

Skills of divided attention*

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Abstract

Two subjects read short stories while writing lists of words at dictation. After some weeks of practice, they were able to write words, discover relations among dictated words, and categorize words for meaning, while reading for comprehension at normal speed. The performance of these subjects is not consistent with the notion that there are fixed limits to attentional capacity.

The study of divided attention has a long history. Most early psychologists, like their contemporary counterparts, believed that consciousness could only be directed to a single activity at a time. Conscious attention to two different actions performed at the same time was thought to be possible only if they were coordinated into a single, higher-order activity, or attended to in rapid alternation. Otherwise, it was assumed that at least one of them was being carried out 'automatically', without conscious control (James, 1890; Woodworth, 1921).

Early investigators attempted to explore the limits of consciousness by combining diverse tasks while introspecting on their performance. Paulhan (1887) recited one poem while writing another, or while executing mathematical calculations. Solomons and Stein (1896) and later Downey and Anderson (1915) practiced reading stories while writing at dictation, and noted the changes that occurred in their conscious awareness of the act of writing. These studies did not always support the view that consciousness is unitary. Experimenter/subjects variously reported that one activity was

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performed unconsciously (Solomons & Stein, 1896), that attention alternated between the two activities (Paulhan, 1887), and that a genuine division of attention was accomplished (Downey & Anderson, 1915).

Modern studies of attention have avoided the dependence on introspection which characterizes the early work. In addition, however, they have usually divorced attention from action. Division of attention has not been defined by simultaneous directed activity, but by concurrent processing in two distinct 'channels'. In experiments on selective listening, for example, subjects are usually asked to shadow only one of two verbal messages; the other is to be 'ignored'. Processing of the secondary input may be assessed by testing memory for the words on the 'unattended channel' (Glucksberg & Cowen, 1970; Norman, 1969), by measuring autonomic responses to those words (Corteen & Wood, 1972), or by observing the facilitatory and inhibitory effects of the secondary message on the focal task (Lewis, 1970). Only a few studies have required subjects to perform two simultaneous tasks (e.g. Allport, Antonis & Reynolds, 1972; Shaffer, 1975; see also Welford, 1968). None of these have examined changes in dual task performance with practice (but see Underwood, 1974).

Our research revives the tradition of earlier experiments on divided attention. Specifically, it replicates and extends the work of Leon M. Solomons and Gertrude Stein at the Harvard Psychological Laboratory (Solomons & Stein, 1896). We have studied the development of skills for attending to and acting on two simultaneous messages. Two subjects, Diane and John, participated in this three-part study. As they read short stories to themselves, John and Diane first practiced writing unrelated words at dictation. When their reading speed stabilized, they were asked to detect semantic relations among the dictated words. Finally, they were asked to categorize words in a manner which forced them to use semantic information. By giving the subjects extensive practice, while gradually increasing the demands of the writing task, we were able to produce very substantial increases in their ability to perform two complex and meaningful activities at the same time.

Method

Diane and John, respectively a graduate student in Biology and a Cornell Hotel School undergraduate, were recruited through the Cornell Student Employment Office. They worked for five one-hour sessions a week over a period of about seventeen weeks, paid by the hour. In each session, they read short stories while writing at dictation. The stories ranged in length

from 700 to 5000 words, and were selected from collections of works by American, English, and translated European writers. Words for the dictation lists were selected randomly without replacement from the norms of Kucera and Francis (1967). The principal dependent variables were reading speed, reading comprehension, dictation rate, and recognition memory for the dictated words. The procedure varied considerably in the different phases of the experiment, and will be described phase by phase. A full chronology of the study appears in Table 1.

