

Table 9. This design was evaluated by means of a two-factor (condition x numeral) analysis of covariance, with the NO INPUT condition as the covariate, and repeated measures (Arabic numbers/English word numbers) on the numeral factor.

Procedure

Subjects were tested individually. Each session was preceded by a trial period in which the subject familiarized himself with the task. Both error and latency data were recorded throughout in order to guard against a speed-accuracy trade-off.

A trial began with the subject seated at a table with one deck of cards, face-upwards but with the top card covered by a blank white card, in front of him. The subject was requested to sort the deck of cards into two piles depending on the side on which the numerically greater number had appeared. If the numerically greater number was on the left of the card, that card would be placed to the left of the main deck; if the numerically greater number was on the right side of the card, the card was to be placed to the right of the main deck.

The experimenter timed each trial by pressing a starter button as soon as the subject began to work through the deck. This button activated a digital millisecond timer which the experimenter stopped as soon as the last card had been sorted. After each trial the experimenter recorded the error data.

Both decks of cards were sorted under conditions of NO INTERFERENCE and prose or articulatory suppression INTERFERENCE. As in Experiments 1 and 2, under the articulatory suppression INTERFERENCE condition, the subject was required to repeatedly say "bla bla bla" for the duration of the trial. (All subjects participating under this condition had practised repeating "bla bla bla" for a few minutes before the test trial was begun).

The order of presentation of the NO INPUT and INTERFERENCE conditions, and of the card decks and the cards within a deck was randomized. Subjects were free to use whichever hand they preferred to sort the cards.

Results

The latency data were analysed by means of a two factor (condition x numerals) analysis of covariance, with repeated measures on the NUMERALS factor. The NO INPUT condition served as the covariate. The results of this analysis are shown in Table 10.

The interference conditions, namely prose and articulatory suppression, did not result in significant differences in the time taken to perform the word number and Arabic numeral tasks ($F(1,17) = 0.45, p > 0.05$). There was no significant difference ($F(1,17) = 0.93, p > 0.05$) between the time taken to perform the word number task and the time taken to perform the Arabic numeral

TABLE 10

Summary of the results of the two factor (condition^a x numerals^b) repeated measures analysis of covariance performed on the latency data of the Magnitude Judgment task in Experiment 3

Source of variation	Sum of squares	Mean square	df	F
INTERFERENCE CONDITION main effect	8 238.756	8 238.756	1	0.45
NO INPUT ^c condition	228 018.151	228 018.151	1	12.58*
Error 1	308 099.834	18 123.520	17	-
NUMERALS main effect	7 886.225	7 886.225	1	0.93
INTERFERENCE CONDITION x NUMERALS interaction effect	49.780	49.780	1	0.01
NO INPUT conditions	11 450.801	11 450.801	1	1.35
Error 2	144 515.664	8 500.921	17	-

* significant ($p < 0.005$).

a The dependent variable in the ANCOVA was the time, expressed in seconds, taken by the subject to perform the Magnitude Judgment task in the presence of prose or articulatory suppression interference.

b There were repeated measures on the NUMERALS factor.

c The covariate in the ANCOVA was the time, expressed in seconds, taken by the subject to perform the Magnitude Judgment task in the absence of prose or articulatory suppression interference.

task. There was also no significant CONDITION x NUMERALS interaction effect ($F(1,17) = 0.01$, $p > 0.05$).

The significant NO INPUT condition main effect ($F(1,17) = 12.58$, $p < 0.05$) reflects a correlation between the covariate and the dependent variables, i.e. the subjects' performance under the NO INPUT condition mimics the way in which they performed under the INPUT conditions.

TABLE 11

Mean numbers of errors scored on the Magnitude Judgment task by the prose and articulatory suppression interference condition groups in Experiment 3

Group	NO INPUT		INTERFERENCE	
	Words	Arabic	Words	Arabic
Prose	0.3	0.3	0.8	0.4
Articulation	0	0	0.1	0

An analysis of the error data was not feasible due to the low error rate: 70% of the subjects scored no errors, 20% scored 1 - 2 errors. The mean number of errors scored are shown in Table 11.

Discussion

In contrast to the findings of Hulme and Ryder Richardson (1981), the results of the present study show that subjects read Arabic and English word numbers equally quickly. The discrepancy between the results of the present study and those of Hulme and

Ryder Richardson may be explained by the use of the ANCOVA technique in the present study, instead of the ANOVA used by Hulme and Ryder Richardson. By partialling out baseline variation the ANCOVA provided a more precise measure of systematic variation in the present study.

It has been argued that Arabic numerals are most likely to be processed visually. Subjects in the present study appeared to use a visual lexical access route in the processing of both Arabic and English word numbers. This conclusion is supported by the anecdotal observation that the errors made with word numbers were visual in nature (e.g. THREE was judged the larger number in the pair SIX THREE). Phonological encoding, where used (e.g. in checking a decision made visually), must therefore have been postlexical in nature.

In contrast with this conclusion, Baron (1977) found that articulatory suppression interfered with the reading of English word numbers to a greater extent than it interfered with the reading of Roman numerals. From this finding he argued that the reading of English word numbers involves the (prelexical) use of phonology which is interrupted by articulatory suppression, whereas the reading of Roman numerals does not involve prelexical phonology. However there were certain artifacts in Baron's study which may account for his results, such as the fact that the physical size of the Roman numerals was consistent with their numerical size. Subsequent studies (Besner, Davies & Daniels, 1981; Hulme & Ryder Richardson, 1981) which attempted to

overcome these flaws have reported findings similar to those of the present study.

In the present study it was shown that articulatory suppression and prose auditory interference had no effect on the time taken to perform the Arabic number task or the English word number task. This supports Besner, et al's (1981) and Hulme and Ryder Richardson's (1981) finding of no numeral x articulatory suppression interaction. The findings of the present study thus provide further support for Hulme and Ryder Richardson's conclusion that:

"There is no support ... for the view that reading English alphabetic numbers depends in part upon a phonological access code which is susceptible to disruption by articulatory suppression" (Hulme & Ryder Richardson, 1981, p.130).

However, the present findings are in conflict with the finding by Besner et al. and Hulme and Ryder Richardson that the tasks were performed more slowly under articulatory suppression than in its absence, whether the numerals were Arabic or English word numbers.

While Experiment 3 investigated the performance of adult skilled readers on the Magnitude Judgment Task, Hulme (1981) has suggested that this task may be used profitably in studying the use of phonological encoding by developmental dyslexics. Consequently, EXPERIMENT 4 was conducted.

