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Divided Attention During Encoding and Retrieval: Differential Control Effects?

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Previous studies have shown that divided attention (DA) during retrieval has little effect on recall of episodic memories, although DA during encoding has a large detrimental effect. One possible reason for this asymmetry is that stimulus presentation at encoding is under experimenter control, whereas retrieval operations and responses are under participant control. This experiment tested this possibility by presenting paired-associate word lists for learning and recall, either at a fixed 4-s rate or at a rate controlled by the participant. The results showed that the higher recall levels for DA at retrieval than for DA at encoding held under all combinations of experimenter and participant control. The implications of these results for a fuller understanding of encoding and retrieval processes are discussed.

It has been known for some time that divided attention (DA) during the encoding phase of a memory task reduces subsequent memory performance. This effect was shown by Murdock (1965) and confirmed in later studies by Baddeley, Scott, Drynan, and Smith (1969) and by Anderson and Craik (1974). Murdock (1965) also found that free-recall performance improved under dual-task conditions when performance of the memory task was emphasized at study as opposed to performance of the secondary task. Memory-encoding processes thus require attention, the amount of attention available can be allocated differentially to the encoding task and the subsidiary task, and this allocation is under the participant's control. On the other hand, DA at the time of retrieval has surprisingly slight effects (Baddeley, Lewis, Eldridge, & Thomson, 1984; Kellogg, Cocklin, & Bourne, 1982). Baddeley and colleagues (1984) suggested that retrieval processes may run off automatically, but this conclusion does not fit well with the results of other studies in which the attentional demands of retrieval and encoding were measured precisely, by means of a continuous visual tracking task, for example. These studies showed that, if anything, retrieval consumed more attentional capacity than encoding (Johnston, Greenberg, Fisher, & Martin, 1970; Johnston, Griffith, & Wagstaff, 1972; Trumbo & Milone, 1971). Addressing this point, Baddeley et al. (1984) suggested that accessing the memory trace may occur with few demands on attention but that response selection takes time and effort, with negative consequences for performance of the secondary task.

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The effects of DA on encoding and retrieval were investigated in a further series of experiments by Craik, Govoni, Naveh-Benjamin, and Anderson (1996). In line with previous work, these researchers found that DA at encoding was associated with a large decline in subsequent memory performance but that DA at retrieval had comparatively slight effects. They also found that DA at retrieval in the free-recall paradigm was associated with a greater degree of slowing on the concurrent continuous reaction time (RT) task than was DA at encoding. This latter result suggests a simple trade-off between the memory task and the RT task; however, other experiments in the series, in which cued recall or recognition memory was used as the retrieval task, revealed the same pattern of greater deleterious effects of DA on encoding than on retrieval, but with equivalent DA costs for the concurrent RT task. A final difference between encoding and retrieval was that with DA at encoding, participants could allocate attention differentially to memory encoding or to the concurrent task, but that with DA at retrieval, the differential emphasis instructions had no effect on memory performance.

These results are of interest for several reasons. First, the apparent differences between encoding and retrieval processes constitute evidence against the notion that retrieval processes are essentially a recapitulation of encoding processes (e.g., Craik, 1983; Kolers, 1973; Roediger, Weldon, & Challis, 1989). If encoding and retrieval processes comprised the same set of perceptual and conceptual operations, then it would be expected that they should be affected similarly by some further variable, yet this is clearly not so for DA. A second point of interest is the apparent similarity between the effects of DA and the effects of normal aging, fatigue, sleep deprivation, and alcoholic intoxication on memory (Birnbaum, Parker, Hartley, & Noble, 1978; Craik, 1977, 1982; Nilsson, Bäckman, & Karlsson, 1989). A fuller understanding of the differential effects of DA on encoding and retrieval processes may therefore lead to further insights into the effects of aging and other conditions. Third, the asymmetrical effects of DA on encoding and retrieval suggest the possibility of links to recent results from neuroimaging studies of memory that have shown different patterns of prefrontal activation during episodic encoding and retrieval (Tulving, Kapur, Craik, Moscovitch, & Houle, 1994).

