious uses of memory. This present link between part set cuing and conscious memory impairment remains novel in the literature.

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## Footnotes

1. . This statement refers mainly to conditions in which more than one list cue is provided at test (i.e., this condition often results in facilitation as mentioned previously--see Lewis, 1971, and Slamecka, 1972).

2. Jacoby (1991) , however, noted that the exclusion formula can underestimate automatic performance unless C is zero.

3. This result is obtained by the simple algebraic combination of the two formulae. $[C + A(1 - C)] - [A(1 - C)] = [C + A - AC] - [A - AC] = C + A - AC - A + AC = C$.

4. The division by 1 - C is are warranted by the assumption of Jacoby, Yonelinas, and Jennings (in press) that controlled/conscious and automatic processes function independently of each other. The results of their research and the present study are compatible with this assumption.

5. Subjects in the divided attention task detected on average 85 percent of the presented target digits. These scores were the average of the number of digits subjects reported divided by the total number of possible digits in a given amount of time. The

amount of time spent listening to digits was determined by the time subjects required to complete the study task and varied between subjects (range= 5 min 40 sec to 12 min 16 sec). Also, the average number of target digits detected contains some scores over a hundred percent due to false positive responses (i.e., more digits than actually presented were reported by subjects). However, when the absolute number of errors both hits and false positives is averaged, subjects made on average 20 percent errors. Consequently, the average number correct here would be 80 percent of the digits correctly detected. This figure is comparable to the 85 percent correct response rate containing false positive errors. So the use of either figure still results in a high success rate for detecting the target digits and indicated the task was of moderate to easy difficulty level.

6. Explicit cued recall mainly tests conscious uses of memory. However, as Jacoby (1991) and Jacoby, Lindsay, and Toth (1992) point out, performance on this test may also include automatic contributions to performance. For the present study, this is not a problem since the conclusions that part set cues affect only conscious processes derive from Experiments 1 and 2. Even with possible contamination by automatic processes, the basic patterns of the first two experiments are replicated with the implicit/explicit test methodology.

7. Typically, implicit tests contain influences of both automatic and controlled/conscious influences of memory. However, the implicit test chosen here has been found by others to be a relatively process pure (Kelly, et al., 1994) test measuring automatic influences of memory. Given this distinction, no problem should arise theoretically from the application of the implicit/explicit test methodology and Jacoby's (1991) framework. This is true because empirically the category production test has been shown to be a process pure indication of automatic influences of memory. Since this test is a process pure assessment of memory, Jacoby's (1991) criticisms should not apply. Furthermore, as noted by Jacoby, Yonelinas, and Jennings (in press), the results of implicit tests often dove-tail with the outcomes derived using the process dissociation framework.