

ical disorders arising from disrupted neuropharmacologic function, but also because they might represent an unrecognized therapeutic problem. With the current tendency to shift patients in and out of institutional settings at frequent intervals, and with neuroleptic drug treatment often paralleling such a cycle, clinicians unwittingly may produce effects resembling those reported here, then treat them by raising the dose or adding additional drugs.

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References and Notes

1. Polypharmacy is among the worst problems. See S. Merlis, V. Beyel, D. Fiorentino, J. Fracchia, C. Sheppard, *Curr. Psychiatr. Ther.* **12**, 89 (1972); L. Hollister, *N. Engl. J. Med.* **286**, 984 (1972); D. Greenblatt and R. I. Shader, *Am. J. Psychiatry* **127** (10), 33 (1971).
2. D. X. Freedman, *Arch. Gen. Psychiatry* **28**, 463 (1973). This represents a statement by a task force appointed by the American College of Neuropsychopharmacology.
3. T. N. Chase, in *Neurotransmitters, Research Publications of the Association for Research in Nervous and Mental Disease* (Williams & Wilkins, Baltimore, 1972), pp. 448-471.
4. A. J. Friedhoff, *Compr. Psychiatry* **18**, 309 (1977).
5. R. J. Baldessarini, *Can. Psychiatr. Assoc. J.* **19**, 551 (1974).
6. G. E. Crane, *Science* **181**, 124 (1973).
7. ———, *Adv. Neurol.* **1**, 115 (1973).
8. H. Bernheimer and O. Hornykiewicz, *ibid.*, p. 152.
9. H. L. Klawans, Jr. and R. Rubovits, *J. Neural Transm.* **33**, 235 (1972).
10. G. A. Deneau and G. E. Crane, in *Psychotropic Drugs and Dysfunctions of the Basal Ganglia. A Multidisciplinary Workshop*, G. E. Crane and R. Gardner, Jr., Eds. (Government Printing Office, Washington, D.C., 1969), p. 12; R. D. Eibergen and K. R. Carlson, *Pharmacol. Biochem. Behav.* **5**, 175 (1976); J. F. Sasson, *Adv. Neurol.* **10**, 47 (1975); L-M Gunne and S. Bárány, *Psychopharmacologia* **50**, 237 (1976).
11. B. Weiss, in *Alcohol, Drugs and Brain Damage*, J. G. Rankin, Ed. (Addiction Research Foundation of Ontario, Toronto, 1975), p. 71; B. Weiss, S. Santelli, G. Lusink, *Psychopharmacologia* **53**, 289 (1977).
12. W. Sette, thesis, University of Rochester (1976).
13. These categories are derived from the Abnormal Involuntary Movement Scale of the National Institute of Mental Health. They represent only illustrative data for one episode. A more detailed, comprehensive assessment is needed, especially one based less on subjective clinical criteria.
14. D. Tarsy and R. J. Baldessarini, *Biol. Psychiatry* **12**, 431 (1977). These authors list an extensive bibliography on the subject. It incorporates the literature on tardive dyskinesias dealing with incidence, neurochemistry, and therapy. See, also, H. L. Klawans, Jr., *Am. J. Psychiatry* **130**, 82 (1973).
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Reading Disability: Methodological Problems in Information-Processing Analysis

Morrison *et al.* (1) present data which they claim indicate that poor readers have a deficit in transferring information from "visual information storage" to "short term storage." Using tachistoscopic presentation, the authors displayed a circular array of a set of eight stimuli (letters, geometric shapes, or abstract shapes). After a variable delay interval of 0 to 2000 msec, a pointer was briefly flashed in one of the eight positions that corresponded with those in the target array. A fixation point preceded the target array and returned after the pointer presentation. Subjects, good and poor readers, were asked to fixate the point and to indicate which stimulus had appeared in the pointer position by selecting the appropriate stimulus from a response card. Correct responses declined for both groups as a function of target array-pointer interval for all three sets of stimuli. Good and poor readers performed about the same for target-pointer intervals of 0 to 300 msec. At intervals of 300 to 2000 msec the poor readers performed consistently worse than the good readers. The authors sug-

gest that memory, rather than perceptual, processes play a role in reading disability.

