

✧ *Slips of the Pen*

Andrew W. Ellis

A corpus of the author's own slips of the pen is analyzed. Four processing levels — lexical, graphemic, allographic, and graphic — are postulated with different types of error being assigned to different levels in the production of handwriting.

Throughout the history of psychology human error has provided a fruitful source of information concerning the processes mediating skilled performance. Nowhere is this more true than in the domain of the psychology of language and especially the skill of speech production which remained relatively uninvestigated until psycholinguistic analyses of naturally-occurring slips of the tongue carried out by Boomer and Laver, Fromkin, MacKay, and others showed just how much could be learned from this rather obscure facet of human behaviour (See Fromkin, 1973, for these and other papers on speech errors; also Fromkin, in press). Hence a psychologist interested in the production of handwriting — and I feel no compulsion to justify such an interest in this context — may undertake a study of writing errors with a reasonable hope that his labours will be rewarded with a deeper insight into the processes underlying the graphic production of language.

Recent analyses of slips of the pen in normals (Hotopf, 1968, 1971; MacKay, 1969a; Van Nes, 1971, 1972; and Wing and Baddeley, 1979) or in individuals with either developmental or acquired disorders of writing (e.g., Lecours, 1966; Chedru and Geschwind, 1972) have begun to provide descriptions of some of the predominant varieties of writing error together with observations on their distributional and other characteristics. In fact, as with so many aspects of modern cognitive psychology, the study of writing errors (and indeed of writing in general) experienced an earlier flowering between the years of, roughly, 1890 to 1930 (see especially Bawden, 1900; Douse, 1900; and Wells, 1906. Spache, 1940, provides an overview). As is so often the case, the results of these

studies lay neglected until the revival of interest in the subject within the last decade.

Before progressing any further, it is necessary to draw a distinction between two different sorts of writing error, namely errors of knowledge and errors of performance. Errors of knowledge arise when a person mis-spells a word through total or partial ignorance of the word's correct, standard spelling. Errors of performance, in contrast, are genuine, unintentional¹ slips of the pen which the writer recognizes, either immediately or subsequently, to be erroneous deviations from the intended product. It is these latter, correctable lapses with which the present paper is concerned.

The errors which will be discussed here are taken from a corpus of the author's own slips of the pen, collected over a period of approximately eighteen months. The corpus currently contains 766 errors. My strategy has been to record any writing error as it occurs, noting the intended (correct) form together with as much of the context as appears necessary to explain the lapse. Care has been taken to record as accurately as possible the precise graphic form of each error (the various examples given in this paper are, therefore, copies of copies of handwritten errors). Having collected a corpus of errors, the task then becomes an exercise in taxonomic natural history, describing in detail the different species of lapse and the different habitats they characteristically occupy. Classification must precede exposition.

What follows is thus an analysis of the errors produced by a single individual. This method has its dangers, but it also has its advantages. The dangers are those inherent in any attempt to generalize to a population from a sample of one, particularly the possibility that individual differences exist such that another writer might produce quite different sorts of error. The author happens to believe that the processes revealed in the error analysis conducted here will hold true for all writers (of English, at least), and he is reinforced in this belief by the degree of congruence between the present analysis of his own errors and other analyses of individual or group data, but a degree of interpretative caution is called for until more corroborative studies are available.²

1. The possibility of unconscious motivation in writing errors as discussed by Freud (1901/1960) will not be dealt with here. The author has expressed doubts elsewhere as to the "psychological reality" of Freudian speech errors (Ellis, in press), doubts which are equally applicable to Freudian slips of the pen.

The advantages in basing one's investigation on one's own corpus accrue from the unique access which a writer has to his own intentions at the time when a slip occurs. Unlike collectors of speech errors, the collector of slips of the pen is rarely in a position to interrogate his subjects as to their intentions and impressions when an error occurs. Some categories of error (particularly the switch — see below) depend critically upon the introspections of the writer for their sure diagnosis. Other lapses would almost certainly have been misclassified had they been encountered in text produced by another writer. For example, on one occasion I wrote "no a," deleted the "a," and altered the text to read "no reaching towards sounds." This suggests either anticipation of the "a" of "reaching" or an incomplete one-apart reversal of "a" and "r," terminated after anticipating the "a." In fact neither of these interpretations is correct as the error was due to my having begun to write "no *attempt* at reaching towards sounds" before deciding upon an alternative wording.

