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Lapses of Attention in Everyday Life[1]

James Reason

Introduction

Although preachers traditionally take their texts from the scriptures, contemporary psychologists—particularly those with an interest in the cognitive processes of everyday life—have come increasingly to rely on the writings of William James. It is not just that he gave elegant expression to a wide range of cognitive experiences, though this is reason enough, but also that he addressed himself to the immediate, ordinary, and recognizable aspects of mental life. This stands in marked contrast to the relentless pursuit of the recondite and the counter-intuitive that characterized, in the name of behavioral science, much of psychology in the years that followed him. Nor did James shrink from stating the obvious when he found it among the commonplace. It is one such statement of the obvious that serves as the text for this chapter: "Habit diminishes the conscious attention with which our acts are performed" (James, 1890, p. 114). That this is a self-evident truth does not alter the fact that understanding how automatization comes about still remains one of the central problems of psychology. The aim of this chapter is to explore a small aspect of this problem: the relationship between attention and skilled performance; or, more precisely, the interaction between the control of highly routinized activities and the deployment of attention necessary to ensure their successful outcome.

Habit and Attention

Habit and attention are words that have more or less equal currency in everyday language, but the mental processes they denote are far from comparable in their conceptual clarity. Whereas the notion of *habit* is something one can hold fast in the mind, something that is as solid and predictable as "the enormous fly-wheel of society" in James's metaphor, the concept of attention is a flickering wraith by comparison. *Attention,* James wrote, "is the taking possession by the

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mind, in clear and vivid form, of one out of what seem several simultaneously possible objects or trains of thought. Focalization, concentration, of consciousness are of its essence. It implies withdrawal from some things in order to deal more effectively with others'' (James, 1890, pp. 403–404). This expresses well enough our common understanding of the term, emphasizing as it does the role of attention as the gatekeeper to consciousness; but what James omitted to mention, at least in this passage, is the extraordinarily labile nature of attentional focus, which varies continually both in its direction and in its breadth. Elsewhere, James (1908) commented on the reciprocity that exists between attention and interest. Novel and exciting objects capture one's attention involuntarily, but those less naturally engrossing demand an effort of will to bring attention to bear on them. And one of the most conspicuous features of this voluntary mode of attention is that it cannot be sustained. ''When we are studying an uninteresting subject, if our mind tends to wander, we have to bring back our attention every now and then by using distinct pulses of effort, which revivify the topic for a moment, the mind then running on for a certain number of seconds or minutes with spontaneous interest, until again some intercurrent idea captures it and takes it off'' (James, 1908, p. 101). It is this continual switching of attention and particularly its occasional misdirection that constitutes the main concern of this chapter because it is this feature that appears to have the most relevance for an understanding of the control of automatized behavior.

Both habit and attention clearly have leading parts to play in the guidance of action. Both serve one's purpose in varying degrees depending on the level of skill that has been attained. In a novel task, one needs to pay close and labored attention to the consequences of one's actions in order to achieve one's ends. In the jargon of the skills theorists, one needs to function in a *feedback* mode of control. But with increasing practice, one shifts more and more to a *feedforward* mode in which preformed motor programs (Keele, 1973; Stelmach, 1976), schemata (Schmidt, 1976), action systems (Shallice, 1972, 1979), or action schemas (Norman, 1980, 1981) determine the course of action with only limited reference to conscious attention. Indeed, when a sufficient degree of proficiency has been achieved, too much attentional involvement can actually disrupt the smooth flow of motor output, as when a skilled typist or pianist is directed to concentrate on the movements of individual fingers.

All of this is common knowledge; but what is not is the extent to which attentional mechanisms are still needed for the guidance of highly practiced activities. Introspection can reveal little because it is in the nature of skilled performance that moment-to-moment control, and hence detailed awareness of what one is doing and how one is doing it, lies mostly beyond the reach of consciousness. This is the realm that James (1890) described as the ''fringe of consciousness'' or what Polanyi (1958) has called ''tacit knowledge,'' something that involves a nonfocal or subsidiary awareness. But there is at least one,

largely neglected, class of everyday events that can yield important clues as to the role of attention in the guidance of routinized behavior, namely the ''slips of action'' that seemingly arise from the misdirection of focal attention.

If one's actions deviate from one's intentions due to some kind of attentional failure, then it seems reasonable to argue by default that a greater degree of attentional involvement was necessary on these occasions in the action sequence to ensure the desired outcome. A similar point was made by Jastrow in 1905: ''It is a peculiar type of straying of the process from the intended path that directs attention to it and makes one aware of a momentary lapse in the relation of issue and purpose; such lapses not only disclose the nature of the ordinary well-adjusted relations, but offer an interesting means of determining what otherwise would be but vaguely recognised'' (Jastrow, 1905, pp. 481–482). The remainder of this chapter is devoted to a consideration of the nature and circumstances of these ''actions not as planned,'' and the light they can throw on the function of attentional processes in skilled or habitual behavior.