Before drawing too many theoretical conclusions, however, we should be sure that the differences between encoding and retrieval described by Baddeley et al. (1984) and by Craik et al. (1996) are not simply attributable to some aspect of the experimental procedure. One possibility in this regard concerns the amount of attentional control that a participant can bring to bear on the management of a dual-task situation. There may be aspects of retrieval, for example, that are more controllable than the corresponding aspects of encoding. In particular, it seems likely that the timing of retrieval is more under the participant's control than the timing of encoding in the sense that he or she can decide when to attend to retrieval or response operations and can therefore carry out these operations at a time that is least disrupted by secondary task operations. On the other hand, encoding operations must be carried out when the material is presented by the experimenter. It is therefore possible that the finding that DA disrupts encoding more than it disrupts retrieval may reflect this difference in participant versus experimenter control.[1] The purpose of the following study was to test this notion.

In overview, lists of word pairs were presented for encoding and retrieval in a paired-associate paradigm. Participants carried out encoding and retrieval either under full-attention or under dual-task (DA) conditions. The rate of presentation either was constant and fixed by the experimenter or was variable and under the direct control of the participant. In the latter situation, the participant signaled the experimenter when he or she was ready to receive the next word pair (during encoding) or cue word (during retrieval). If the encoding-retrieval asymmetry is in fact attributable to greater participant control at retrieval, then the standard results (i.e., a substantial reduction of memory performance associated with DA at encoding but little reduction associated with DA at retrieval) should be obtained when the rates of encoding and retrieval are fixed by the experimenter but should not be obtained when the rates are under the participant's control. It might even be expected that the effects of DA would be greater at retrieval than at encoding when the former is under experimenter control and the latter is under participant control. On the other hand, if differential control is not a crucial issue, then memory performance may be generally superior under participant control, but the effects of locus of control should not interact with the variable of full attention versus DA.

Method

Participants

The participants were 24 University of Toronto undergraduates who received course credit for their efforts.

Design

The experiment had a 2 × 2 × 3 within-subjects design. The independent variables were control (experimenter control vs. subject control), where control was manipulated (encoding vs. retrieval), and attention condition (full attention at both encoding and retrieval vs. DA at encoding only vs. DA at retrieval only). The design thus yielded 12 conditions that were counterbalanced across participants. That is, each participant performed the same tasks but in a different order and with different word lists.

Materials

Twenty-four lists, each containing 10 pairs of unrelated common nouns, were used in the memory task. The word pairs were presented visually, and the cue words were scrambled randomly for the retrieval phase, with the provision that at least five events intervened between presentation and test. Two formats of the materials were prepared (12 lists in each format), with half of the participants using Format A and half using Format B.

Experimental Tasks

Two tasks were involved in the experiment—a paired-associate memory task and an auditory RT task. During the encoding phase, word pairs were presented visually on a computer screen, and during the retrieval phase, the first words of each pair were presented visually in a new random order. When pacing was controlled by the experimenter, participants were given 4 s to encode or retrieve each word pair. When pacing was controlled by the participant, he or she had a maximum of 10 s to encode or retrieve. If participants were ready for the next pair (or cue item) before the 10 s had elapsed, they said "next" as a signal to the experimenter to display the next event. If participants did not signal, the next item was presented automatically after 10 s. The experimenter controlled the appearance of each successive event by pressing a button, and the times between button presses were used to calculate average encoding and retrieval times in each experimental condition. During retrieval, the participants attempted to recall orally the second word in each pair.

The RT task involved three auditory tones (500, 250, and 125 Hz) presented for 0.5 s, and the participant's task was to press the button corresponding to the presented tone. A correct response caused a new tone to sound, and an incorrect response led to the repetition of the same tone until a correct response was made (this was the only situation in which the same tone was repeated). The instructions were to carry out the RT task as quickly and as accurately as possible. The task was performed alone for 60 s, with the encoding phase of the memory task, or with the retrieval phase of the memory task.

Procedure

All participants received five practice trials. First, they practiced the memory task under full-attention conditions and participant control at both encoding and retrieval. Then, they practiced the RT task twice, for 90 s on each occasion. Next, they performed the RT task while also carrying out memory encoding; pacing was experimenter controlled (i.e., 4-s rate) at both encoding and retrieval. Finally, participants performed the RT task during retrieval; presentation of word pairs at encoding was experimenter paced, and word presentation at retrieval was participant paced. In the dual-task conditions, participants were asked to pay equal attention to both tasks.

The main test conditions were divided into three blocks (full attention, DA at encoding, and DA at retrieval), each of which contained the four combinations of participant or experimenter control at encoding or retrieval. The three blocks were presented in a counterbalanced order across participants; the order of conditions within blocks was also counterbalanced. Participants also took part in three baseline trials of the RT task for 60 s on each occasion; these trials preceded the first, second, and third blocks of memory trials.