Table 1. *Chronology of the Study*

Sessions 1–29	Practice: 14 trials per week of reading while writing at dictation – 10 full experimental trials, 4 recognition trials, and 1 control trial.
Sessions 30–35	Controlled testing: 1 full experimental, 1 recognition, and 1 control trial per day.
Sessions 36–43	Dictation with embedded lists of related words: Sentences, words from semantic categories, words from syntactic classes, or rhymes. Subjects were not forewarned that the dictated words would be structured in any way.
Sessions 44–46	Dictation with embedded lists of related words: Subjects were asked to look for and report the occurrence of any structured sublists. (a one-week vacation followed session 46).
Sessions 47–49	Retraining (comprehension trials only).
Sessions 50–55	Controlled testing of reading comprehension by means of free and cued recall of the stories.
Sessions 56–61	Dictation of categorizable lists, in which subjects either wrote the dictated word or the name of its category.
Sessions 62–68	Continuation of sessions 44–46.
Sessions 69–74	Continued practice of reading while categorizing dictated words, as in sessions 56–61. (Diane only).
Sessions 75–80	Controlled testing of reading while categorizing dictated words.
Session 81	Writing at dictation while reading aloud.
Sessions 82–85	Writing at dictation while shadowing.

I: Simultaneous Reading and Writing

After two pre-experimental sessions to be described below, the first phase of the experiment was devoted to practicing the dual task. Diane and John participated together in 29 one-hour sessions spread over six weeks. In each session, they silently read three short stories while writing words dictated by the experimenter (WH or ES). As soon as both of them had finished writing

a given word, the next word was dictated. The average rate of dictation was about 10 words per minute. They wrote on plain paper, moving their hands vertically down the page for each new word. On reaching the bottom of the page, they turned to a new sheet of paper and continued to write. Except when they changed sheets, the subjects rarely looked at their writing.

There were three kinds of reading trials in this phase, given in random order. In a *control trial* (one each week), Diane and John each read one short story from beginning to end without any concurrent writing. At the end of the story they received a comprehension test. Comprehension questions were prepared by the first two authors. Memory for the important details of plot and character were assessed by 8 to 15 short answer questions (e.g., "What did Laura say to the dead man at the cottage?" was a question pertaining to the story, "The Garden Party", by Katherine Mansfield). In a *full experimental trial* (ten each week), the subjects copied dictated words while reading stories; on the average about 60 words were dictated during a single story. As in the control trials, they read the stories to completion and were given comprehension tests. In a *recognition trial* (four each week), reading was interrupted after exactly 40 words had been dictated, and there was no comprehension test. Instead, a test of recognition memory for the dictated words was immediately administered. Recognition tests consisted of 20 randomly selected words from the dictated list, and 20 other words, (which were never dictated) from the same norms. The lists were read aloud by the experimenter; Diane and John indicated (in writing) whether they recognized each item as having been on the dictated list.

Throughout the experiment, instructions emphasized the importance of writing all the dictated words, of comprehending the stories, and of reading as rapidly as possible. On the other hand, we did not encourage John and Diane to try to remember the dictated words. They were never told in advance whether reading comprehension or word recognition would be tested. At the end of each week, they were shown how much they had progressed and were encouraged to read still more rapidly.

In two pre-experimental sessions, we assessed the subjects' normal reading speed and comprehension as well as their recognition memory for dictated words. In each of these sessions, conducted before Diane and John knew the nature of the main experiments, they read two short stories and copied two lists of 40 words from dictation on separate, alternating trials. John read at an average of 483 words per minute (wpm) and answered 73% of the comprehension questions correctly; Diane read 351 wpm and correctly answered 90% of the questions. John correctly recognized an average of 87.5% of the dictated words, with a false alarm rate of 2.5%; Diane recognized 77.5% of them, with 5% false alarms.

The levels of comprehension manifested in the pre-experimental sessions were little affected by the simultaneous dictation task introduced in the main experiment. Comprehension was high even in the first session. Both Diane and John's comprehension improved somewhat over the course of the practice sessions (Table 2, line 1). The rate at which words were written (and hence the rate at which they were dictated) showed no systematic change. Recognition of the words dictated on experimental trials also showed little change with practice. Recognition memory was somewhat poorer than in the pre-experimental sessions, especially for John (Table 2, lines 2 and 3). The quality of the subjects' handwriting deteriorated rapidly in the first week of practice and then improved, appearing normal by the fourth week. Omissions and misspellings were rare throughout.