Everyday Slips and Lapses

Those who have stepped into their baths still wearing some garment, or struggled to open a friend's front door with their own latch key, or switched on the light as they left the room in the daytime, or attempted to pour a second kettle of water into a pot of freshly made tea, or turned off the television set when they meant to extinguish the gas fire, or said ''Thank you'' to a stamp machine, will recognize the species. Our daily lifes are strewn with such trifling and usually inconsequential blunders—what Freud (1901, 1922) called ''the refuse of the phenomenal world,'' or, in a more daunting phrase, ''the psychopathology of everyday life.''

One of the factors that makes these lapses worthy of close study is that they are *not* bizarre or random events, determined exclusively by the idiosyncracies of those who commit them, or by the place and period in which they occur. Rather, they follow a clearly discernible pattern that is largely independent of their perpetrator or the surrounding circumstances. Two quotations will serve to demonstrate the timelessness of these ''absent-minded'' errors. The first comes from the French essayist, Jean de La Bruyère. Writing in the seventeenth century, he described the antics of one of his contemporaries. the Comte de Brancas, thus:

> [He] comes downstairs, opens the door to go out and shuts it again; he perceives that his nightcap is still on, and examining himself a little more carefully, discovers that only one side of his face is shaved, that his sword is on his right side, that his stockings are hanging about his heels, and his shirt out of his breeches. . . .
>
> In his walks about town he thinks that he has lost his way, puts himself into a fret, and asks of passers-by where he is; they tell him the name of his own street, he at once enters his own house but hastily runs out again, fancying himself mistaken. . . .

> He plays at backgammon and asks for something to drink; it is his turn to play, and having the dice-box in one hand and the glass in the other, being very thirsty, he gulps down the dice, and almost the box as well, throwing the liquor on the board and half drowning his antagonist. (Pritchard, 1953, pp. 363–366)

Consider also the following charming account of a slip of action contributed to the *Spectator* in 1711 by an English journalist and man-about-town, Mr. Budgell:

> My Friend Will Honeycomb is one of the Sort of Men who are very often absent in Conversation, and what the French call *a reveur* and *a distrait*. A little before our Club-time last Night we were walking together in Somerset Garden, where Will picked up a small Pebble of so odd a make, that he said he would present it to a Friend of his. After we had walked some time, I made a full stop with my Face towards the West, which Will knowing to be my usual method of asking . what's o'Clock, in an Afternoon, immediately pulled out his Watch and told me we had seven Minutes good. We took a turn or two more when, to my great Surprize, I saw him squirr [fling] away his Watch a considerable way into the Thames, and with great Sedateness in his Looks put up the Pebble, he had before found, in his Fob. As I have naturally an Aversion to much Speaking, and do not love to be the Messenger of ill News, especially when it comes too late to be useful, I left him to be convinced of his Mistake in due time, and continued my Walk. (Bond, 1965, pp. 329–330)

Note the similarity between this incident and that in which the Comte de Brancas attempted to swallow the dice instead of his drink. In both cases, the actions were appropriate, but the objects to which they were directed had become reversed. Such errors bear a close resemblance to the spoonerisms that occur in speech; as, for example, saying "queer old dean" instead of "dear old queen," or "you kissed my mystery lectures" for "you missed my history lectures." Slips such as these, involving complete or, more commonly, partial reversals, occur often in action as well as in speech, as is discussed later in this chapter.

Although slips of action rather than slips of the tongue are the principal concern of this chapter, it is worth noting that although psycholinguists have been assiduously recording, analyzing and making useful theoretical inferences from speech and writing errors for nearly a century (Fromkin, 1973, 1979), their nonverbal counterparts have been largely ignored until the 1970s. The causes of this neglect are many and complex (see Reason, 1979); but there were some notable exceptions to this rule, possibly the best known being Freud's (1901, 1922) minute observations of his own and other people's "erroneously carried out actions," or what he termed *parapraxes*. These too have been considered in some detail elsewhere (Reason, 1979). Of more relevance to the present issue was the interest taken in these slips by William James at Harvard and his younger contemporary at the University of Wisconsin, Joseph Jastrow.