Results

Memory Task

Figure 1 shows the mean numbers of words recalled under the various experimental conditions. The most obvious feature of the results is that whereas DA at encoding was associated with a marked reduction in performance, DA at retrieval had little or no

[1] This point was suggested to us by Nelson Cowan.

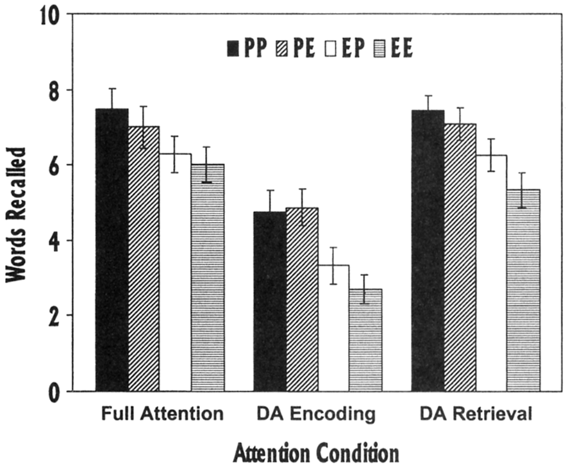

Figure 1. Mean numbers of words recalled as a function of experimental condition. DA = divided attention; P = participant control; E = experimenter control. For example, PE indicates participant control at encoding and experimenter control at retrieval. Error bars indicate standard errors.

effect on memory performance; this result is in line with previous findings (Baddeley et al., 1984; Craik et al., 1996). With regard to control of pacing, Figure 1 shows that memory performance was somewhat higher when participants controlled their own encoding times (PP and PE) than when encoding times were controlled by the experimenter (EP and EE). Similarly, participant-controlled retrieval times were associated with somewhat higher memory performance than were experimenter-controlled retrieval times (PP and EP vs. PE and EE). However, there was no sign of a reversal of the general superiority of memory levels associated with DA at retrieval over memory levels associated with DA at encoding. In particular, when encoding was participant controlled and retrieval was experimenter controlled (PE), memory performance was still higher with DA at retrieval.

In order to analyze the effects shown in Figure 1 unambiguously, comparisons among the three attentional conditions were carried out on a pairwise basis. That is, full-attention performance was compared separately with performance under DA at encoding and performance under DA at retrieval; the last two conditions were also compared directly. Comparisons were conducted with a 2 (attentional condition) × 2 (participant or experimenter control at encoding) × 2 (participant or experimenter control at retrieval) analysis of variance (ANOVA). The first analysis (full attention vs. DA at encoding) yielded a main effect of attention, $F(1, 23) = 65.28$, $p < .001$, $MSE = 5.69$, showing that full attention was associated with higher recall levels than was DA at encoding. Also found were an effect of control at encoding, $F(1, 23) = 42.47$, $p < .001$, $MSE = 2.37$ (participant control was better than experimenter control), and a marginal effect of control at retrieval, $F(1, 23) = 3.64$, $p < .07$, $MSE = 1.37$ (participant control was somewhat better than experimenter control). No interactions were reliable.

In the second comparison, full attention was contrasted with DA at retrieval in a similar 2 × 2 × 2 analysis. In this analysis, the effect of attentional condition was not significant, $F < 1.0$, but the effects of locus of control were again reliable. For participant versus experimenter control at encoding, $F(1, 23) = 17.47$, $p < .001$, $MSE = 4.58$, and for participant versus experimenter control at retrieval, $F(1, 23) = 5.99$, $p < .03$, $MSE = 2.17$. In both situations, participant control was better than experimenter control. None of the interactions reached significance, all $Fs < 1.10$.

Third, the comparison of DA at encoding and DA at retrieval yielded a main effect of locus of DA, $F(1, 23) = 79.03$, $p < .001$, $MSE = 4.15$, showing that DA at retrieval was associated with higher recall levels. The effects of participant versus experimenter control at encoding, $F(1, 23) = 39.24$, $p < .001$, $MSE = 3.27$, and at retrieval, $F(1, 23) = 5.68$, $p < .03$, $MSE = 1.70$, were again reliable. In both situations, participant control was better than experimenter control. Again, none of the interactions approached significance, all $Fs < 1.75$.