EXPERIMENT 4

MethodSubjects

Ten English-speaking children (7 males and 3 females), selected from a school for learning disabled children, participated in the study. They had normal hearing and normal or corrected vision, and were diagnosed as being dyslexic (i.e. having a reading age two or more years below their chronological age) on the basis of their performance on the Boder Test of Reading - Spelling patterns. Seven English-speaking boys and three English-speaking girls were selected to constitute the control group. They had normal hearing and normal or corrected vision and had no reading difficulties. These subjects were matched as closely as possible with the dyslexics on the basis of their reading ages. Reading age was again determined on the basis of performance on the Boder Test of Reading - Spelling patterns. The mean chronological and reading ages for both groups are given in Table 12.

Materials

1) Visual stimuli The card decks used in Experiment 3 were used in this experiment.

ii) Auditory input The auditory interference used was the prose used in Experiments 1, 2 and 3. It was

of an auditory/phonological code at tertiary cortex level. Because the nonword task does not require lexical access or the maintenance of the semantic equivalent of the printed words and therefore involves a shallow level of processing (Craik & Lockheart, 1972), the possibility of interference between the task which involves a deeper level of processing and auditory input was minimized. Also, the fact that little memory load and hence little use of a phonological code in maintaining the phonological representation of the nonwords, was involved, further minimized the likelihood of interference between the task and the auditory input.

With regard to the performance on the MAGNITUDE JUDGMENT TASK by normal adult skilled readers, both Arabic and Word numbers were processed initially by primary and secondary visual cortices of Unit 2, in the absence of auditory interference. At the tertiary level both types of numbers probably gained lexical access visually. The judgment as to which number of the pair is larger was then made. If a phonological code was activated it would have been postlexical in nature and would have been used to verify the magnitude decision made earlier, e.g. in deciding that the visually longer number SEVEN is in fact the smaller number in the pair SEVEN NINE. The task does not involve a large memory load: no more than two words must be processed at a time, and subjects did not have to recall the numbers they had seen. Therefore the usefulness of the postlexical phonological code was minimized, in that visual processing space was not so greatly taxed in terms of information load as to necessitate the use of a

TABLE 13

Summary of the design of Experiment 4

Group	Condition ^a			
	No input		Prose	
	Numerals			
	Arabic	Words	Arabic	Words
Dyslexics				
Non-dyslexics				

^a There were repeated measures on the CONDITION and NUMERALS factors.

Procedure

All subjects were tested individually. The reading age of each subject was determined by means of the Boder Test of Reading - Spelling patterns at the beginning of the testing session. Thereafter the subject performed the Magnitude Judgment task, described in Experiment 3, under conditions of NO INPUT and PROSE auditory interference. Both error and latency scores were recorded for all subjects.

Results

Results of the three factor repeated measures analysis of variance performed on the latency data are shown in Table 14.

There was a significant difference ($F(1,18) = 8.71, p < 0.01$) between the time taken to read the numbers when there was NO INPUT (mean latency: words - 53.602 sec.; Arabic - 44.592 sec. - see Table 15), and the time taken to perform the task under the PROSE auditory interference condition (mean latency: words - 57.536 sec.; Arabic - 44.064 sec. - see Table 15). All other main and interference effects were non-significant ($p > 0.01$).

An analysis of the error data was not feasible due to the low error rate. The mean error scores for each group are given in Table 16.

TABLE 14

Summary of the three factor (reading group x interference condition x numerals) repeated measures^a analysis of variance performed on the latency^b data of the Magnitude Judgment task in Experiment 4

Source of variation	Sum of squares	Mean square	df	F
READING GROUP main effect	1535882.248	1535882.248	1	2.55
Error 1	10843509.262	602417.181	18	-
INTERFERENCE CONDITION main effect	2527505.136	2527505.136	1	8.71*
Error 2	5223744.101	290208.006	18	1.14
NUMERALS main effect	57944.590	57944.590	1	0.33
NUMERALS x READING GROUP interaction effect	43916.107	43916.107	1	0.25
Error 3	314246.577	174581.254	18	-
INTERFERENCE CONDITION x NUMERALS interaction effect	99544.989	99544.989	1	0.66
INTERFERENCE CONDITION x NUMERALS x READING GROUP interaction effect	27719.528	27719.528	1	0.18
Error 4	2708679.992	150482.222	18	-

* significant ($p < 0.01$).

a There were repeated measures on the INTERFERENCE CONDITION (NO INPUT/PROSE) and the NUMERALS (Arabic numerals/English word numbers) factors.

b All latencies are given in seconds.

TABLE 15

Summary of the latency^a data of the Magnitude Judgment task in Experiment 4

Reading group	NO INPUT		PROSE			
	Words		Arabic		Words	
	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Non-dyslexic	54.623	9.502	50.853	15.588	61.215	12.545
Dyslexic	52.582	14.667	38.331	7.773	53.856	36.878
					50.629	15.547
					37.498	8.216

^a All latencies are given in seconds.

TABLE 16

The mean number of errors scored on the Magnitude Judgment task by the reading groups in Experiment 4

Reading group	NO INPUT		PROSE	
	Words	Arabic	Words	Arabic
Non-dyslexic	0.4	0.3	1.3	0.4
Dyslexic	1.9	0.4	1.1	0.6

Discussion

The results obtained showed that both poor and skilled readers performed the task equally quickly and accurately. (The difference in the number of errors scored by each group could not be reliably assessed due to a low error rate, but the trend in results suggests that both groups performed the task equally accurately). Thus it appears that, contrary to Hulme's (1981) assumption, the poor reader group used in this study did not rely too heavily on a visual lexical access route to the exclusion of the use of (postlexical) phonological encoding as a "check".

That a visual access route was used by both groups is obvious from the finding that in neither group was there a significant difference in the time taken to perform the task where word numbers were used as opposed to where Arabic numerals were used.

ERRATUM: p.130, line3. After the word "nature" insert:

"i.e. lexical access was affected by the visual "size" of the words rather than their magnitude".

A qualitative analysis of the errors made, further revealed that a visual lexical access route was used as the errors made were visual in nature (e.g. judging THREE to be the bigger number in the pair THREE SIX).

There are two possible explanations of the significant INTERFERENCE condition main effect. Firstly, an ANOVA was used in the present study rather than an ANCOVA which would probably have yielded a more precise measure of systematic variance by partialling out baseline variation. The ANCOVA method with the "no input" condition as a covariate in the analysis could not be used in the present experiment as only one form of interference, viz. prose, was used. It was considered impractical to use an articulatory suppression task with children who would probably find the task more distracting than adults do. There is support for this assumption from studies (Higgins, 1978) that have demonstrated a developmental decline in distractibility.