Table 2. *Comprehension and Recognition Memory on Experimental Trials (Sessions 1-35).*

		Sessions						
		1-5	6-10	11-15	16-20	21-25	26-29	30-35 (Testing)
Comprehension ^a (% Correct)	Diane	83.4	86.8	86.5	100.0	99.6	97.6 ^b	99.2 ^c
	John	75.0	70.3	71.6	82.2	89.5	84.3 ^b	86.3 ^c
Recognition ^d <i>p</i> (hit)	Diane	0.72	0.76	0.88	0.70	0.80	0.82	0.76
	John	0.61	0.66	0.68	0.71	0.68	0.72	0.70
Recognition ^d <i>p</i> (false alarm)	Diane	0.23	0.18	0.19	0.25	0.26	0.28	0.33
	John	0.02	0.04	0.09	0.10	0.15	0.12	0.12

^a Each score is the mean of 10 trials, except as noted.

^b Each score is the mean of 8 trials.

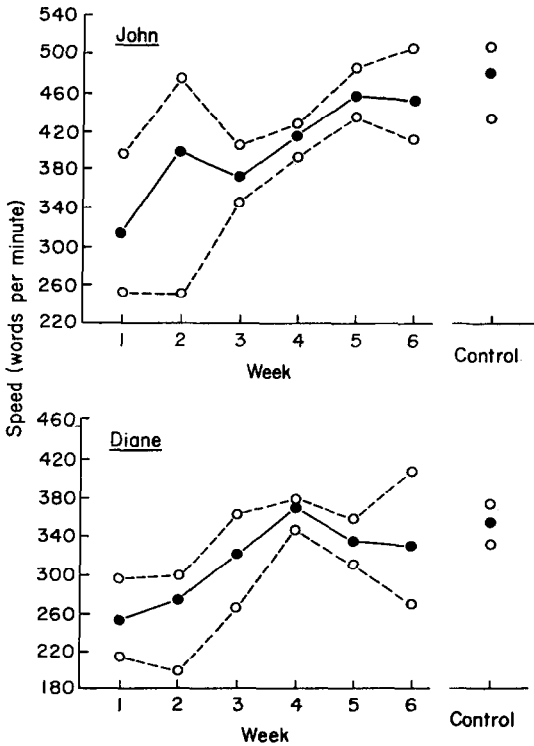
^c Each score is the mean of 12 trials.

^d Each score is the mean of 4 trials.

Reading speeds dropped sharply on the first full experimental trials, as was expected, but soon began to increase. By about the fourth week, they began to approach normal levels (Figure 1). There was a great deal of variability from one trial to the next. In part, this must have been due to the varying strategies and motivations of our subjects. A more obvious source of variability, however, was the relative difficulty of the stories being read. In particular, some authors seemed to demand slower reading than others.

In the seventh week, a different procedure was adopted to confirm that Diane and John could indeed read just as fast while taking dictation as on

Figure 1. Reading speeds during the practice phase: weekly means and interquartile ranges.



control trials. This second phase of the experiment involved six sessions. Each day the subjects read three stories by the same author: one in a full experimental trial, one under control conditions, and one for a recognition test. The stories which Diane read on control trials were read by John on experimental trials, and vice versa. Summary results for this phase appear in the last column of Table 2. A day-by-day comparison of experimental and control trials, presented in Table 3, reveals no systematic differences. Diane and John read as quickly, and apparently as effectively, while taking dictation as when they read alone.

Some weeks later, in sessions 50–55, we attempted a stricter test of reading comprehension. In each of six sessions, five control and five full experimental trials were followed by a demanding probed-recall test of memory for selected episodes from the story read on that trial. The

Table 3. *Controlled Testing of Reading Speed and Comprehension*

Session	Reading speed (wpm)		Reading comprehension (% correct)	
	Experimental	Control	Experimental	Control
Diane				
30	336.7 ^a	331.0	100	100
31	365.8	354.9	100	100
32	302.1	330.8	100	100
33	322.2	297.6	100	100
34	358.2	325.2	100	100
35	303.6	332.4	95	95
\bar{X}	331.43	328.65	99.17	99.17
John				
30	485.5	593.3	100	100
31	412.1	502.0	90	100
32	573.5	555.0	82.5	80
33	477.6	471.6	65	95
34	468.0	380.4	100	100
35	450.0	441.8	80	100
\bar{X}	477.78	490.68	86.25	95.83