These analyses demonstrate that whereas participant control at both encoding and retrieval was associated with higher levels of recall, these locus-of-control effects did not interact with the attentional conditions in any instance. In particular, the superiority of DA at retrieval over DA at encoding cannot be attributed to greater participant control in the former condition, when encoding and retrieval times were controlled by the experimenter. This conclusion follows from the result that the same superiority of DA at retrieval over DA at encoding was found when both sets of operations were under participant control. The point is reinforced even more strongly by the finding that the same superiority of DA at retrieval held under the condition in which encoding was under participant control and retrieval was under experimenter control (condition PE in Figure 1).

To what extent can the results shown in Figure 1 be attributed to participants simply giving themselves more time when pacing is under their control? The average times taken per encoding or retrieval event are shown in Table 1; note that these times are 4.0 s in all instances of experimenter control. Table 1 shows that participant-controlled times are longer than experimenter-controlled times in all instances and that this effect is especially marked for encoding times. It is therefore not surprising that memory performance was reliably higher when participants controlled the pacing of presentation, both at encoding and at retrieval. However, the superiority of DA at retrieval over DA at encoding cannot be attributed to differences in pacing. The reasons are as follows. First, recall performance is higher for DA at retrieval than for DA at encoding in the EE condition, in which encoding times and retrieval times are both set at 4.0 s. Second, in the participant-controlled DA conditions, the times are actually longer for encoding ($M = 8.4$ s) than for retrieval ($M = 6.1$ s), yet recall levels are lower for encoding ($M = 5.0$ items) than for retrieval ($M = 6.9$ items).

Table 2 summarizes the participant-controlled times for encoding and successful retrieval averaged across the relevant pacing conditions. Table 2 shows that the increase in retrieval time from full attention to DA at retrieval was 1.1 s and that this increase was slightly smaller than the corresponding increase in encoding time from full attention to DA at encoding (1.2 s). It is clear that the superior memory performance associated with DA at retrieval cannot be attributed to participants taking differentially longer to retrieve than to encode. In greater detail, encoding times are equivalent for full attention and for DA at retrieval (both 7.2 s); this equivalence was expected, as the conditions were identical up to that point. Encoding times are longer for DA at encoding (8.4 s),

Table 1
Times per Encoding or Retrieval Event as a Function of Experimental Condition

Locus of control		Full				DA (encoding)				DA (retrieval)			
		Encoding		Retrieval		Encoding		Retrieval		Encoding		Retrieval	
Encoding	Retrieval	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*	*M*	*SD*
P	P	7.3	2.1	5.0	1.5	8.3	1.9	6.2	1.5	7.2	2.3	6.3	1.5
P	E	7.1	2.2	4.0		8.4	1.8	4.0		7.1	2.2	4.0	
E	P	4.0		4.9	1.6	4.0		5.9	1.7	4.0		5.8	1.4
E	E	4.0		4.0		4.0		4.0		4.0		4.0	

Note. Data are reported in seconds. DA = divided attention; P = participant control; E = experimenter control. For example, P and E in the same row indicates participant control at encoding and experimenter control at retrieval. Experimenter-controlled times were all 4.0 s, with no variability (thus, no *SD*).

showing that participants devoted more time to encoding under DA conditions. The retrieval times shown in Table 2 are times for the complete retrieval event, which was sometimes terminated by successful retrieval, sometimes by the participant giving up and calling for the next retrieval cue ("next"), and sometimes by the expiration of the 10-s deadline. Both DA at retrieval (6.1 s) and retrieval following DA at encoding (6.1 s) yield longer retrieval latencies than does retrieval under full attention (5.0 s). The higher value for DA at retrieval is expected; retrieval takes longer under DA conditions (Baddeley et al., 1984). The higher value for retrieval following DA at encoding is surprising at first consideration but is understandable on the basis of the assumption that DA at encoding leads to a relatively poor encoded representation, which then takes longer to retrieve, even though retrieval is carried out under full attention. The same lengthening of retrieval times following DA at encoding was reported by Naveh-Benjamin and Guez (2000). It is also probable that the average retrieval time following DA at encoding is lengthened by a larger number of retrieval failures in this condition; such failures would contribute long latencies to the overall mean for that condition.