Most errors involve omission, intrusion, or re-arrangement in sequences of discrete elements (letters, words, punctuation marks, etc.). The literature on errors in domains such as writing, typing, speech production, or memory contains a plethora of terms to describe what are, in fact, formally identical types of error. Table I shows the set of terms which will be used here where possible; the terminology is designed to be applicable wherever errors of intrusion, transposition, or omission occur.³ The system will not extend to errors where items undergo complex modification, e.g., blends in speech (MacKay, 1973) or switches in writing (see below).

2. The generalisations proposed here are not based upon a statistical analysis of the corpus. The reasons for this are partly to do with the small numbers of errors in some of the subcategories and partly to do with the considerable difficulties inherent in attempting to formulate appropriate statistical tests (see MacKay, 1970, and Garrett, 1976, for discussions of this problem in the speech error literature). Where empirical claims are supported by other analyses of writing errors, this is indicated in the text.

3. For example, classes A and C of Table I on the one hand and class B on the other correspond to the distinction commonly drawn between item errors and order errors respectively in studies of short-term or long-term memory for serial lists of items (Ellis, in 1979). There are interesting parallels to be drawn between the types of error which occur in a variety of areas of human serial ordering behaviour (Lashley, 1951; Shaffer, 1976).

Table I. A terminology for errors in linear sequences of discrete elements. In all cases the target (intended) sequence is taken to be 1 2 3 4 5.

ERROR SEQUENCE	DESCRIPTIVE TERM
<i>A Intrusion errors</i>	
1 2 3 X 4 5	Addition
1 2 X 4 5	Substitution
<i>B Transposition errors</i>	
1 2 3 3 4 5	Immediate repetition
1 2 4 4 5	Anticipation with replacement (adjacent)
1 4 3 4 5	Anticipation with replacement (1-apart)
1 5 3 4 5	Anticipation with replacement (2-apart), <i>etc.</i>
1 4 2 3 4 5	Anticipation with addition
1 2 2 4 5	Perseveration with replacement (adjacent)
1 2 3 2 5	Perseveration with replacement (1-apart), <i>etc.</i>
1 2 3 4 2 5	Perseveration with addition
1 2 4 3 5	Reversal (adjacent)
1 4 3 2 5	Reversal (1-apart), <i>etc.</i>
<i>C Omission errors</i>	
1 2 4 5	Omission (1-item)
1 4 5	Omission (2-item), <i>etc.</i>
<i>D Ambiguous errors</i>	
1 2 4	<i>Either</i> Omission
	<i>Or</i> Incomplete transposition

In the corpus, letter errors outnumber lexical (word) errors by about seven to one — the amount of space in this paper devoted to these two classes of error will reflect this disparity. A number of punctuation errors, word space errors, *etc.*, have been recorded, but these are not discussed here.

Lexical Errors

Lexical substitution errors come in a number of different forms. One variety involves homophone substitution — that is, substitution of one word by another which is phonologically identical through semantically and orthographically different (*e.g.*, *there* →

their; *weak* → week; *too* → two; *piece* → peace).⁴ A second variety involves substitution of a word which is related in meaning to the intended word. Such semantic substitutions (e.g., *speaking* → reading; *last week* → next week; *semantic targets* → syntactic targets) are relatively few in my corpus, but their occurrence has been attested independently by Hotopf (1971) and they may be placed with reasonable confidence in a category of their own.

A third, and rather odd, category of lexical substitution error is exemplified by lapses such as *worms* → words; *the case* → the cause; *R.S. Woodworth* → R.S. Woodwork; and *Waugh and Norman* → Waugh and Normal. It is my conjecture that these errors, which I have termed completion errors, arise as a by-product of the writer (myself) monitoring the written output. A fragment of a partially-completed word may suggest another, different word (in the way that the word fragment "Hippo" may suggest the word Hippopotamus although the intended word was *Hippocrates*), causing that word to be (somehow) translated into writing.