^a Each score is based on 1 trial.

episodes, which ranged in length from 192 to 410 words, were divided into 'idea units': 14 to 43 idea units per episode. For example, from the sentence, "When he heard the whistle of the northbound train arriving from Los Angeles, he led the girl to the window" we extracted the idea units, "when he heard the whistle of the northbound train", "the train arrived from Los Angeles", and "he led the girl to the window". After each story, Diane and John were first asked to give a written account of the episode in as much detail as they could. Then they answered probing questions about all the ideas that had been left out of their recalls. One question served as a cue for each omitted idea unit. For example, the last cue for the sentence above was "Where did he lead the girl?"

This procedure revealed no decrement in comprehension or memory that could be attributed to the added task of writing from dictation. John's mean probed comprehension, in terms of the proportion of 'idea units' recalled, was 0.90 on experimental trials and 0.88 on control trials. Diane's probed comprehension was 0.94 on experimental and 0.95 on control

trials. Their initial free recall scores (the percentage of idea units recalled before the probing questions) were about 20 percentage points lower in all conditions.

II. Detection of Structured Sublists

The observations reported so far establish that John and Diane could copy dictated words while reading with normal speed and comprehension, but they give little indication of how much information the subjects picked up from the dictated words. In the second part of the study, we explored the degree to which they analysed and understood the words they wrote.

In these sessions, the subjects were observed individually and no recognition or control trials were administered. Instead, John and Diane were asked to report any of the dictated words, or any 'general properties' of the list, which they remembered. They were also asked why they thought they remembered what they did. Lengthy stories were used (three per session) so that we could dictate lists of 80 to 100 words without interruption. Unknown to the subjects, the lists were no longer entirely random. Each included a sublist of 20 consecutive words that were interrelated in one of four ways. On the first day, the words of the sublist all came from the same superordinate category: the three trials used the categories 'furniture', 'vehicles', and 'dwellings', respectively. On the second day, the sublist words all came from one of three syntactic classes: plural nouns, past tense verbs, and adjectives. On the third and fourth days, consecutive words in the sublists formed sentences. These six 20-word lists each included two to five sentences, three to ten words long. On the fifth day, the words of the sublists rhymed: each consisted of 20 words rhyming with the words 'board', 'bee', and 'bean', respectively. The category sublists were taken from the Battig and Montague (1969) norms; the others were constructed *ad hoc* by the authors. Each sublist appeared after the first 35 to 45 random words in the longer list.

Of the several thousand words dictated in this phase, only 35 were spontaneously recalled. The subjects gave several reasons for these recalls. In six cases, the word had some personal significance: Diane recalled 'diameter', which she at first thought was her own name, and John recalled several words related to his studies, such as 'luncheon' and 'finances'. In ten cases, the word recalled was semantically or phonetically related to the story being read. John noticed 'ecumenical' while reading a story about a priest, and 'aversion' while reading the word 'version'. In six cases, one of the subjects was uncertain about exactly what word the experimenter had said, and he

“had to think about it”. No reasons were given for the recall of the remaining 13 words.

The subjects seemed completely unaware of the presence of the sublists on the first four days of this phase. Neither of them noted the existence of the categories, the consistent syntactic classes, or the sentences. Neither recalled more than two words from any sublist. The single exception was the phrase ‘muddy water’ from the sentence ‘Dogs drink muddy water’. Both subjects reported this phrase, but assumed that juxtaposition of words was accidental. This failure to notice the list structures is quite striking. As a control, we asked each of three naive subjects to copy one of the 80-word lists from dictation without looking at it, and subsequently to report such words and general properties as he could remember. Each type of list was read to one subject. Those who were given category and sentence lists noticed the structure immediately, though the subject who was given 20 words from the same syntactic class, plural nouns, did not.

The effect of the rhyming list, given on the fifth day, was very different. Both John and Diane noticed the rhymes on the first trial (as did another naive control subject).