James and Jastrow

For James, the key to understanding slips of action lay in the cognitive mechanisms that enable one to carry out well-practiced tasks with only a minimal

degree of conscious involvement. A brief quotation from his chapter on "Habit" will best convey the flavor of his argument:

> Not only is it the right thing at the right time that we involuntarily do, but the wrong thing also, if it be an habitual thing. Who is there that has never wound up his watch on taking off his waistcoat in the daytime, or taken his latch-key out on arriving at the doorstep of a friend? Very absent-minded persons on going to their bedroom to dress for dinner have been known to take off one garment after another and finally get into bed, merely because that was the habitual issue of the first few movements when performed at a later hour . . . We all of us have a definite routine manner of performing certain daily offices. . . . Our lower centres know the order of these movements, and show their knowledge by their "surprise" if the objects are altered so as to oblige the movement to be made in a different way. But our higher thought-centres know hardly anything about the matter. (James, 1890, p. 115).

For James, therefore, these unintended actions arise out of the mechanism governing the running off of more or less invariant sequences of behavior. "In action grown habitual, what instigates each new muscular contraction to take place in its appointed order is not a thought or a perception, but the sensation occasioned by the muscular contraction just finished" (James, 1890, p. 115). This view of action slips is appealing because it acknowledges the two most salient features of these errors: that their occurrence is a part of highly practiced and routinized activities; and also that the erroneous actions themselves take the form of intact segments of automatized behavior, albeit unsuited for the prevailing intention.

Implicit in this view is the idea that some kind of attentional intervention is necessary to prevent actions forever running along frequently and recently trodden pathways. Jastrow (1905) makes this explicit with an equine analogy. "As to the conditions favoring such lapses, they are so familiar as to make it sufficient to recall that they occur in moments of weakened or too dispersed attention. It is because the reins are too freely relaxed, or are relaxed at an inopportune moment, that our habits take the bit between the teeth, and, it may be, lead us where we had no intention of wandering" (Jastrow, 1905, p. 482). And, in reviewing his corpus of some 300 lapses of consciousness contributed by students at the University of Wisconsin, he commented, "This collection of illustrations thus suggests upon what various occasions, with what different tempos, the mind freed of its normal guidance continues to trot with the accustomed gait, stopping, like the horse that draws the milk-cart, at the proper points of call without the direction of the driver (who for the moment may be asleep)" (Jastrow, 1905, p. 501).

Both James and Jastrow present a hierarchical picture of action control that, in its broad essentials at least, is perfectly compatible with contemporary computer metaphors (see Stelmach, 1976). In the modern idiom, one might say that repeated performance of a task permits the central processor to delegate control to largely automatic subroutines, the sequencing and timing of which are governed by superordinate executive programs, or plans. But the penalty one pays for this

necessary downgrading of the locus of control is the degree of autonomy attained by these subroutines. This allows them, on occasions when the central processor is engaged elsewhere, to divert action along unintended pathways. And it also follows that these errant pathways are likely to be more familiar than the intended ones. In other words, slips of action, as has been demonstrated for many verbal slips (Timpanaro, 1976) are likely to take the form of banalizations, or what Chapman and Chapman (1973) have termed *strong associate substitutions*.

Slips of Action: Circumstances and Frequency of Occurrence

This section is concerned with presenting new data bearing on a number of basic questions relating to the production of slips of action. Under what circumstances do they occur? What form do the erroneous actions take? Are they associated with particular times of the day? How frequently do they occur during the normal course of everyday life?

For none of these questions was it thought possible to seek answers through direct observation. As both James and Jastrow have indicated, slips frequently occur as the result of misdirected or diminished attention, and such attentional states would seem to be especially vulnerable to any intrusive mode of investigation. Moreover, although inferences can be made about people's intentions from their behavior, the fact remains that only the person in question has firsthand knowledge of the plans governing his or her actions, and only he or she can claim directly to recognize a departure of action from intention. Inevitably, considerable reliance must be placed on self-reports in order to obtain data about slips of action. In view of the largely unpredictable and ephemeral nature of these lapses, some form of diary keeping seemed the most appropriate way to approach the question of the conditions under which they occur.

Before considering the findings of these diary studies, it is worth making some cautionary remarks about this technique. In addition to the more obvious problems of diary keeping (Oppenheim, 1966), our experience suggests that there are at least three kinds of bias peculiar to the reporting of action slips:

1. *Volunteer bias:* Individuals who undertake to keep a diary often do so on the assumption that they are unduly prone to absent-minded behavior.
2. *Selection bias:* It must be assumed that not all the slips of action committed by the respondent during the diary-keeping period will get recorded. Some slips will pass unnoticed, others will be regarded as too fleeting or trivial to be of interest, yet others will be forgotten before they are written down. Only the more noteworthy, amusing, or memorable slips are likely to find their way into the diary.
3. *Recording bias:* Less information will be recorded in the diary than was available to the diarist at the time of making the slip. Moreover, what goes into the diary report may well be influenced by the diarist's personal theory as to why the error occurred. This seems especially true of whatever additional information the diarist chooses to give concerning the circumstances of the error.