Were it not for the existence of visual completion errors, one would be tempted to diagnose errors such as *postulating* → postulate; *relative* → relating; *possibly* → possible; and *discussion* → discussing as morphological substitutions, and errors such as *of* → or; *by* → be; *an* → as; and *is* → in as function word substitutions. However, all these examples are open to an alternative diagnosis as completion errors, and until such time as the corpus contains sufficient examples of unambiguous derivational errors (e.g., **dislike* → unlike)⁵ or function word errors (e.g., **if* → but) the relative importance of these two putative categories must remain in doubt.

As well as lexical substitutions, the corpus also contains lexical transposition errors, but not as yet in sufficient numbers to warrant any confident generalizations. These errors could, in principle and given a larger corpus, provide data on grammatical and lexical planning in writing (cf. the studies on lexical speech errors by Fromkin, 1971, and Garrett, 1975, 1976).

4. In these and all subsequent examples, the correct (intended) form is given in italic to the left of the arrow, and the error form (as written up to the point of detection by the writer) to the right of the arrow.

5. An asterisk (*) before an error denotes a lapse which could occur, but which has not yet been seen to occur.

1. LOOKS → LOOKKS
2. correct → corrr
3. Vienna → Viennn
4. agrammatism → agrrr
5. inaccurate → innna
6. these → thesse
7. University → Unnn

Figure 1. Letter transposition errors involving immediate (false) repetition of letters.

Letter Errors

Letter transpositions occur in a number of different forms. Immediate repetition errors — which cannot by their very nature be classified as either anticipatory or perseverative — appear to be of three basic types. The first type, the perseverative switch, will be discussed later. The second type, tripling of a doubled letter, can be seen in Figure 1, examples 1 to 3. The third type of immediate repetition error, doubling of a single letter, is shown in examples 4 to 7. When perseverative switches are excluded, 13 of the remaining 15 cases where a single letter has been repeated in error have occurred in the process of writing words which already contain a

8. sound like → sould
9. but might → mut
10. intrepidity → intrepididy
11. near me → near mea
12. council → cone

Figure 2. Other varieties of letter transposition error.

(different) repeated letter. The repeated letter in the intended word may take the form of an adjacent pair of identical letters (examples 4 and 5), but this is not an essential prerequisite (examples 6 and 7). The association between false repetition and the presence of other repeated letters in the intended word has been noted by Douse (1900) and Lecours (1966), and a possibly analogous phenomenon in short-term memory for letter sequences was reported by Lee (1976). The implication of this type of immediate repetition error appears to be that the information which specifies that a particular letter is to occur twice in a word can be dissociated from that letter and be erroneously applied to one of the other letters in the word, causing it to be doubled incorrectly.

Other letter transpositions may involve anticipation (Figure 2, example 8 and 9), perseveration (examples 10 and 11) or reversal of letters (example 12) — note that many incipient anticipations and reversals may be noticed and corrected before the “full” error is made (cf. Table I, category D). Perseverative errors have been recorded both within words (example 10) and between words (example 11). All the unambiguous letter anticipations in the corpus occur between words (examples 8 and 9), the possible instances of within word anticipation being open to an alternative

13. *satisfactory* → *sati fa*
14. *than when* → *than wen*
15. *transpⁿ* → *traspⁿ*
16. **SHORT - TERM** → **SHOR - TERM**

Figure 3. Omission of one of two repeated letters (letter masking).

classification as incomplete reversals. Unambiguous within word anticipations have, however, been noted by other investigators (e.g., Douse, 1900, p. 87; Wells, 1906, p. 82; Lecours, 1966).

Letter omissions fall into at least three distinguishable sub-categories. First are errors involving the omission of one of two repeated letters in a sequence. This process, illustrated by examples 13 to 16 in Figure 3, may be termed letter masking by analogy with the similar phenomenon of phoneme masking in speech (MacKay, 1969b). Masking may be forwards, with the second of the two repeated letters being omitted (see examples 13 and 14), or backwards, with the first repeated letter omitted (examples 15 and 16). Masking may occur within words (examples 13 and 15) or between words (examples 14 and 16). Within my corpus, 22 errors may be classified as forward masking and five as backward masking. This predominance of forward over backward letter masking was also noted by Lecours (1966) and MacKay (1969a).