After these sessions, we showed Diane and John the 15 sublists they had copied and asked if they remembered noticing anything about them. They confirmed that they had not. Indeed, they were not easily convinced that these lists had actually been dictated. They found it hard to believe, for example, that they had copied “trolley, skates, truck, horse, airplane, tractor, car, rocket, bike, taxi, scooter, jet, trailer, subway, tank, feet, cab, ship, tricycle, van” without noticing the category.

In the final ten sessions of this phase, we determined whether the subjects, now alerted to the possible presence of structure in the dictated lists, could detect it on request. Each day, they read two very long stories (4500 to 7000 words); 200 or more words were dictated during each story. Five ten-word sublists were embedded in each (otherwise random) dictation list. One such sublist consisted of words from a particular category, one of words from a given syntactic class, one of rhyming words, and two of sentences. The order of sublists, and their positions in the 200 word list, were randomly determined. As always, Diane and John were encouraged to read at their normal rate with full comprehension. In addition, they were asked to indicate whenever they had noticed a sublist by interrupting the experimenter and telling him the basis of the relation among the words (e.g., ‘sentence’, ‘clothing’).

These final sessions were originally planned to take only three days, which immediately followed the earlier sessions in phase II. Five weeks later, in sessions 62–68, we returned to this task to obtain more information about performance under these conditions.

The subjects proved to be quite good at detecting the structured sublists once the task had been set for them. Rhymes were always, and superordinate category lists nearly always, detected. Diane identified rhyming sublists after only 3.2 words had been dictated, on the average, and category lists after an average of 5.0 words. John detected rhyming and category lists after 2.3 and 3.1 words, respectively. Sentences were detected most of the time (42 of 69 times by Diane, 41 of 55 by John), and syntactic class lists about half the time. Diane and John were slightly outperformed by two control subjects, who each copied three of our lists from dictation under the same instructions but without simultaneous reading.

The reading speed of both subjects dropped when this phase began, and again when it was resumed (Table 4). John's reading speed recovered rapidly, while Diane's increased more gradually. By the final sessions they read at rates comparable to those exhibited during the controlled testing of sessions 30–35. Diane's comprehension was high throughout these sessions; John's declined and then recovered. The initial decline in reading performance indicates that the demand to report structure from the dictated list was not fully compatible with the reading and copying skills that the subjects had developed in the preceding sessions.

Table 4. *Reading Speed and Comprehension While Detecting Structured Sublists.*

Sessions	Diane		John	
	Speed	Comprehension	Speed	Comprehension
44	252.3 ^a	92	388.5	42
45	339.4	100	500.1	78
46	409.5	100	442.8	100
(...)				
62	283.0	100	385.7	72
63	299.4	95	531.6	60
64	326.4	100	403.0	98
65	310.5	100	474.0	98
66	360.6	100	520.8	100
67	342.6	100	655.2	78
68	325.5	95	448.5	100

^a Each score is the mean of 2 trials.

The fact that the subjects did not read with normal speed or with full comprehension on some of these trials suggested a further analysis. Were they more sensitive to relations among words on trials in which they read

more slowly, or more superficially? We made a separate tabulation of the structure-detection data for those trials on which normal speed and 90% comprehension were achieved, and for the remaining trials. No systematic differences appeared.

III. Reading While Categorizing Words

Judging from their ability to detect the structured sublists in the final sessions of the second phase, Diane and John appeared able to read and write simultaneously while understanding both the stories they read and the words they wrote. In order to obtain clearer evidence about the ability to extract meaning from the dictated words, a new task was introduced. On some trials, Diane and John were asked to write the names of superordinate categories to which the words belonged, rather than the words themselves.

In this phase, every dictated list consisted exclusively of words from one or the other of two semantic categories, such as 'animals' and 'furniture'. Different categories, either from Battig and Montague (1969) or devised by the authors, were used on each trial. We announced the names of the two categories immediately before the start of each trial.