These difficulties clearly set limits on the kind of inferences that can be drawn from diary studies. Not only would it be unwise to use diary material to obtain estimates of action slip incidence in the general population, but also the selection and recording biases suggest that these data cannot even be taken as representative samples of the diarist's own error behavior over the recording period. So what are diary studies good for?

It is believed they serve a useful function as wide-gauge trawl nets, picking up the more salient slips of action. If the trawls are extensive enough, it is reasonable to expect to catch a qualitatively representative sample of action slips as a whole, even if the quantities of any particular type of slip cannot be taken as reflecting their presence in the error population at large.

The Extended-Diary Study

In a preliminary diary study (Reason, 1979), the diarists were asked to note whenever their actions deviated from intention, and to record the data and time of the slip, what they had intended to do, what they actually did, and the circumstances prevailing at the time. The second study, discussed here, involved a more elaborate—extended—diary form in which, as well as providing the basic details of each error, subjects were also required to answer a standard set of questions in regard to every slip recorded. These questions were divided into five sections relating to the nature of the intended actions, the nature of the erroneous actions, the relationship between the intended actions and any wrong actions that were recognizable as belonging to some other activity, the mental and physical state at the time of the slip, and the prevailing environmental conditions.

The extended-diary study was primarily designed to test a number of hypotheses emerging both from the preliminary diary study and from the observations of James and Jastrow. The most important of these was the notion that the performance of a highly automatized task in relatively predictable and familiar surroundings liberates the central processor from moment-to-moment control. As a consequence, focal attention tends to be "captured" by some pressing but parallel mental activity or by some unrelated external event so that, on occasion, it fails to switch back to the task in hand at some "critical decision point." This permits the guidance of action to fall by default under the control of some "strong" habit. In addition, the extended-diary was constructed to yield raw data suitable for cluster analysis; namely, N entities (slips) each with seven-point ordinal scale values on p variables (the answers to the questions discussed above).

Sixty-three undergraduates used the diaries to provide a record of their slips of action over a continuous period of 7 days. They were instructed to note down what happened whenever they became aware that their actions had deviated from their intentions, no matter how trivial these lapses might appear. They were asked to record these details and to answer the standard questions as soon as possible after the occurrence of the slip. This study yielded a total of 192 slips, with an average of 3 per person.

The data presented in Figure 14.1a show very clearly that the activities that produced these slips were recently and frequently executed, and were perceived as being carried out in a largely automatic way. Figure 14.1b indicates that in 77 of the 192 slips (40%), a relationship between the erroneous actions and some other activity, not intended on this occasion, was very clearly recognizable. This other activity was recently and frequently engaged in, and the data summarized in Figure 14.1c reveal that it was seen as sharing similar locations, movements, and objects with the intended actions on the occasion the error was committed. Similarity of timing and purpose, however, was less clearly evident. In the case of purpose, the scale ratings were bimodally distributed with 35.1% giving ratings below and 57.1% above the midpoint of the scale. Inspection of Figure 14.1d and e reveal that slips were associated with either internal preoccupation or with some external distraction. Only 24% of the errors were assigned scale values greater than 4 for both preoccupation and distraction, indicating that for three quarters of the recorded errors, it was either preoccupation or distraction that was perceived as being the most influential factor. Figure 14.1b also shows that worry, one's emotional state, and feeling unwell or pressed for time were generally regarded as unimportant in contributing to the slip. Responses to the fatigue question, on the other hand, were fairly evenly distributed along the scale. Finally, Figure 14.1e makes it evident that slips occurred in highly familiar circumstances, but that potentially bothersome factors such as noise, cold, heat, and illumination were not regarded as contributing in any significant fashion to the making of the slip.

Taken as a whole, these findings indicate a high degree of homogeneity in the nature of the error-producing activities and in the mental and physical conditions associated with the occurrence of the slips netted in this study. The data provide clear support for the notion that slips of action occur during the execution of highly familiar tasks requiring little in the way of close attention. In those cases where the erroneous actions were identified as more properly belonging to some "other activity," it seems evident that they took the form of "strong-habit" intrusions or strong-associate substitutions. The remaining 60% of the errors involved omissions, repetitions, and the use of wrong objects.