A second type of letter omission also concerns repeated letters, but in this case the error involves omission of one of two repeated letters plus the letters intervening between the repeated pair. The term "haplogy," as used in linguistics (e.g., Sturtevant, 1917/1961, p. 54) may be adopted for this type of error. Figure 4 shows examples of haplogies occurring both within words (example 17) and between words (example 18). Omissions of one of two adjacent repeated letters (examples 19 and 20) may be subsumed under this category, but may also be construed as a variety

17. dependence → depence
18. began as → begas
19. Apple → Aple
20. Yours sincerely → Yours unce

Figure 4. Omission of one of two repeated letters plus any intervening letters (hap-
 lology).

of masking error. A third category of letter omission (switches) will be discussed later.

Thus far, in considering letter transpositions and letter omissions, the suitability of the term "letter" has not been questioned. However, the word letter is in some ways an imprecise one. Are the capital (upper-case) "S," the printed (lower-case) "s," and the handwritten "s" the same letter or different letters, and if they are the same letter what term is to be used to distinguish between the various forms? Linguists interested in written language (e.g. Pulgram, 1951; McIntosh, 1956; Hamp, 1959) have proposed a number of sets of terms for describing graphic units. Following these writers, I shall adopt here a three-tier system which recognizes the grapheme as the most abstract unit (hence, the English alphabet comprises 26 graphemes, of which < s > is one⁶). Each grapheme is represented at the next lowest level by a number of allographs: thus, grapheme < s > is represented in my own handwriting by the three allographs { S }, { s }, and { s }. Now, any given allograph will receive perceptibly different realizations in the writing of different individuals or the same individual on different occasions. Hence, the lowest level in the descriptive hierarchy is the concrete graph — the pattern of ink on the paper. (The term "letter" may usefully be retained as a general designa-

6. The bracketing notation (pointed brackets < > for graphemes and corner brackets { } for allographs) is as suggested by Hamp (1959).

21. J. Neurol. Neurosurg. → J. Seuro
22. Cognitive → Go
23. If not → N
24. Pye Cambridge → Pyce

Figure 5. Letter transpositions showing allographic accommodation to the error context.

tion, or for use when the writer wishes to expressly avoid specifying the exact descriptive level involved).

A system of this sort is only of value in a context such as this if its use clarifies the nature of the psychological processes involved in writing. It is my contention that it does; in particular, I wish to argue that letter transpositions are more accurately described as grapheme transpositions, whereas letter masking is, in fact, allo-graph masking.

The evidence that transpositions are graphemic in nature comes from errors in which a letter is transposed into a position where it is required to adopt an allographic form different from that which it would have displayed in the correct, intended version. Such a process of accommodation has been independently attested by Wells (1906, pp. 90-91), and can be seen in examples 21 to 24 (Figure 5). This process whereby transposed letters change from lower-case to upper-case, or vice-versa, has occurred in all the eleven errors noted to date where change of case is required by the error context. The most parsimonious way of explaining these observations is to propose that transpositions involve abstract graphemes and that allographic form is determined after the level at which transpositions occur.

In contrast, all of the instances of omissions attributable to letter masking in my corpus involve identical allographic variants (see Figure 3). Figure 6 shows errors of the sort which would be indi-

25. * Geography → Georaphy
26. * None → Noe
27. * sash → sah
28. * fifteen → fiteen
29. * kicking → kicing

Figure 6. Possible, but non-occurring, examples of grapheme (as opposed to allo-graph) masking.

cative of graphemic as opposed to allographic masking, but which have not yet been seen to occur. By the same token, haplological errors involving omission of one of two repeated letters plus the intervening letters (Figure 4) also seem to occur between identical allographs.