An alternative explanation is that children may have found the Magnitude Judgment task more difficult than did the adults. It may also have demanded a lot of attention and processing space. Thus the imposition of any form of interference (in this case, semantically and syntactically complex prose) may have overloaded their processing capacities and consequently a decrement in performance resulted. This was particularly evident during the simultaneous processing of verbal input and word numbers - there was a nonsignificant tendency in the results towards the slowing down of the word number Magnitude Judgment task in the presence

of prose input. This argument is further strengthened by a trend in the latency data (see Table 15) which, although nonsignificant, suggests that the younger non-dyslexic group (mean chronological age = 7,9 years) found the task more difficult and more attention demanding and therefore took longer to perform it, than did the older dyslexic group (mean chronological age = 13,4 years).

CHAPTER SEVEN: GENERAL DISCUSSION AND CONCLUSIONS

The main aim of the present research was to investigate the effects of interference on reading. The first experiment tested performance on a reading task assumed to involve postlexical phonology. Auditory input in the form of prose interfered with the reading of semantically and syntactically complex prose, as did verbal input at Level IV approximation to English. This finding was attributed to interference by the verbal auditory input which was of a comparable complexity to the primary reading task.

Verbal auditory input consisting of random words did not interfere with the reading of prose in this study. This is in accordance with Baddeley, Eldridge and Lewis' (1981) findings. The different levels of complexity of the primary and interference tasks was suggested to account for the present finding.

Nonverbal auditory input (white noise and music) did not interfere significantly with the reading of prose. This is in keeping with the results of previous studies (Franklin, 1976; Hintzman, 1965; Murray, 1965), which revealed no effect of nonverbal auditory input on less complex reading and short-term memory tasks. The lack of interference by nonverbal input was attributed to right-hemispheric processing of the nonverbal

input, or the discrepancy in levels of processing complexity between the auditor^u input and the visual reading task being performed.

Auditory input did not interfere with the subjects' performance on the Nonword-rhyming task which involved the use of pre- or nonlexical phonological encoding and did not require the maintenance of a memory load or the use of an auxiliary phonological buffer store.

Auditory input in the form of prose did not interfere significantly with the reading of Arabic numerals and English word numbers by skilled adult readers, as the task involved a small memory load and did not require extensive use of (postlexical) phonological encoding. Phonological encoding was probably only used as a "check" when the numerical magnitude of a number conflicted with its visual length (e.g. NINE in the pair SEVEN NINE), rather than as a means of maintaining information in a memory store while other information was being processed.

Prose auditory input did, however, interfere with normal and dyslexic children's performance on the Magnitude Judgment task. This finding was explained in terms of children finding the task more difficult and therefore more demanding of attention than adults. Therefore any interference (in this case, prose) would result in attention and processing capacity overload and thus a decrement in performance.

The present findings support Coltheart's (1980) conclusions, that articulatory suppression tasks similar to the one used in this study do not interfere with performance on reading tasks involving either pre- or postlexical phonological encoding.

This is contrary to Baddeley's (1979) conclusion that articulatory suppression will interfere with phonological encoding particularly where such encoding is used to maintain information in a short-term working memory buffer store. The discrepancy may be explained in that no attention to order of information was required by the reading tasks in this study (with the exception of one question in the prose comprehension task), whereas most short-term memory tasks demand the recall of information in a specific order. (Baddeley includes the need to recall or "hold" information in a specific order as an important factor in determining the conditions under which articulatory suppression tasks will be effective in interfering with phonological encoding in reading). In the light of the findings of the present study, the use of articulatory suppression as an interference technique in the study of phonological encoding during reading, particularly where the reading task closely approximates normal reading of complex prose by skilled readers, appears at best to be limited and at worst to be totally inadequate. Therefore it is suggested that future researchers employ alternate methods of tapping and/or interfering with phonological encoding during silent reading for meaning. One such technique, auditory interference, has proved successful in interfering with phonological encoding during reading for meaning

While Boder's (1982) classification system may be sufficiently useful where the type of dyslexia is clearcut, the experimenter in the course of the present research encountered a number of children who clearly had reading difficulties but did not fit into any of Boder's categories. Further research could aim at a means of analyzing the reading and spelling strengths and weaknesses of such "grey area" children in an attempt to provide guidelines for suitable remediation. It may also be that the "grey area" children, drawn from the students of a school for dyslexics, were already partly remediated and thus could not be categorized according to Boder's criteria. If the Boder test is sensitive to remediation, it should be employed prior to remediation.

Furthermore, if the Bodar test is to be wholly applicable in the South African context, South African school standard reading equivalents corresponding to Boder's "grade levels" must be calculated.

8.2.b Using the Magnitude Judgment task in screening for developmental dyslexia

Although the hypothesis of Experiment 4 in the present research did not make predictions about the performance of different groups of dyslexics, the Magnitude Judgment task may be used effectively to distinguish between different dyslexic subgroups. As has been discussed, there may be some dyslexics who rely too

7.1 Towards a neuro-cognitive model of reading

These results may be accommodated within a neuro-cognitive model of reading based largely on the cognitive model of word recognition proposed by Morton (1969; Clarke, & Morton, 1983; Morton, & Patterson, 1980) and Luria's (1973, 1979) neuropsychological model of the "working brain", described above in Chapters 2 and 3 respectively.

In terms of Luria's model, normal reading of PROSE in the absence of interfering material commenced with the sensory registration of the printed word. The next step in the process involved feature analysis and synthesis of the printed word by the visual primary and secondary cortices of Unit 2. This corresponds to the "visual analysis" and "excitation of visual input logogens" stages of Morton's (1979) Logogen model. Although there is some evidence of capacity limitation at the sensory level, the processing of information by the primary and secondary cortices does not require attentional space:

"There is an initial registration and analysis of sensory information occurring prior to and independent of attentional selection" (Picton, Campbell, Baribeau-Braun & Proulx, 1978, p.446).

Because the reading task demanded a sufficiently high level of processing, incoming visual information was then passed on to the tertiary cortex of Unit 2, where lexical access probably occurred. In Morton's terms information was transferred from the visual logogens to the cognitive system for further processing. Luria suggested that there is a decrease in modality-specificity

as one moves from primary to tertiary cortex. According to Luria the tertiary cortex is non-modality-specific, although he does allow for a "gradation" of modality-specificity within tertiary cortex: for example, that area of tertiary cortex closer to visual secondary cortex, while largely non-modality-specific, is more biased than other parts of tertiary cortex towards processing of information with a large visual component. Support for this distinction between processing in the primary and secondary, and tertiary cortices is also evident in the cognitive psychology literature: Treisman and Davies (1973) asserted that physical processing is modality specific while semantic processing is unitary.