These data provided little basis for classifying the slips, other than the distinction just made between intrusion errors and others. But even here the conditions of occurrence were remarkably similar. This conclusion was further supported by the results of three hierarchical clustering procedures: Ward's error sums of

			1	2	3	4	5	6	7	
(A)	1.	Hardly ever	0.5*	1.6	2.1	3.1	8.3	14.6	69.8	Very often
	2.	Not for a long time	0*	1.5	4.2	3.7	10.4	17.7	62.5	Very recently
	3.	Required constant attention	1.0*	0.5	3.1	9.9	17.7	26.0	41.8	Very automatic
(B)	1.	Only just recognizable	1.3*	0	5.2	6.5	5.2	13.0	68.8	Very clearly recognizable
	2.	Hardly at all	0*	1.3	3.9	1.3	13.0	22.1	58.4	Very often
	3.	Not for a long time	1.3*	1.3	1.2	5.2	9.1	24.7	57.1	Very recently
(C)		Locations	6.5*	3.9	5.2	2.6	7.8	7.8	66.2	
		Movements	10.4	5.2	2.6	5.2	3.9	15.6	57.1	
		Objects	15.6	7.8	2.6	5.2	1.3	16.9	50.7	
		Timing	16.9	10.4	1.3	11.7	5.2	10.4	44.2	
		Purpose	23.4	7.8	3.9	7.8	10.4	7.8	38.9	
(D)		Preoccupied	6.4*	10.1	9.5	12.6	20.1	27.0	14.3	
		Upset or worried	52.9	21.9	6.9	5.8	7.9	3.7	1.1	
		Emotional or excited	42.3	22.2	5.3	10.1	11.1	5.8	3.2	
		Tired or sleepy	15.3	20.1	9.5	16.4	15.9	13.8	9.0	
		Unwell	50.0	22.9	6.4	5.8	9.6	3.7	1.6	
		Rushed	30.7	16.4	8.5	7.4	13.8	16.4	6.8	
(E)	1.	Not at all	1.1*	0	2.6	1.6	3.1	11.5	80.1	Very familiar
	2.	Not at all	48.2*	26.7	7.3	8.9	3.1	4.7	1.1	Very bothersome
	3.	Not at all	2.6*	10.0	15.2	6.7	7.9	20.9	36.7	Very distracted

Figure 14.1 Results of extended diary study (scale value range, 1–7; asterisk (*) indicates a percentage error associated with the scale values). In (A) responses to questions regarding the nature of the intended actions are shown (N = 192 errors): (1) How often have you successfully carried out actions identical or very similar to those you intended on this occasion? (2) How recently did you successfully perform actions identical or very similar to those you intended on this occasion? (3) To what extent were the intended actions ones that would normally be carried out in an automatic way without demanding close attention? In (B), responses to questions regarding the nature of the erroneous actions are shown (N = 77 errors): (1) Were the wrong actions on this occasion recognizable as being appropriate to some other task or activity? To which 40% of the subjects responded *yes* and 60% *no*. Subjects who responded *yes* were asked, To what extent were these wrong actions recognizable as belonging to this other activity? (Responses are recorded on Scale 1.) (2) How often do you engage in this other activity? (3) How recently have you engaged in this other activity? In (C), responses regarding the similarity in locations, movements, objects, timing, and purpose between intended actions and some other activity not intended on this occasion are shown (scale values—1, not at all similar and 7, very similar; (N = 77 errors). In (D), responses regarding the subjects' mental and physical state at the time of the slip are shown (scale values—1, not at all and 7, feeling very preoccupied, upset or worried, emotional or excited, tired or sleepy, unwell, or rushed, N = 192 errors). In (E), responses regarding the circumstances prevailing at the time of the slip are shown (N = 192 errors): (1) How familiar to you were the surroundings in which the slip occurred? (2) How bothersome were your surroundings at the time that the slip was made (e.g., too noisy, cold, hot, bright, dark)? (3) To what extent did something other than your own thoughts distract your attention?