Substitution (intrusion) errors, whatever the level of analysis, are problematic in that an error is classified as a substitution only by default, i.e., when the intruding item does not occur elsewhere in the nearby co-text (the definition of "nearby" is itself problematic). The probability of mis-classification is obviously greater for small sets of items like letters than for large sets such as words. Nevertheless, some substitutions of letters have occurred in the process of writing single, isolated words or short phrases where the possibility of transposition can be ruled out. Figure 7 gives examples of such letter substitution errors. A characteristic of these errors is an element of allographic similarity between the intruding letter and the replaced letter. Allographs which are similar in appearance will also tend to be similar in terms of the strokes involved in their execution (where a stroke may be

- | | |
|------------------------|-----------------|
| 30. differences during | → differences b |
| 31. Ambiguous | → Amp |
| 32. within | → mi |
| 33. lapse from | → lapse trom |
| 34. MALE | → MAT |
| 35. and | → ang |
| 36. Touch | → Touck |

Figure 7. Letter substitution errors.

defined, following Mermelstein and Eden [1964] as a segment occurring between points of zero vertical movement of the pen). It is possible therefore that similarity of motoric (stroke) representation is the causative factor underlying these substitution errors. Thus the substituting letter may be a left-right or up-down inversion of the intended letter (examples 30, 31, and 32, respectively), or may incorporate the same strokes recombined to form a different letter (examples 33 and 34).

Of the three graphic levels (graphemic, allographic, and graphic) discussed earlier, letter substitutions appear to arise during the process of translation from an allographic code to a graphic product. This translation process seems to be implicated in the genesis of two other varieties of error. The first of these is the stroke repetition error (Figure 8). Inspection of these errors reveals certain apparent similarities with the immediate letter repetitions, but once again the corpus is not sufficiently large to warrant any firm generalizations.

The final category of graphic error is illustrated in Figure 9, and most strikingly in examples 41 to 44. This type of error occurs within a particular graph at a point where the execution of the

37. show → show
38. number → num
39. laborious → laborious
40. Wednesday → Wednesday

Figure 8. Stroke repetition errors.

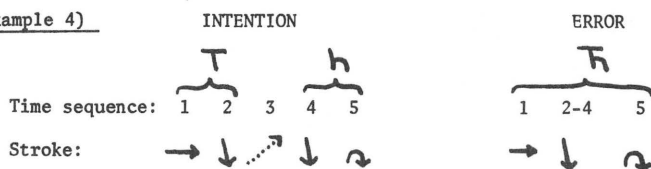
graph requires a movement or stroke which also occurs in a contiguous, usually adjacent, graph. What results is a switch in the motor program from the intended graph into the other nearby graph. Thus Hotopf (1971, p. 30) writes of an error *good* → *god* that "instead of completing the second 'o,' the pen makes an upward movement, converting it into a 'd'" (see also Bawden, 1900, p. 83; Book and Harter, 1929, p. 111; and Van Nes, 1972, Figure 1). Figure 10 attempts to illustrate the process involved when a switch occurs. Although irregular switches like examples 41 to 44 provide the more dramatic cases, it is much more common for a switch to occur when contiguous allographs share an identical initial stroke or set of strokes. By far the most common outcome of a switch is the (apparent) complete omission of the first graph (Figure 9, examples 45 to 48), but five examples of perseverative switches, which result in false letter repetitions, have been recorded (e.g., Figure 9, example 49).

The switch completes the list of discrete categories of error which have emerged from the corpus (Table II shows the frequencies in each of the major categories, together with the frequencies of ambiguous and other errors). This is not to say that other categories will not be discerned; the corpus contains, for example, letter omission errors which resist being classified as masking errors, haplogologies, or switches, but which may form the basis of new categories when more errors are collected. The reader will note the large number of ambiguous errors in Table II; such ambiguity is an unfortunate but unavoidable aspect of analyses of naturally occurring slips.

41. The → He ('T' to 'h')
42. p38 → pß ('p' to '3')
43. DUMMY → DUMM ('M' to 'Y')
44. Amer. → me ('A' to 'm')
45. REFLECT → REFECT ('L' to 'E')
46. NAMING → NAMNG ('l' to 'N')
47. language → languag ('a' to 'g')
48. Killride → Kld ('l' to 'b')
49. quickly → quickk ('l' to 'k')

Figure 9. Switch errors.