RT Task

RTs were measured for correct responses only. The mean RT on baseline trials was 647 ms. Table 3 shows that the mean RTs from all DA conditions were substantially higher, suggesting that both encoding and retrieval processes made considerable demands on processing resources. Table 3 also shows that RTs were higher when the RT task was performed at retrieval than when it was performed at encoding, suggesting that in this experiment, retrieval was more demanding than encoding. The RTs from the DA conditions were analyzed by a 2 (DA at encoding vs. retrieval) × 2 (participant vs. experimenter control at encoding) × 2 (participant vs. experimenter control at retrieval) ANOVA. The analysis showed a significant effect of DA at encoding versus DA at retrieval, $F(1, 23) = 6.83$, $p < .05$, $MSE = 89{,}326$. Significantly longer RTs were observed when the task was performed at retrieval. The only other reliable effect was the interaction between locus of the DA task and pacing at encoding, $F(1, 23) = 15.99$, $p < .01$, $MSE = 19{,}984$. This effect is best understood as showing that with DA at encoding, RTs were longer with participant control (PP and PE) than with experimenter control (EP and EE). No such effect was apparent with DA at retrieval. The interaction can be interpreted as showing that when participants controlled their own encoding times, they concentrated relatively more on the encoding task than on the RT task; this effect did not occur at retrieval, however.

Errors in the RT task are shown in Table 3. The proportions of errors were high in all conditions, reflecting the difficulty of discriminating the three tones. An ANOVA on the 2 × 2 × 2 DA conditions yielded only one reliable effect—DA at encoding vs. retrieval, $F(1, 23) = 14.27$, $p < .01$, $MSE = 0.0084$. More errors were made with DA at retrieval (M = .29) than with DA at encoding (M = .24).

Table 2
Participant-Controlled Times per Encoding or Retrieval Event

Event	Full		DA (encoding)		DA (retrieval)	
	M	*SD*	*M*	*SD*	*M*	*SD*
Encoding	7.2	2.1	8.4	1.7	7.2	2.3
Retrieval	5.0	1.4	6.1	1.4	6.1	2.3

Note. Data are reported in seconds. DA = divided attention.

Discussion

The purpose of this study was to provide data on the possibility that the asymmetry between the effects of DA at encoding and those of DA at retrieval is attributable to differential control in the two conditions. The results shown in Figure 1 effectively rule out this possibility. If the typical superiority of DA at retrieval over DA at encoding is attributable to greater participant control at retrieval, then memory performance should have interacted with the locus of participant control, with superior performance being associated with DA at encoding when encoding was under participant control and retrieval was under experimenter control (condition PE in Figure 1). There was no trace of such an effect; DA had a much greater effect at encoding than at retrieval under all experimental conditions. Participant control boosted memory performance when it was permitted, both at encoding and at retrieval,

Table 3
Performance on the Continuous Reaction Time (RT) Task

Attentional condition	PP *M*	PP *SD*	PE *M*	PE *SD*	EP *M*	EP *SD*	EE *M*	EE *SD*
RTs (ms)								
DA (encoding)	1,006	397	982	448	895	335	856	353
DA (retrieval)	1,014	388	1,036	515	1,121	482	1,021	385
Baseline	647	186	647	186	647	186	647	186
Proportions of errors								
DA (encoding)	.24	.09	.24	.09	.24	.09	.25	.11
DA (retrieval)	.29	.10	.31	.16	.28	.11	.29	.13
Baseline	.12	.06	.12	.06	.12	.06	.12	.06

Note. DA = divided attention; P = participant control; E = experimenter control. For example, PE indicates participant control at encoding and experimenter control at retrieval. Experimental condition: PP, PE, EP, EE.

but these effects were probably attributable to the longer times taken; in any event, the control of pacing variable did not interact with the attentional conditions. Table 2 provides evidence against an explanation in terms of differential processing times devoted to the two processes; participants took more time to encode than to retrieve, yet performance was superior with DA at retrieval.

The RT data shown in Table 3 suggest at first consideration that retrieval processes were allocated more processing resources (i.e., more slowing of the RT task) and that this detail may be a factor underlying the asymmetry. Two counterarguments may be made. First, Craik et al. (1996) reported several instances in which RTs on the secondary task did not differ between DA at encoding and DA at retrieval, yet asymmetry was found. Second, in the PP condition in this study, RTs were virtually identical between DA at encoding and DA at retrieval (*M*s = 1,006 and 1,014 ms, respectively; average *SD* = 393 ms), yet DA at encoding was associated with substantially lower memory performance than DA at retrieval.