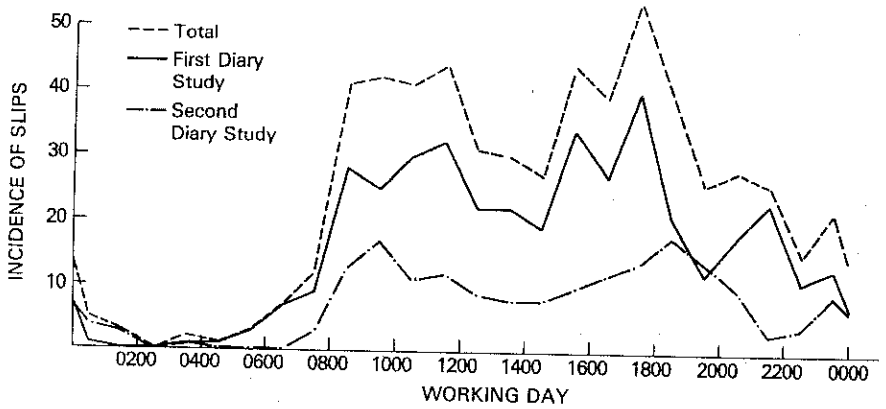

Figure 14.2 Hourly distribution of reported slips of action throughout the day. Slips are shown for two diary studies (see text), both separately and together.

squares, average linkage, and medians. All three algorithms gave a picture of a central core of slips with outliers at various distances from the centroid, rather than of disjoint clusters.

Distribution of Slips over Hours of the Day

In both the initial and the extended-diary studies, subjects were asked to record the time at which the slip occurred. To determine whether there were any discernible temporal patterns in the occurrence of slips of action, the distributions over hours of the day were plotted for each study, both separately and together (433 slips from the initial study and 192 from the extended-diary study). The resulting histograms, broken down into hourly periods, are shown in Figure 14.2.

Both groups of diarists revealed a similar temporal pattern of slips, with a rapid increase in their occurrence during the early hours of the waking day, a decline between noon and 3.00 p.m., and a clear tendency to "peak" somewhere between 5:00 and 7:00 in the evening. Chi-squared values computed for the total sample ($N = 625$) were all highly significant ($p < .001$), regardless of whether they encompassed the whole 24-hour cycle, the working day (9 a.m.–5 p.m.) or the waking day (8 a.m.–12 p.m.). The variations that existed between these two samples could reasonably be accounted for by their differences in lifestyle. The initial diary study utilized a much more heterogeneous group, both in age and occupation, than did the extended-diary study in which subjects were all undergraduates aged between 18 and 25 years. Thus, the somewhat earlier "peak" for the initial study sample could be explained, in part at least, by the

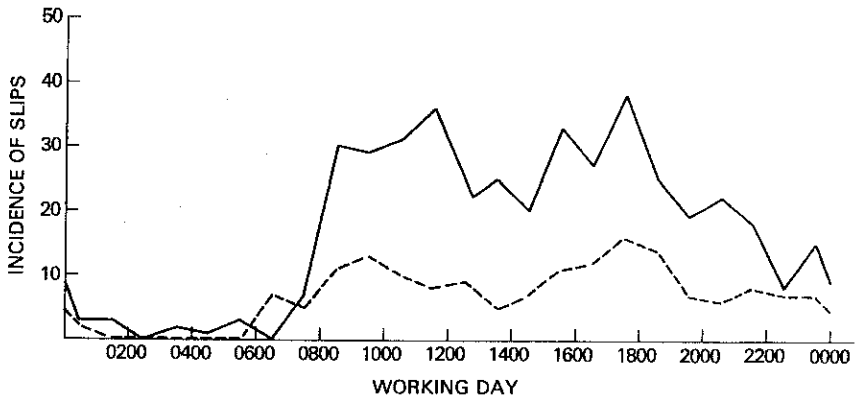

Figure 14.3 Comparison of hourly distributions of slips for males (dashed line) and females (solid line). ($N = 625$ slips.)

fact that many of the diarists were involved in preparing meals between 5:00 and 6:00 in the evening.

A comparison of the hourly distributions for males and females is shown in Figure 14.3. It can be seen that there were no marked differences in the temporal patterns of slips committed by the two sexes.

These hourly distributions suggest, obviously enough, that errors are associated with periods of maximum activity. There is also a hint that slips are most likely to occur during transitions between home and work; that is, when people are either preparing to depart for work, or immediately on their return home. In general, these distributions appear to reflect the influence of situational factors rather than what is known about diurnal variations in efficiency.

The Relative Frequencies of Error Types

In this section, the concern is with estimates of the relative frequency with which different kinds of slips and lapses occur during the course of everyday life. To obtain these estimates an error-proneness questionnaire (EPQ) was constructed that comprised 30 items. Each item took the form of a general statement of a particular type of error; and for 26 of the items, this statement was followed by 3 instances. For example the question How often do you make mistakes in which you omit something because you have switched to some other activity prematurely? was followed by the following 3 instances:

1. "I was just about to step into the bath when I discovered I still had my socks on."
2. "While running water into a bucket from the kitchen tap, I put the lid back on before turning off the tap."
3. "I walked out of the shop without waiting for my change."