Three features of the experiment make interpretation difficult:

1) The authors do not report ascertaining eye position before, during, or after target-pointer presentation. Furthermore, the fixation point was apparently not displayed in the interval between the presentation of the target array and the pointer. If the subject's eyes were not in the same position during presentation of the pointer as during presentation of the target array, then detection of the pointer itself, as well as perception of pointer position relative to the target array, would be difficult. Failure to determine eye fixation points at the time of both target and pointer presentation makes it possible that differences in data for the two groups may be caused by differences in ability to maintain constant eye position on a blank visual field for target-pointer intervals of greater than 300 msec.

2) It is not clear whether only one target array card was used throughout the

80 trials for each stimulus set. If only one card was used, some learning of stimulus position on the target array would be expected. The greater the learning of the position of each stimulus element in the array, the less the subject need rely on each presentation of the array in selecting the correct array element indicated by the pointer position; correct responses may no longer reflect short-term visual information storage.

3) No information is provided about the order in which delay intervals were tested over the 80 trials. If the sequence of delay intervals over each set of 80 trials was not randomized or counterbalanced, then delay interval was confounded with the cumulative effects of repeated presentation of the same target array.

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References

1. F. J. Morrison, B. Giordani, J. Nagy, *Science* **196**, 77 (1977).

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Morrison *et al.* (1) drew two major conclusions from their study of good and poor readers: (i) the basic deficits of poor readers may be related to memory skills rather than to the perception of written symbols, and (ii) this memory deficit affects the poor reader's ability to process not only linguistic but nonlinguistic information. The second claim contradicts the results of several studies (2, 3) in which the poor reader's memory was found to be inferior on tasks employing linguistic stimuli, but equal to that of good readers in tests on nonlinguistic materials.

This apparent contradiction might be caused by the choice of nonlinguistic stimuli used by Morrison *et al.* Many of the "abstract" forms, which they presume to be relatively free from linguistic mediation, probably could not be perceived by sixth graders without some form of labeling. Several of them closely resemble familiar objects (a cup, a flying bird, a cross, a dagger, and so forth). Even if that were not the case, the distinctive configurations of the forms should encourage a strategy of singling out in each a particular labelable characteristic, which could then be sought out on the response card. A set of more nearly nonlabelable stimuli, such as Kimura's nonsense designs (4), would be

more appropriate for testing memory of nonlinguistic information. When we used the Kimura figures in a test of memory for recurring designs, we found no difference in performance between good and poor readers (3).

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References

1. F. J. Morrison, B. Giordani, J. Nagy, *Science* **196**, 77 (1977).
2. F. R. Vellutino, J. A. Steger, G. Kandel, *Cortex* **8**, 106 (1972); F. R. Vellutino, R. M. Pruzek, J. A. Steger, U. Meshoulam, *ibid.* **9**, 368 (1973).
3. I. Y. Liberman and D. Shankweiler, in *Theory and Practice of Early Reading*, L. Resnick and P. Weaver, Eds. (Erlbaum, Hillsdale, N.J., in press).
4. D. Kimura, *Arch. Neurol.* **8**, 264 (1963).

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The study by Morrison *et al.* (1) lacks relevant controls. If, as the authors claim, the poor readers "appear to suffer from a basic information-processing deficiency," a normal comparison group is inadequate to reveal this. A normal group differs in two ways from a group of poor readers. It does not suffer from some basic deficit which would have prevented it from reading normally, and it reads normally. This means that certain skills connected with reading have received a larger amount of practice in the normal readers than in the poor readers. In other words, the differences found between normal and poor readers may be an effect rather than a cause of any differences that may be found. Here, as in most studies of the basic cause of dyslexia, a control group consisting of illiterate children, otherwise normal but not taught to read, is necessary to evaluate the information-processing changes brought about by reading.