Table 3 also shows that DA at retrieval was associated with a higher error rate than DA at encoding as well as with longer RTs. These results further confirm the conclusion that retrieval processes are, in general, more resource demanding than encoding processes (Craik et al., 1996; Johnston et al., 1972). Finally, the reliable interaction between the locus of participant control (at encoding or at retrieval) and the locus of DA (encoding or retrieval) in the data in Table 3 shows that whereas participant control at encoding is associated with increased RT costs for DA at encoding, participant control at retrieval has no comparable effect on DA at retrieval. This result is in line with the notion that encoding processes are relatively more controlled and trade off more directly against performance of the secondary task than retrieval processes (Craik et al., 1996). Despite the fact that encoding is relatively more controlled than retrieval, the overall conclusion from this study is that this difference in the degree of control that participants can exert on the two processes does not appear to mediate the asymmetry between the effects of DA on encoding and retrieval.

Two further sets of studies should be considered before concluding that DA at retrieval has little or no effect on memory performance. First, Jacoby (1991) found rather substantial effects of DA at retrieval, especially when the initial encoding was semantic. One of the two experiments was done with Jacoby's (1991) exclusion recognition procedure, in which participants were instructed to call previously presented words "new" if they were presented visually in the encoding phase; "old" words were presented auditorily in the encoding phase. DA at testing was associated with substantially higher false-alarm rates for visually presented words that were semantically encoded in the first phase. It is conceivable that the necessity to make both a recognition decision and a source decision under DA conditions was a factor underlying the difference in results. Jacoby's (1991) other relevant experiment was done with a straight recognition test yet again revealed that DA at retrieval reduced recognition performance for semantically encoded words. Participants were instructed to perform the recognition task "somewhat automatically," so perhaps this difference in procedure caused the difference between Jacoby's (1991) results and those of Baddeley et al. (1984), Craik et al. (1996), and this study.

Second, Fernandes and Moscovitch (2000) reported some experiments in which they varied the similarity of the secondary task to the primary task of memory retrieval; they found substantial reductions in memory performance. They combined free recall of a list of words with a task in which participants monitored a long sequence of visually presented words for the presence of targets defined as either three successive words denoting man-made objects or three successive two-syllable words. Recall performance declined by an average of 35% when one of these tasks was performed concurrently with retrieval. When the secondary task was performed at encoding, the decline in performance from full-attention conditions was even larger—an average of 52%. In a further experiment, the researchers showed that a digit-monitoring task carried out during retrieval had a relatively small effect (13% decline in performance), although the same digit-monitoring task was associated with a 50% decline in performance when conducted during encoding.

Fernandes and Moscovitch (2000) concluded that whereas any task that consumes attentional resources will reduce concurrent memory performance when it is performed at encoding, only tasks that deal with materials qualitatively similar to the retrieved information will disrupt retrieval. That is, DA at encoding exerts its effects by diverting processing resources from the encoding operations, but DA at retrieval exerts its effects by reducing the discriminability of wanted target items from the noisy background caused by the secondary task. Our own results are compatible with this view. In earlier experiments in which free recall was combined with a four-choice RT task at retrieval, DA at retrieval was associated with an average decline of 12% from full-attention conditions (Craik et al., 1996). This figure is comparable to the 13% decline reported by Fernandes and Moscovitch using a digit-monitoring task during retrieval. Craik et al. found that the effects of DA at retrieval were small but significant for free recall, less for cued recall, and even less for recognition memory; the authors concluded that the effects of DA at retrieval were attenuated as environmental support increased.

A plausible interim conclusion is that the disruption in performance associated with DA at retrieval will depend on several factors, of which the qualitative similarity of materials between the retrieval task and the concurrent task may be the most important. Other factors clearly play some role, however, and these are likely to include the difficulty or resource requirements of the concurrent task (Naveh-Benjamin, Craik, Gavrilescu, & Anderson, 2000), the degree to which encoding context must also be retrieved (Jacoby, 1991), the time pressure on retrieval (this study), and the degree of contextual or environmental support for appropriate retrieval processes (Craik et al., 1996).

The growing list of factors that affect encoding and retrieval differently casts further doubt on the equivalence or even similarity of these two sets of processes suggested by previous researchers (Craik, 1983; Kolers, 1973, 1979; Roediger et al., 1989). On the other hand, there must be some congruence between encoding and retrieval given the empirical facts of the encoding specificity principle (Tulving & Thomson, 1973) and transfer appropriate processing (Morris, Bransford, & Franks, 1977; Roediger et al., 1989), as well as the logical fact that successful encoding and retrieval processes refer to the same external event. One possible resolution of this paradox is that the encoded and retrieved representations are the same but that the processes involved in encoding and retrieving are substantially different.

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