TABLE 14.1

Relative Frequencies of Error Types as Shown by Error-Proneness Questionnaire Data[a]

Rank	Error type	Response (percentage of sample)[b] More than daily	Daily	More than weekly	Weekly	More than monthly	Monthly
1	Attending but not taking in	20.0	21.2	18.8*	10.6	14.1	9.4
2	Forgetting plan item	4.7	11.8	14.1	27.1*	20.0	8.2
3	Blocked on name	5.9	8.2	18.8	17.6*	23.5	10.6
4	Forgetting intention (to do something)	3.5	4.7	27.1	17.6*	22.4	12.9
5	Forgetting intention (to say something)	3.5	8.2	22.4	11.8	27.1*	12.9
6	Should-be-doing-something feeling	3.5	8.2	17.6	18.8	9.4*	20.0
7	Action different from intention	2.4	2.4	17.1	11.8	25.6*	17.6
8	Recall blank on known fact	2.4	11.0	8.5	17.1	14.6*	15.9
9	Executing necessary actions	2.4	8.2	14.1	15.3	15.3*	12.9
10	Time-gap experience	2.4	4.7	15.3	20.0	14.1*	10.6
11	Omission after interruption	0	4.7	5.9	10.6	23.5	21.2*
12	Forget to consult reminder	0	1.2	14.1	18.8	10.6	16.5*
13	Losing place in sequence	1.2	1.2	9.4	5.9	24.7	17.6*
14	Searching for carried object	1.2	0	8.2	3.5	18.8	24.7*
15	Carrying object after disposal time	1.2	0	8.2	10.6	8.2	21.1*
16	Omission of step from sequence	0	0	7.1	9.4	11.8	11.8
17	Right actions but objects reversed	0	1.2	5.9	5.9	8.2	23.5
18	Premature exit from sequence	1.2	0	2.4	9.4	14.1	21.4
19	Familiar but unintended actions	0	0	2.4	5.9	22.4	28.2
20	Wrong receptacle	0	0	3.5	9.4	14.1	14.1
21	Familiar action in changed conditions	0	0	1.2	7.1	12.9	22.4
22	Note need for change but continue	0	0	8.3	4.8	10.7	17.9
23	Revert to abandoned plan	0	1.2	4.8	2.4	10.7	15.5
24	No recollection of previous action	1.2	0	3.7	7.2	9.8	17.1

TABLE 14.1 (*Continued*)

Rank	Error type	Response (percentage of sample)[b] More than daily	Daily	More than weekly	Weekly	More than monthly	Monthly
25	Picked up wrong object	0	0	7.1	4.8	7.1	8.3
26	Repetition of action	0	3.5	0	2.4	3.5	8.2
27	Intrusion from some other activity	0	3.5	0	2.4	3.5	8.2
28	Right action but wrong object	0	1.2	3.5	2.4	5.9	7.1
29	Action reversal	0	0	2.4	2.4	2.4	12.9
30	Wrong remembrance of place	0	0	1.2	1.2	5.9	7.1

[a] Number of subjects sampled was 85.
[b] Asterisk (*) indicates mean category.

The respondents were required to indicate how often they made that particular kind of mistake by selecting one of eleven possible response categories: (1) never; (2) about once in my life; (3) more than once in my life, but less than once a year; (4) about once a year; (5) more than once a year, but less than once a month; (6) about once a month; (7) more than once a month, but less than once a week; (8) about once a week; (9) more than once a week, but less than once a day; (10) about once a day; (11) more than once a day.

The EPQ was made up of two classes of items: action slips and nonaction slips. Eighteen of the items involved a clear deviation of action from intention, and seemed, on the face of it, to implicate some form of control or attentional failure. The remaining 12, the nonaction slips, could for the most part be described as lapses of memory, involving failures of encoding, storage, or retrieval.

The EPQ was administered to 85 undergraduate and postgraduate psychology students. The data relating to the relative frequency of these 30 error types is summarized in Table 14.1. The items are listed in the order of their mean frequency of perceived occurrence.

It can be seen from Table 14.1 that there was a clear tendency for nonaction or memory slips to be assessed as occurring more frequently than slips of action. Table 14.2 compares the numbers of action and nonaction items falling above and below the frequency median ($\chi^2 = 6.81$, $df = 2$, $p < .01$).