I (Example 4)



II (Example 45)

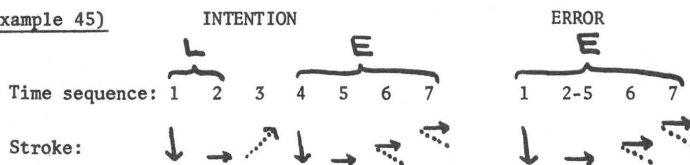


Figure 10. Analysis of two switch errors.

Table II. Frequencies of errors in each of the major categories in the corpus (N = 766)

		<i>Frequency</i>	<i>Category</i>
LETTER LEVEL			A Letter intrusions
	19		Letter substitutions
			B Letter transpositions
			Immediate repetition of 1 letter
	11		— tripling of a doubled letter
	5		— perseverative switch
	15		— others
	8		Immediate repetition of more than 1 letter
	5		Anticipation with replacement
	30		Perseveration with replacement
	23		Reversal
			C Letter omissions
			Omission of 1 letter
	135		— switch
	19		— 1 of 2 adjacent, repeated letters
	22		— forward mask
	5		— backward mask
			Omission of more than 1 letter
	14		— switch
	28		— haplology
	7		— others
	151		D Ambiguous
WORD LEVEL			A Lexical substitution
	9		Semantic
	9		Homophonic
	11		Completion
	8		(morphological)
	18		(function word)
	11		Others
	7		B Lexical transpositions
			D Ambiguous
	6		Omission or transposition
	54		Ambiguous letter(s) or lexical error
OTHER SLIPS	41		Irregular switch
	9		Stroke repetition
	86		Punctuation, spacing and misc.

Clearly there is much information of value still to be gleaned from the study of writing errors. It is the author's opinion that the way forward lies with the development of functional models of writing performance (though it is not my intention to articulate such a model here). Functional models (e.g., Morton, 1970; Ellis, 1979,) seek to unify and explain particular domains of human performance by describing the various ways in which information must be encoded, stored, and translated in order for tasks involving that domain to be successfully accomplished (Garrett, 1975, 1976). Thus, on the basis of the preceding analysis of slips of the pen, a model of writing performance must incorporate facilities for storage and inter-translation of (minimally) lexical, graphemic, allographic, and graphic information. A model for writing must also attempt to characterize the nature of the inter-relationship between the production of speech and of writing (thus, it seems a reasonable assumption that the two modalities of language production share common mechanisms at least at the semantic and syntactic levels). With a developed model, disorders of writing (Lecours, 1966; Chedru and Geschwind, 1972) should be explicable in terms of impairment affecting one or more functional subsystems within the total system.

Whatever the future directions of research, it is gratifying to see that writing — the neglected modality — is once again receiving its due share of psychological attention.