In skilled readers, lexical access for words presented in a printed form is likely to be achieved through the visual route. By gaining access to the lexical entries associated with the words being processed, the reader would also gain access to the phonological representation of these words which are stored in the lexicon. Thereafter visual information which had been transferred from primary and secondary cortices to tertiary cortex was probably "held" postlexically in a phonological form. Such information may have consisted of words in a word group but was probably transformed into an abstract, summarized phonological representation of a word group.

The argument proposed in the preceding paragraph may be paralleled by Morton and Patterson's (1980) suggestion that in the processing of a printed word:

"The word is categorised in the visual input logogen system and information is then sent to the cognitive system. Here the appropriate semantics can be found and sent to the output logogen system where the appropriate phonological code could be obtained" (p.94).

From this quotation it appears that Morton views phonological encoding as a passive byproduct of the reading process which arises only after the printed word has been processed by the cognitive system. The present argument provides an extension to Morton and Patterson's argument, if processing of information by the cognitive system is taken to correspond to processing by the tertiary cortex. As it is argued that a phonological code was employed at a tertiary cortical level, it is apparent that a phonological code may arise and be used at the level of processing by the cognitive system, i.e. prior to the activation of the output logogen system. Thus phonological encoding may play an active role in the cognitive system's processing of information, rather than being merely a passive vehicle for response following the channelling of processed information from the cognitive system to the output logogen system.

In the present study postlexical phonology served the dual purpose of providing a working memory buffer store (Baddeley, 1973), and conserving attentional space. This "conservation of attentional space" function of postlexical phonological encoding was necessary because:

"the experimental literature provides evidence that maintaining a memory load competes with other processes for attention" (Lansman, 1978, p.2542).

Attentional storage space was conserved because the high-level information, initially processed through the visual modality, was transformed from a visual code into an auditory code. Auditory processing requires a qualitatively different level of attention, so the visual mode was thus freed to process incoming information without the danger of visual attentional overload. In support of the assumption that there are different "levels" of attention which may operate concurrently, Hebb (1949 - quoted by Mowbray, 1953) has provided anecdotal evidence for the complex nature of attention:

"Hebb (1949) stated that more than one phase sequence may be in operation in the association areas at the same time, presumably leading to simultaneous perceptions in separate sense modalities"
(Mowbray, 1953, p.366).

To summarize, in the absence of interfering material, the normal reading of prose commenced with the sensory registration, feature analysis and synthesis of the printed word by the primary and secondary cortices of Unit 2. The visual information was then passed on to the tertiary cortex of Unit 2 where lexical access probably occurred. Here the phonological representation of the printed words was probably also accessed. The printed word was then transformed into an abstract summarized phonological representation at the level of the tertiary cortex. This (postlexical) phonological code was used to "hold" information in memory at the tertiary cortical level to conserve attentional space while the eye moved to fixate on the next "chunk" of information.

ERRATUM: p.140, line 6. Before the word "it" insert:

"It may be attended to and processed initially as part of the process of recognition, but may not require further processing."

Thus far the normal reading of prose in the absence of interfering material has been considered. Normal reading of prose in the presence of the interfering stimuli used in the present study may have occurred in the following way:

White noise does not require high levels of cognitive processing. It can therefore be processed by primary auditory cortex, leaving the tertiary cortex with sufficient attentional capacity to process complex prose.

There is a possibility that the musical interference, because it is more complex than white noise, could have led to less attentional space being available for the processing of the high-level printed prose passage. However this possibility is unlikely because:

- i) there is neuropsychological evidence that music is processed largely by the right hemisphere (Kimura, 1961; Luria, 1973), therefore the music interference would not be competing with the prose comprehension task for "attentional space".
- ii) according to Kinsbourne's (1982) "functional space" model, the complex verbal nature of the primary task would bias attention to the left hemisphere, allowing maximum attention for processing of the verbal task.

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These arguments provide theoretical backing for the finding that nonverbal auditory input did not interfere with skilled reading of prose. The interference which arose from concurrent verbal auditory input will now be discussed.

The amount of cognitive processing which the auditory interference required may have caused it to interfere differentially with the process of comprehending the prose since this may have involved transforming the visual information into a phonological code. All verbal auditory interference was registered initially by the primary auditory cortex of Unit 2. It was then transferred to the secondary and tertiary cortices where it presumably gained lexical access through an auditory channel or code (a phonological code). Auditory interference in the form of random words required a lower level of cognitive processing and less attention than more complex verbal interference at Level IV approximation to English or prose. Because of the similarity in the level of complexity of cognitive processing required by the Level IV approximation to English and the prose interference, and the complexity of the printed prose information now held in the auditory postlexical phonological store, the auditory interfering material and the postlexical phonological encoding competed for processing space. This led to a decrement in performance on the prose task which would have been evident either as an increase in error rate, particularly if the subject attended to both the visual and the auditory passages (memory would have been overloaded), or as an increase in latency. The absence of an accuracy decrement in the present

study may be explained by the fact that the subject was not instructed to attend to the auditory input and did not have to retain it for a long time in memory. An increase in latency occurred because the visual information had to be transformed into a phonological code whereas the auditory information was already in that form of coding and so began to be processed immediately. The transformed visual information had to compete with the auditory information for processing space in working memory.

The low level of interference provided by the articulatory suppression task may have been due to the fact that "giving out" of linguistic information, as in the articulatory suppression task, involved different brain mechanisms to those involved in the "taking in" of information during the reading process. Hence the possibility of interference due to the tasks requiring the same functional (and attentional) space was minimized. On the other hand, the articulatory suppression task may have become sufficiently automatized as to be processed subcortically. Thus the possibility of it interfering with higher cortical processing of the printed prose was minimized. Any performance decrement which occurred in the presence of articulatory suppression was probably due merely to the distracting nature of the task and the kinesthetic distress arising from the continuous repetition of a single syllable.

In summary, white noise does not require high levels of cognitive processing and therefore did not interfere with the normal

reading of prose. Musical auditory input, although more complex than white noise, did not interfere with prose reading because: it is processed largely by the left hemisphere; the complex nature of the reading task biases attention to the left hemisphere, allowing maximum attention for the task. Verbal auditory input was processed by primary and secondary auditory cortices and the tertiary cortex of Unit 2. At tertiary cortical level the syntactically and semantically complex interference (prose, level IV approximation to English) competed with the phonological encoding of the printed word for processing space, resulting in a decrement in reading performance. Random word input, although it was initially distracting, interfered to a lesser extent overall as it required a lower level of processing than the more complex auditory and visual verbal input. Articulatory suppression did not interfere with the reading of complex prose because: it requires the "giving out" of information as opposed to the "taking in" of information during reading. It may be sufficiently automatized as to be processed subcortically and any interference effects noted may be due to the fact that it is physically difficult to perform.