The first six sessions consisted of four kinds of trials. On 'word trials', John and Diane wrote the words that were dictated. On 'category trials', they wrote the name of the superordinate. Word and category trials both used the fully categorizable lists described above. Every trial was followed either by a reading comprehension or a word recognition test. Recognition tests consisted of 20 randomly selected items from the dictation list and 20 distractors, never dictated, from the same semantic categories. Each of the six sessions consisted of one category trial with a comprehension test, one category trial with a recognition test, and one word trial. The word trial was followed equally often by a recognition or a comprehension test.

Reading comprehension and recognition memory were unaffected by the new categorization task (Table 5a). Reading speed dropped markedly for both subjects on the first few sessions of the categorization trials (Figure 2). By the end of these six sessions, only John appeared to have reached normal speed; Diane was given additional practice, with categorization trials only, for six sessions.

By the end of her additional practice sessions, Diane too appeared to achieve normal reading speed while categorizing words (Figure 2). The final six sessions of the categorization phase attempted to verify that both subjects were reading as well while categorizing as they did normally. In each two hour session, the subjects read seven stories by the same author. Each session consisted of six category trials with comprehension tests and

Table 5. *Comprehension and Recognition Memory: Categorization Phase*

a. Sessions 56–61

		Category Trials ^a	Word Trials ^b
Comprehension (% correct)	Diane	98	100
	John	88	80
Recognition <i>p</i> (hit)	Diane	0.91	0.83
	John	0.86	0.86
Recognition <i>p</i> (FA)	Diane	0.23	0.28
	John	0.12	0.17

b. Sessions 75–80

		Category Trials ^c	Control Trials ^d
Comprehension (% correct)	Diane	100	100
	John	81	88

^a Each score is the mean of 6 trials.^b Each score is the mean of 3 trials.^c Each score is the mean of 36 trials.^d Each score is the mean of 6 trials.

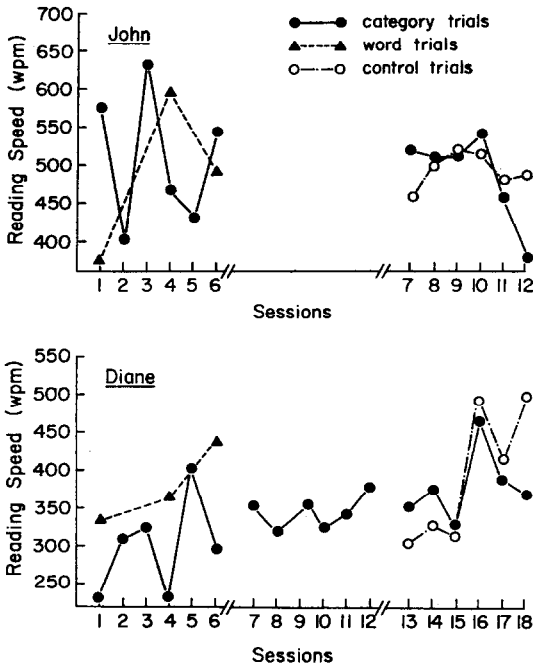
one control trial (with no writing at dictation). Reading comprehension appeared little affected by the writing task (Table 5b). Diane read with full comprehension, both on categorization and on control trials. John's comprehension on control trials exceeded his comprehension on categorization trials slightly, but both sets of scores were within his usual range. Reading speed also appeared unaffected by simultaneous categorization (Figure 2). After sixteen weeks' practice, Diane and John were able to categorize words semantically while reading at normal speed, and probably with normal comprehension.

Discussion

Diane and John appear able to copy words, detect relations among words, and categorize words for meaning, while reading as effectively and as rapidly as they can read alone. What accounts for their surprising abilities? We conclude this report by considering several possible descriptions of the attentional skills that they acquired.

Following Paulhan (1887), one might suggest that Diane and John rapidly 'alternated their attention' between the tasks, making use of redundancies

Figure 2. Reading speeds during the categorization phase.



in the stories they read to avoid any decrement in performance. This hypothesis is not directly tested in our work, and indeed it may not be testable at all. Our results do show, however, that this hypothetical alternation would have to occur so rapidly as to take no measurable amount of time. Paulhan never predicted (or achieved) this degree of efficiency in any of the task combinations he studied.