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References

1. F. J. Morrison, B. Giordani, J. Nagy, *Science* **196**, 77 (1977).

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With regard to the methodological questions raised by Rothenberg and Gross:

1) The fixation dot did reappear dur-

ing the interstimulus interval. In addition, before commencing each trial, the experimenter reminded the child to stare at the fixation dot throughout the presentation sequence. Further, there was a 750-msec delay between the warning signal and presentation of the array. If poor readers had trouble maintaining steady eye fixations longer than 300 msec they would have performed poorly at all interstimulus intervals. The fact that their performance equaled that of good readers at short intervals argues persuasively that the problems in eye fixation cannot account for the lower performance of poor readers.

2) A total of 80 different cards per stimulus set was presented, eight per interstimulus interval. Hence, on each trial the subject saw a completely different configuration of forms. Since there was no correlation between a given item and its position in the array, learning of stimulus position could not occur.

3) Order of presentation of delay intervals was randomized.

Restrictions on length and format of reports in *Science* limits presentation of certain methodological points. Further details on these methodological features are presented elsewhere (1, 2).

Although, as Liberman *et al.* point out, the abstract forms are potentially labelable, the more relevant question is whether subjects did in fact use verbal labeling to code the stimulus forms. We have one piece of evidence from the *Science* study (3) and several other pieces of evidence from a related study [(1), also cited in (3)] that differences in verbal labeling were not responsible for performance differences in the partial report task. In the *Science* report we mentioned (1, p. 78) that the predominant basis of confusion for both reading groups across all sets of figures was visual. For example, the letters most often confused with each other were P and F, N and W, D and S, and B and P. The similarity of the first three pairs seems exclusively visual while that of B and P is both visual and auditory. For the geometric forms the items confused most frequently were eight and circle, square and triangle, and X and wheel; items in each pair overlap in one or more visual features. Similar patterns of confusions on the basis of a shared perceptual feature were observed for the abstract forms. Comparable analyses in (1) also found no evidence for acoustic confusions and strong evidence for visual confusions. In addition, at the end of that experiment we recorded la-

tencies for the adults to verbally label the forms on the simple assumption that if verbal labeling were being used to code the figures, naming latencies would have been approximately equal across the three sets of stimuli. We found that average latency to begin a verbal label was around 1 second for a set of common objects and geometric forms compared to more than 5 seconds for the abstract forms. We were persuaded by these data that verbal labeling was not occurring to a substantial degree in the partial report procedure. Thus we are hesitant to conclude that verbal mediation alone can account for the effects found across age and reading groups in the partial report procedure.

Finally, in many studies in which labelability of forms is varied, the forms are not equated on dimensions such as complexity or discriminability-confusability. These dimensions often covary with degree of labelability and can influence performance in information-processing tasks. Sets of nonlabelable forms are often more confusable than are sets of labelable forms. The inability of subjects to adequately discriminate the forms could wipe out potentially real differences between groups.

The point raised by Deutsch about the direction of causality is appropriate and pertains to most research comparing groups of self-selected subjects. However, it is virtually impossible to find a group of completely illiterate children who are comparable in all other respects, lacking only the opportunity to read. Differences in nutrition, social environment, and a host of other factors could account for performance differences between illiterate and reading children. Hence, the value of such a group in untangling the cause-effect relation is minimal. More promising, we believe, is an examination of information-processing differences among prereading children coupled with a longitudinal investigation of the contribution of these skills to early reading acquisition. In this way we should be able to pinpoint and trace the underlying deficits.

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References

1. F. J. Morrison, D. L. Holmes, M. M. Haith, *J. Exp. Child Psychol.* **18**, 412 (1974).
2. K. Sheingold, *ibid.* **16**, 1 (1973).
3. F. J. Morrison, B. Giordani, J. Nagy, *Science* **196**, 77 (1977).

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