In terms of the model put forward in this research, in the absence of interference input the processing of the NONWORDS as a prelude to rhyme-judgment, commenced with the sensory registration, feature analysis and synthesis of the printed letter string by the visual primary and secondary cortex of Unit 2. This incoming visual information was then passed on to tertiary cortex of Unit 2 so that rhyme-judgment could take

place. If the task was to be performed with maximal accuracy and speed, no attempt would have been made to access visually similar words in the lexicon. Instead the tertiary cortex matched the graphemic representations of the nonwords as analysed by the visual cortex with their phonemic/phonological equivalent codes pre- or nonlexically (Funnell, 1983), and the decision "rhyme/nonrhyme" was made. This corresponds with Morton and Patterson's (1980) assertion that:

"The stimulus is treated as a sequence of graphemes and converted by rule into a phonological code" (p.94).

As the task does not involve a memory load, there was no need for the maintenance of the phonological representation of the nonwords. Therefore both visual and auditory coding stores were quickly cleared of their information load and the possibility of processing overload was minimized whether the following "chunk" of information reaching them was (originally) visual or auditory in nature.

With regard to the nonsignificant effect of nonverbal auditory input and of articulatory suppression on nonword rhyming decisions, the arguments put forward in the preceding discussion of the results of Experiment 1 also apply to the results of this study. However, the finding that verbal auditory input had no effect on the performance of the nonword task warrants discussion.

The verbal auditory input was processed initially by primary and secondary auditory cortices, and gained lexical access by means

phonological working memory "store" (Baddeley, 1979).

Under the prose interference condition, the Arabic and word numbers were processed in the same way as under the NO INTERFERENCE condition. The auditory input was registered, analysed and synthesized by primary and secondary auditory cortex of Unit 2, and probably gained lexical access auditorily at the tertiary cortex level. (Lexical access may not necessarily have occurred, as subjects were not instructed to attend to the auditory input. There was no interference between the primary task and the auditory input, because:

- i) the two inputs (visual and auditory) were at different semantic levels of complexity,
- ii) the auditory/phonological processing store was not overloaded because it did not have to maintain or "hold" information from the primary task together with information from the auditory input.

The lack of interference from articulatory suppression may have stemmed from the same reasons advanced earlier; different brain mechanisms govern the "giving out" as opposed to the "taking in" of information, therefore there was little likelihood of interference or competition for functional processing space between the two tasks.

There was evidence that children (both dyslexics and normal skilled readers) performed the MAGNITUDE JUDGMENT TASK in much

the same way as did adults. That is, both Arabic and English word numbers were processed initially by primary and secondary visual cortices of Unit 2 and probably gained lexical access visually at a tertiary cortex level. However, the children might have found the task more difficult and therefore more demanding of attention. Hence more processing space would probably have been required at tertiary cortex level for a longer time than in the case of adults. Thus there was less space available to children for the processing of prose input at the tertiary cortex level, and a decline in performance on the task in the presence of prose resulted. This argument is further strengthened by the post hoc observation that the overall performance of the adults on the Magnitude Judgment task was faster than the performance of the children on the task.

In conclusion, Kolers (1970) has stated that:

"The sophisticated practitioner of a skill has a hierarchy of options available to him. An accurate representation of any complex skill must account for the various levels at which it can be executed and for the conditions that determine any level of performance" (p.112-3).

While the model proposed in this research does not attempt to explain in detail the entire reading process involved in every reading task available, it does provide an analysis of the role of phonological encoding in the performance of three tasks chosen to represent different types of reading. The model may be applied favourably to other reading tasks (e.g. poetry, "scan" reading for meaning, reading aloud), and in the study of dyslexia.

CHAPTER EIGHT: IMPLICATIONS FOR FURTHER RESEARCH

There are three areas for further research which stem from the present study, namely: i) the role of individual differences in reading ability due to bilateral organization of cerebral function linked with a history of parental sinistrality; ii) the use of the Boder(1982) Test of Reading - Spelling patterns in the diagnosis of dyslexia; and iii) the use of the Magnitude Judgment Task as a screening test in the diagnosis of dyslexia.

8.1 Bilateral representation of cognitive function

Cohen and Freeman (1978) have demonstrated the existence of hemispheric differences in the operation of visual and phonological strategies in word recognition and suggest that such differences may also obtain in the reading of complex texts. Their study highlights the need for further investigation into

"whether any link exists between individual differences in reading proficiency, the ability to shift flexibly between visual and phonological strategies and patterns of cerebral lateralization"

(Cohen & Freeman, 1978, p.425).

In the light of these observations it appears that individual differences in the utilization of .articulate lexical access strategies (Besner, Davies & Daniels, 1981) by both skilled readers and retarded readers may involve a hitherto unexplored source of variation - individual hemispheric processing capacity.

From Hardyck and Petrinovich's (1977) review of the relevant literature, it appears that individuals with a history of familial sinistrality are more bilaterally organized in terms of neural representation of cognitive function (and hence have a greater hemispheric processing capacity) than those with no familial history of sinistrality:

"Both behavioural and clinical lesion studies indicate systematic differences in lateralization of cerebral function between ... the familial and nonfamilial left-handed"
(Hardyck & Petrinovich, 1977, p.385).

In terms of the model proposed by the present study, it can be argued that the more bilaterally organized individual will be less susceptible to interference due to auditory input than will the asymmetrically cerebrally organized individual. This individual difference in processing capacity would be most marked where both the experimental reading task and the auditory input required a similarly high level of processing. In order to investigate this possibility, a post hoc two factor (condition x familial sinistrality) analysis of covariance was performed on the latency data of the Prose Comprehension test obtained in Experiment 1. Results of this analysis are given in Table 17.

This analysis revealed a significant CONDITION main effect ($F(4,39) = 3.947, p < 0.05$) and a significant FAMILIAL SINISTRALITY main effect ($F(1,39) = 3.943, p < 0.05$). The interaction between CONDITION and FAMILIAL SINISTRALITY was not significant.