The other traditional explanation for our results was first offered by Solomons and Stein (1896). These authors suggested that one learns to read and write simultaneously by training attention away from one of the tasks: one learns to write 'automatically'. Automaticity is a widely used concept in the literature on human performance, and it has been assessed by a number of different criteria. Solomons and Stein judged the automaticity of their behavior introspectively: they considered their writing to be 'automatic' when they ceased to be aware of it. Introspections do not always agree, however, and Downey and Anderson (1915) reported no full loss of consciousness when they read and wrote together. The introspective reports

of Diane and John were no more decisive. They sometimes reported that they thought clearly about each dictated word, repeating it to themselves while copying it. On other occasions, however, they said that they were unaware of even writing.

A more objective "operational indicant" of automatic processing has been suggested in a recent theoretical discussion by Posner & Snyder (1975). An activity or a mental process might be called 'automatic' if it caused no interference with a concurrent attentive activity. By this criterion, Diane and John's writing would seem to be 'automatic' by definition. An interference criterion of automaticity becomes more interesting when we ask if our subjects' writing at dictation would interfere with concurrent activities other than the one on which they were trained. We did explore two transfer tasks in the final week of study: the subjects wrote at dictation while reading aloud (for one day) and while shadowing prose (for four days). Writing at dictation caused a decrement both in reading aloud and in shadow prose, but not if they shadow single letters (Shaffer, 1975). An the interference began to decrease with practice.

We do not regard these transfer tasks as a definitive test of the automaticity of writing by the interference criterion. Indeed, we doubt that any definitive test will be possible. Whether or not a given response interferes with a given task depends on the nature of the response and the nature of the task. Typists appear to type 'automatically' from written copy if they shadow prose, but not if they shadow single letters (Schaffer, 1975). An examination of subjects' performance on a wide range of dual tasks need not converge in any simple way on a unitary conception of attention or capacity.

A third conception of automatism, which we prefer, would term behavior 'automatic' if it did not involve certain high-order attentional skills. We suggest that attention be regarded as a matter of extracting meaning from the world, and perceiving the significance of events. Attention is involved in comprehending what one reads or hears, or in following any meaningful event over time. Our results suggest that the writing skills developed by John and Diane in the first eight weeks were not of this kind. Since they failed to notice sentences and categories in the dictated lines, they were evidently copying the words without much semantic analysis. In this sense, their writing might be called 'automatic'. As the demands of the experiment changed and the subjects were given additional practice, however, they gradually learned to analyze the dictated words semantically and to detect simple sentential relations among them. Finally, both subjects succeeded in categorizing dictated words with no loss of reading speed or comprehension. By our definition, their writing was no longer 'automatic', as it had been in earlier stages of practice.

Since we did not dictate connected discourse to our subjects, we do not know whether they would have become able to read normally while following another meaningful sequence over time. That achievement remains to be demonstrated. It seems clear, however, that they understood both the text they were reading and the words they were copying. In at least this limited sense, they achieved a true division of attention: they were able to extract meaning simultaneously from what they read and from what they heard.

Our results suggest that attention itself is based on developing and situation-specific skills. Particular instances of attentive performance should not be taken to reflect universal and unchanging capacities. Performance necessarily depends on one's knowledge about a particular set of tasks and situations, and one's skills for coping with them. Although individual strategies may have their own limitations, there are no obvious, general limits to attentional skills. Studies of attention which use unpracticed subjects, and infer mechanisms and limitations from their performance, will inevitably underestimate human capacities. Indeed, people's ability to develop skills in specialized situations is so great that it may never be possible to define general limits on cognitive capacity.

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Résumé

On a demandé à deux sujets de lire des petites histoires tout en écrivant sous dictée des listes de mots. Après quelques semaines de pratique les sujets ont pu écrire les mots dictés, découvrir des relations entre ces mots et les classer selon leur sens tant en lisant à une vitesse normale et en comprenant ce qu'ils lisaient.

La performance de ces sujets est en désaccord avec l'idée que la capacité d'attention à des limites fixes.