References

- Bawden, H.H., 1900. A study of lapses. *Psychological Review: Monograph Supplements*, 3: 1-122.
- Book, W.F., and Harter, R.S., 1929. Mistakes which pupils make in spelling. *Journal of Educational Research*, 13: 106-118.
- Chedru, F., and Geschwind, N., 1972. Writing disturbance in acute confusional states. *Neuropsychologia*, 10: 343-353.
- Douse, T. Le M., 1900. A study of misspellings and related mistakes. *Mind*, 9: 85-93.
- Ellis, A.W., 1979. Speech production and short-term memory, in J. Morton and J.C. Marshall (eds.), *Psycholinguistics Series*, 2. London: Elek Science Press; Cambridge, Mass.: MIT Press.
- Ellis, A. W., in press. On the Freudian theory of speech errors, in V.A. Fromkin, in press (ed.), *op. cit.*
- Freud, S., 1901. *The Psychopathology of Everyday Life*, (complete standard edition, 6, J. Strachey, trans.), London: Hogarth Press, 1960.
- Fromkin, V.A., 1971. The nonanomalous nature of anomalous utterances. *Language*, 47: 27-52. (Reprinted in V.A. Fromkin, 1973, *op. cit.*)
- Fromkin, V.A. (ed.), 1973. *Speech Errors as Linguistic Evidence*. The Hague: Mouton.
- Fromkin, V.A. (ed.), in press. *Errors in Linguistic Performance: Slips of the Tongue, Ear, Pen, and Hands*. New York: Academic Press.
- Garrett, M.F., 1975. The analysis of sentence production, in G.H. Bower (ed.), *The Psychology of Learning and Motivation*, 9. New York: Academic Press.
- Garrett, M.F., 1976. Syntactic processes in sentence production, in R.J. Wales and E. Walker (eds.), *New Approaches to Language Mechanisms*. Amsterdam: North-Holland.
- Hamp, E., 1959. Graphemics and paragraphemics. *Studies in Linguistics* 14: 1-5 (Department of Anthropology and Linguistics, University of Buffalo, New York).
- Hotopf, W.H.N., 1968. Unintentional errors in speech and writing as clues to the processes underlying word production. Paper given to the Annual General Meeting of the British Psychological Society in Sheffield.
- Hotopf, W.H.N., 1971. What light do slips of the tongue and of the pen throw on word production? Unpublished paper: London School of Economics.
- Lashley, K.S., 1951. The problem of serial order in behavior, in L.A. Jeffress (ed.), *Cerebral Mechanisms in Behavior*. New York: Wiley.
- Lecours, A.R., 1966. Serial order in writing — a study of misspelled words in "developmental dysgraphia." *Neuropsychologia*, 4: 221-241.
- Lee, C.L., 1976. Short-term recall of repeated items and detection of repetitions in letter sequences. *Journal of Experimental Psychology (Human Learning and Memory)*, 2: 120-127.
- McIntosh, A., 1956. The analysis of written Middle English. *Transactions of the Philological Society*, 26-55.
- MacKay, D.G., 1969a. The repeated letter effect in the misspellings of dysgraphics and normals. *Perception and Psychophysics*, 5: 102-106.

- MacKay, D.G., 1969b. Forward and backward masking in motor systems. *Kybernetic*, 6: 57-64.
- MacKay, D.G., 1970. Spoonerisms and the structure of errors in the serial order of speech. *Neuropsychologia*, 8: 323-350. (Reprinted in V.A. Fromkin, 1973, *op. cit.*)
- MacKay, D.G., 1973. Complexity in output systems: evidence from behavioural hybrids. *American Journal of Psychology*, 86: 785-806.
- Mermelstein, P., and Eden, M., 1964. Experiments on computer recognition of connected handwritten words. *Information and Control*, 7: 255-270.
- Morton, J., 1970. A functional model for memory, in D.A. Norman (ed.), *Models of human memory*. New York: Academic Press.
- Puglram, E., 1951. Phoneme and grapheme: a parallel, *Word*, 7: 15-20.
- Shaffer, L.H., 1976. Intention and performance. *Psychological Review*, 83: 375-396.
- Spache, G., 1940. A critical anlysis of various methods of classifying spelling errors. *Journal of Educational Psychology*, 31: 111-134.
- Sturtevant, E.H., 1917. *Linguist Change: an Introduction to the Historical Study of Language*, Chicago: Chicago University Press. Re-issued (Phoenix edition), 1961.
- Van Nes, F.L., 1971. Errors in the motor programme for handwriting. I.P.O. (Eindhoven), *Annual Progress Report*, 6: 61-63.
- Van Nes, F.L., 1972. Motor programming and errors in handwriting, in *Neurophysiology Studied in Man*. Amsterdam: Excerpta Medica (International Congress Series No. 253).
- Wells, F.L., 1906. Linguistic lapses, in J. McK. Cattell and F.J.E. Woodbridge (eds.), *Archives of philosophy, psychology and scientific methods*, No. 6 New York: The Science Press.
- Wing, A., and Baddeley, A.D., 1979. Spelling errors in handwriting, in U. Frith (ed.), *Cognitive Processes in Spelling*. London: Academic Press.