TABLE 17

Summary of the results of the post hoc two factor (condition^a x familial sinistrality) analysis of covariance performed on the latency^b data of the Prose Comprehension test of Experiment 1

Source of variation	Sum of squares	Mean square	df	F
NO INPUT condition ^c	13276.430	13276.430	1	45.068
INTERFERENCE CONDITION main effect	4650.488	1162.622	4	3.947*
FAMILIAL SINISTRALITY main effect	1161.549	1161.549	1	3.943*
INTERFERENCE CONDITION x FAMILIAL SINISTRALITY interaction effect	1799.627	449.907	4	1.527
Explained	20113.207	2011.321	10	6.828
Residual	11488.953	294.588	39	-
Total	31602.160	644.942	49	-

* significant ($p < 0.05$).

a The scores of only the subjects who had participated under the first five conditions of EXPERIMENTS 1 and 2 were included in this analysis, as no subject with a history of familial sinistrality had been assigned to the "articulatory suppression" condition group.

b The dependent variable in the ANCOVA was the total time, expressed in seconds, taken by the subject to read through each prose passage once.

c The covariate in the ANCOVA was the total time, expressed in seconds, taken by the subject to read the prose passages once under the NO INPUT condition.

These results offer tentative support for the theory of bilateral organization of cognitive function in individuals with a history

of familial sinistrality. However the significant FAMILIAL SINISTRALITY main effect found in this study may be due to artifact. As can be seen from Table 18, there was a highly unequal distribution across conditions of individuals with a history of familial sinistrality.

TABLE 18

Summary of the distribution across conditions (in Experiment 1) of individuals having a history of familial sinistrality

Condition	Male	Female	Total
white noise	1	0	1
music	1	0	1
level I approximation to English	0	1	1
level IV approximation to English	2	1	3
prose	2	1	3

A replication of this study, using normal skilled readers, which allows for the a priori inclusion of familial sinistrality as a factor, could yield results pertinent to the question of the existence of individual differences in processing capacity due to bilateral representation of cerebral function, both within the immediate context of reading research and within the broader context of neuropsychological theory in general.

8.1.a The relationship between bilateral representation of cognitive function and dyslexia

Bilateral organization of cerebral function or "faulty" lateralization has also been proposed as a major underlying factor in learning disabilities and dyslexia. For example, Witelson (1977) demonstrated bilateral cerebral representation of spatial functioning in dyslexics as opposed to the right-hemisphere specialization observed in normal children, coupled with a left-hemispheric representation of linguistic functions. She proposed that the representation of spatial functions in the dyslexic's left hemisphere interfered with the linguistic processing of the left hemisphere, resulting in deficient linguistic cognitive processing, neglect of the phonetic-sequential strategy in reading, and overuse of the spatial, wholistic cognitive mode. Gross and Rothenberg (1979) have cast doubt on Witelson's (1977) conclusion by exposing methodological flaws in the study, while Naylor (1980) has drawn attention to the need for the use of tasks representative of different verbal processing stages in examining the "faulty lateralization" hypothesis.

If it can be shown that bilateral representation of cognitive function is present, and indeed an advantage, in normal skilled readers with a history of familial sinistrality, further doubt may be cast on the hypothesis that bilateral representation of cerebral function is associated with dyslexia. A replication of the present study, possibly using groups of dyslexics

differentiated according to the nature of their reading disability (see below), tasks observing the prelexical/post-lexical phonological encoding distinction, and including familial handedness as an a priori factor in the study would also be valuable in this regard.

8.2 Classification of dyslexics into subgroups, phonological encoding and the use of the Magnitude Judgment task

Although it is apparent from the literature reviewed in Chapter 5 that many poor readers experience difficulty in using a phonological code in reading, some recent research (Boder, 1982; Mitterer, 1982) suggests that all dyslexics do not experience the same difficulties. Reading difficulties may arise from a breakdown in the use of any or all of the subprocesses which together comprise the complexity which is reading. In the light of this statement, within the "poor reader" group there may be subgroups identifiable according to the type of reading breakdown they manifest. Mitterer (1982), for example, has suggested that two such subgroups exist:

- i) those poor readers who rely too heavily on the use of a sound-based code,
- ii) those who have difficulty in using phonological encoding and rely too heavily on "whole-word" or visual methods in reading.

This division of dyslexics corresponds well with Boder's (1971, 1982) classification of dyslexics.

According to Boder three broad "categories" of dyslexics exist:

- i) dyseidetic dyslexics who rely too heavily on the use of phonology in reading and have difficulty in using a visual route of lexical access.
- ii) dysphonetic dyslexics who have difficulty in the use of phonological encoding in reading and rely almost entirely on visual lexical access routes. The child in this group has a limited sight vocabulary of whole words he recognizes and reads fluently.
- iii) dysphonetic-dyseidetic (alexia) dyslexics, consisting of those children who experience difficulties characteristic of both groups i) and ii).

Paralleling Boder's classification of dyslexics, and observing a prelexical/postlexical phonological encoding distinction, Doctor (1981) has suggested different groups of dyslexics characterized by their use or misuse of phonological encoding in reading. She hypothesized that reading retardation results from either:

- i) overreliance on prelexical phonological encoding processes, which results in reading errors similar to those of very young readers (Boder's "dyseidetic" group), or
- ii) an inability to acquire prelexical phonological encoding skills (Boder's

"dysphonetic" group), or

iii) a breakdown in postlexical phonological encoding processes, possibly related to a disturbance in working memory and attention.

Various experimental tasks and diagnostic tests which observe a prelexical/postlexical phonological encoding distinction may be used to identify these dyslexic subgroups. For example, nonwords have been used by Mitterer (1982) with both normal and poor readers. His experiments revealed that the poor reader group he tested was not homogeneous with regard to the type of reading difficulties they experienced. "Recoding" poor readers' lexical decision accuracy declined under concurrent vocalization to a greater extent than did that of "whole word" poor readers.

8.2.a The Boder (1982) Test of Reading - Spelling patterns and the diagnosis of dyslexia

The Boder Test of Reading - Spelling patterns involves the analysis of reading and spelling patterns in order to ascertain whether the subject tested is dyslexic, and if so, what particular form the dyslexia takes. While the Boder test may be useful in determining the existence of dyslexia, its usefulness in determining the type of dyslexia may be limited. Boder has laid down comprehensive classification criteria for the categorization of the dyslexic child into one of three dyslexic groups, namely, dysphonetic, dysidetic, and dysphonetic-

dyseidetic (alexia). As this categorization is based almost entirely on an analysis of the child's spelling errors, the validity of this approach may be questioned.

Frith (1979) has proposed that the spelling process involves a system quite distinct from that governing the reading process. Hence the assumption that qualitative breakdowns in spelling may be used to "predict" parallel qualitative breakdowns in reading may be unfounded. Further, if Frith's (1979) hypothesis that "the role of sound is of overriding importance in writing or written spelling" (p.385), is accepted, this may invalidate Boder's classification of children with reading disability according to their spelling performance: Children who score badly on the spelling test may be labelled dysphonetic and their reading ability "written off". Further research could examine the precise link between spelling and reading processes, and could examine more rigorous methods of diagnosing types of dyslexia from reading rather than spelling errors.

Boder's classification of dyslexics according to their spelling performance may be further criticized in that her classification of the words in her test as "regular" or "exception" appears to be fairly arbitrary. Some words that she has classified as regular in fact have irregular grapheme-phoneme correspondences (Venezky, 1970; Wijk, 1966). This misclassification of the spelling words could contribute to the difficulty of classifying a child into one of her dyslexic subgroups or, worse still, could lead to misclassification.

heavily on a visual lexical access route and will manifest many "visual" errors on the task. Their latency scores might compare favourably with those of normal readers, while a decrement in accuracy performance may be apparent. It should also be possible to identify the group of dyslexics who rely too heavily on prelexical phonological encoding, using the Magnitude Judgment task. This group should take longer to do the word numbers than the Arabic numbers, while (possibly) making fewer visual confusion errors than do those who rely too heavily on a visual lexical access strategy. Their performance should also be better when the word numbers read are regular rather than exception words. This group's latency scores should be slower than normal readers' scores, while accuracy scores may not differ across groups. Future research might test these hypotheses and a Magnitude Judgment task may be used to screen readers for the existence of one of the dyslexia subtypes.

GLOSSARY

GRAPHEME - a written sign, e.g. , z th.

HETEROPHONE - having a different sound. (As in two words being "heterophones" of each other - i.e. having different sounds).

HOMOPHONIC - having the same sound e.g. "wear" and "where".

ILLEGAL ORTHOGRAPHIC REPRESENTATIONS - written representations of words violating the ORTHOGRAPHIC RULES of a particular language.

LEGITIMATE ENGLISH WORD - a letter string that obeys the rules of English orthography and phonology and is semantically acceptable as an English word.

LEXICAL ACCESS - the process whereby a word's representation in the LEXICON (including visual, phonological, semantic and syntactic information) is retrieved.

LEXICAL ACCESS ROUTE - means by which LEXICAL ACCESS occurs. Direct (visual) and indirect (phonological encoding) lexical routes exist.

LEXICAL DECISION TASK - a task requiring the subject to decide whether or not a particular letter string is a meaningful and legitimate English word. The task may also involve deciding whether or not a phrase is meaningful and acceptable.

LEXICON - a person's "internal dictionary" wherein is stored all the information he has acquired with respect to words, including their visual "shape", what they sound like, their meaning, their correct grammatical usage, e.

NONLEXICAL - used where LEXICAL ACCESS does not occur. (As in "nonlexical phonological encoding").

NONWORD - a letter string which is not a recognized word in the particular language being used.

ORTHOGRAPHIC RULES - rules determining which letter combinations and which letter strings are permissible within the written representation of a particular language. (See Venezky, 1970; Wijk, 1966).

ORTHOGRAPHICALLY REGULAR - corresponding to the general spelling rules of a language and is related to regular grapheme-phoneme correspondences existing in that particular language.

PHONEME - a sound in a language that is linguistically or phonologically distinct from all other sounds in that particular language.

PHONOLOGICAL ENCODING - the process whereby the printed word is translated into an abstract phonological equivalent.

PHONOLOGICALLY REGULAR - obeys the rules governing the use and

combination of sounds in a particular language.

PHONOLOGICAL RULES - rules determining the use of particular sounds and their combinations within a particular language.

POSTLEXICAL - occurring or used after lexical access. (As in "postlexical phonological encoding").

PRELEXICAL - occurring or used prior to lexical access. (As in "prelexical phonological encoding").

APPENDIX A

PROSE COMPREHENSION TEST

Instructions

This is a reading task. Look into the machine - do you see the black X in the top lefthand corner? When you press the middle button on the panel in front of you (don't press it now), the X will disappear and a passage of prose will appear in its place. Keeping your finger on the button, read the passage through to yourself as quickly and as accurately as possible. Afterwards you will have to answer questions on the passage you have read. When you have read the passage through once, release the button.

AUDITORY INPUT condition: Please put the headphones on and begin when you hear the noise coming through the headphones.

NO INPUT condition: Please put the headphones on and begin when you are ready - there will be no noise coming through the headphones.

ARTICULATORY SUPPRESSION condition: Please begin saying "bla bla bla" over and over, and keep on saying "bla" while you are reading. I will signal to you when you may press the button and begin reading. (Let the subjects say "bla bla bla" for approximately 1 - 2 minutes before signalling to them to begin reading).

NO SUPPRESSION condition: Please begin when you are ready.

Please fill out these questions now. (Read through instructions on the sheet with the subject).

We are now going to repeat the procedure but with a different prose passage and different questions. (Choose and read appropriate alternate "INPUT" condition instructions, given above, to the subject).

Please fill out these questions as before. (Again read though the instructions on the sheet with the subject).

APPENDIX A

PROSE COMPREHENSION TEST

Prose passage 1

Surprising as it may seem to the bulldozer generations, the really profound changes in the earth's landscapes occurred several thousand years ago. They were the work of the few million men who, during more than two hundred generations, worked with the simple tools and techniques of the Neolithic and Bronze ages. It may be true that more factories and highways have been built during recent decades than in all ages past, and it is certain that technology now enables more men than at any time before to move farther and faster. But these achievements may not have consequences either as profound or as lasting as was the conversion of wilderness into agricultural lands during the very early phases of civilization.

The valleys of the Euphrates and the Nile were unpromising swamps and reed jungles teeming with wild beasts before Neolithic man disciplined the banks of the rivers and introduced irrigation to the surrounding areas. This was a tremendous enterprise carried out largely through brute physical labour. As a corrective for modern technological conceit, it is well to remember that by 2 000 B.C. the irrigation civilizations of the eastern Mediterranean had invented basket works, fabrics, and pottery; harnessed the force of oxen and the wind; developed wheeled vehicles and sailboats; and learned to use most of the nonferrous metals. The arch, the solar calendar, writing, numeral notations, and most of the fundamental social institutions around which our own life is now organized date from this most productive era in human history.

(FROM: Johns, J.L. Advanced Reading Inventory - Grade Seven through College. Dubuque, Iowa: Wm.C.Brown Company Publishers, 1981).

APPENDIX A

PROSE COMPREHENSION TEST

Comprehension questionnaire on passage 1Instructions

Where the questions are multiple choice, circle the correct answer (only 1 answer per question).
Where the questions are open-ended, answer briefly in your own words.

1. This passage, as a whole, is about
 - a. early man's lasting achievements.
 - b. modern technological advantages.
 - c. Neolithic man's inventions.
 - d. irrigation of the Nile valley.
2. What two periods of early civilization were discussed in this passage?
3. The two periods of early civilization referred to in the passage spanned about
 - a. twenty generations.
 - b. twenty-two generations.
 - c. two hundred generations.
 - d. none of the above.
4. As it is used in the passage, what does "profound" mean?
5. According to the passage, what one significant achievement of early man had the most lasting consequences?
 - a. learning to use nonferrous metals.
 - b. forging simple tools.
 - c. harnessing the force of oxen and the wind.
 - d. converting wilderness into agricultural lands.
6. How was the enterprise of draining and irrigating the Euphrates and Nile river valleys carried out?
7. Modern achievements "may not have consequences either as profound or as lasting" as the projects undertaken during early civilizations. As used in the sentence, "consequences" means
 - a. sequences.
 - b. contributions.
 - c. results.
 - d. sequels.
8. What does "disciplined" mean in the following sentence:
early man "disciplined the banks of the river"?

9. According to the passage, by 2 000 B.C. man had created
 - a. span arches, chemistry, and negotiable currency.
 - b. the arch, solar calendar, and basic social institutions.
 - c. the Julian calendar, philosophy, and steam power.
 - d. mathematics, archery, and basic educational institutions.
10. What followed early man's disciplining of the river banks?

APPENDIX A

PROSE COMPREHENSION TEST

Prose passage 2

On a brilliant day in May, in the year 1868, a gentleman was reclining at his ease on the great circular divan which occupied the centre of the Salon Carré, in the Museum of the Louvre. He had taken serene possession of the softest spot of this commodious ottoman, and, with his head thrown back and his legs outstretched, was staring at Murillo's beautiful moon-borne Madonna in profound enjoyment of his posture. He had removed his hat, and flung down beside him a little red guidebook and an opera glass. The day was warm; he was heated with walking, and he repeatedly passed his handkerchief over his forehead, with a somewhat wearied gesture. His exertions on this particular day had been of an unwonted sort, and he had often performed great physical feats which left him less jaded than this tranquil stroll through the Louvre. He had looked at all the pictures to which an asterisk was affixed in those formidable pages of fine print in his Bädker; his attention had been strained and his eyes dazzled, and he had sat down with an aesthetic headache. His physiognomy would have sufficiently indicated that he was a shrewd and capable fellow, and in truth he had often sat up all night over a bristling bundle of accounts, and heard the cock crow without a yawn. But Raphael and Titian and Rubens were a new kind of arithmetic, and they made him, for the first time in his life, wonder.

(FROM: Johns, J.L. Advanced Reading Inventory - Grade Seven through College. Dubuque, Iowa: Wm.C.Brown Company Publishers, 1981).

APPENDIX A

PROSE COMPREHENSION TEST

Comprehension questionnaire on passage 2Instructions

Where the questions are multiple choice, circle the correct answer (only 1 answer per question).

Where the questions are open-ended, answer briefly in your own words.

1. What is this passage about?
 - a. a man's pleasure and satisfaction in the Louvre Museum.
 - b. the shrewdness of the man.
 - c. a man's discomfort in the Louvre Museum.
 - d. spring in Paris.
2. What is the gentleman holding in his hand?
3. The gentleman is sitting on a
 - a. hard sofa.
 - b. comfortable divan.
 - c. soft chair.
 - d. hard bench.
4. What is he staring at?
5. What does the man have with him?
 - a. an umbrella and raincoat.
 - b. a hat, a guidebook, an opera glass.
 - c. a guidebook, an opera glass, gloves.
 - d. a hat, an opera glass, money.
6. Describe the weather.
7. What colour is his book?
 - a. red.
 - b. black.
 - c. blue.
 - d. orange.
8. What kind of a book has he been reading?
9. What probably is the man's job?
 - a. painting.
 - b. teaching.
 - c. athletics.
 - d. accounting.
10. After this gentleman had looked at the paintings, what were his next actions, in proper order?

APPENDIX A

PROSE COMPREHENSION TEST

Scoring KeyPassage 1

1. a.
2. Neolithic and Bronze.
3. c.
4. deep; extreme; significant; intense.
5. d.
6. brute physical labour.
7. c.
8. controlled, tamed.
9. c.
10. irrigation of surrounding areas; more agricultural land.

Passage 2

1. a.
2. handkerchief.
3. b.
4. Murillo's Madonna; a painting.
5. b.
6. warm.
7. a.
8. guidebook.
9. d.
10. became tired; sat down; stared at Murillo's Madonna; flung down his guidebook and opera glass; wiped his forehead with his handkerchief.

APPENDIX B

NONWORD - RHYMING TASK

Instructions

This is a word-rhyming task. Look into the machine - do you see the black X in the centre of the screen? When I press a button the X will disappear and a card will appear with either YES or NO printed on it. If the word YES appears, press the YES button, which is this one here (point to appropriate button) firmly down with your left/right hand. If the word NO appears, press the NO button, which is this one here (point to appropriate button) firmly down with your right/left hand. READY ... That is the end of the first part of this task.

Look into the machine again. This time when I press a button, the X will disappear and a card will appear with two nonsense words on it. If the nonwords sound the same, press the YES button firmly down with your left/right hand. If they don't sound the same, press the NO button firmly down with your right/left hand. Try to respond as quickly and as accurately as possible.

(Please put the headphones on and) we will begin with a few practice trials. (If ARTICULATORY SUPPRESSION is to be used later in the task, omit the instructions in the brackets).

That is the end of the practice run - are there any questions?

We will now do the same thing with another set of cards.

AUDITORY INPUT condition - Please put the headphones on. You will hear noise coming through them this time. Please signal to me when you hear the noise coming through so that I will know when to present the first card.

NO INPUT condition - Please put the headphones on. You will not hear noise coming through them this time.
READY? ...

ARTICULATORY SUPPRESSION condition - Please begin saying "bla bla bla" over and over and keep on saying "bla bla bla" throughout the task. I will present the first card after a while - keep on looking into the machine.

NO SUPPRESSION condition - Look into the machine and we will begin.
READY? ...

(Repeat the procedure with the alternate set of cards and the appropriate alternate "INPUT" condition instructions).

Author Christowitz J

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