Factor analysis of these data also discriminated reasonably well between the action and nonaction slips. Figure 14.4 shows the unrotated loadings for the two-factor solution. It can be seen that all the items have moderately high loadings on the general factor (Factor I); but (with some minor degree of overlap) the nonac-

TABLE 14.2

Comparison of the Numbers of Action and Nonaction Error-Proneness Questionnaire Items Falling Above and Below the Frequency Median

Relation to median for EPQ	Action items	Nonaction items
Above	5	10
Below	13	2

tion items tend to have positive loadings on Factor II, whereas the action slips have negative loadings on Factor II. Figure 14.5 shows the same data after Varimax rotation with Kaiser normalization. Here Factor I would appear to be one of attentional failure, and Factor II to be memory failure. The four items loading most highly on each of these factors are listed in Table 14.3.

The results of this factor analysis indicate, in general, that those people who regard themselves as liable to mental lapses perceive this disposition to be present for all types of error, and the converse. However, relatedness *within* the separate sets of action and nonaction slips is greater than *between* these two groups. In other words, perceived liability to commit certain kinds of, say, action slips is a better predictor of one's tendency to perform other kinds of deviant actions than it is of one's proneness to nonaction lapses, and vice versa. Though, as can be seen from Figures 14.4 and 14.5, these differences are minimal or nonexistent for a number of intermediate items. Those items most poorly discriminated by the factor analysis tended to be ones that involved both action and

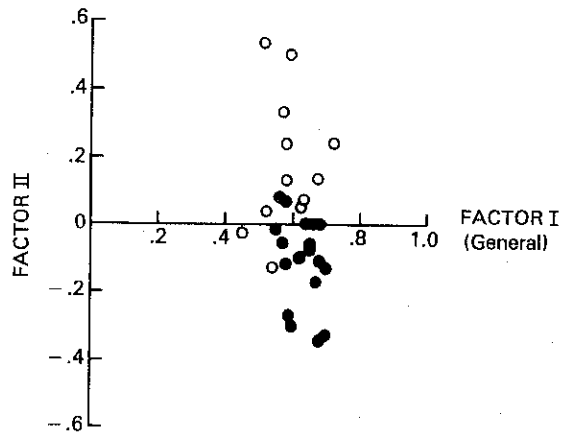

Figure 14.4 Nonrotated two-factor loadings for EPQ (error proneness questionnaire) items. ○, nonaction items; ●, action items.

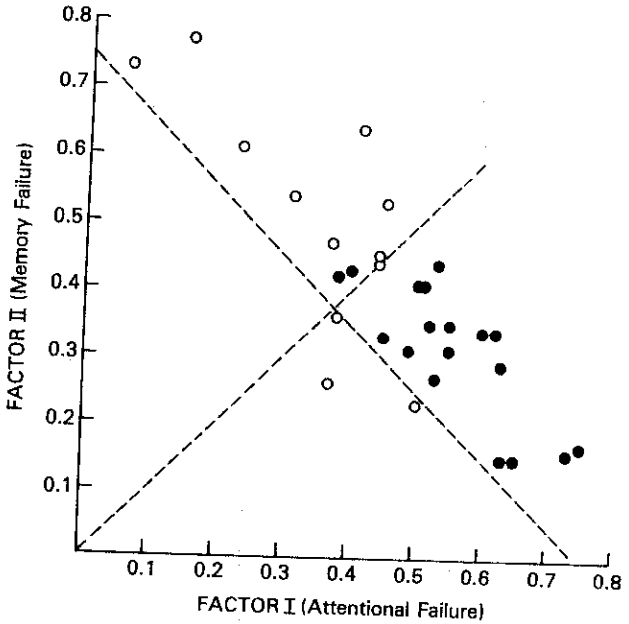

Figure 14.5 Rotated two-factor loadings for EPQ items. ○, nonaction items; ●, action items.

TABLE 14.3

The Four Items Loading Highest on Factors I and II (Rotated)

Item	Factor loadings I	II
Note need for change but continue with familiar actions	.750	.177
Omission after unexpected interruption	.739	.165
Reverse direction of actions	.655	.145
Still carrying something that should have been disposed of earlier	.638	.158
Apparently attending but not taking in	.146	.766
Cannot immediately recall a name	.065	.733
Forget to carry out planned action	.406	.645
Forget intention to say something	.234	.612

nonaction components, for example, How often do you write down a reminder to yourself to do something and then forget to consult it so that you fail to carry out the intended activity?

Classifying Slips of Action

From Aristotle onwards, many attempts have been made to classify the varieties of human error. These taxonomies are too numerous to consider here, though limited reviews may be found elsewhere (Meister, 1971; Singleton, 1972; Swain & Guttman, 1980). However, if one examines those taxonomies concerned primarily with the intraindividual origins of error, it is possible to penetrate beyond the idiosyncracies of terminology to distinguish at least three levels of analysis in the classificatory process.

At the most superficial level, mistakes may be classified according to some easily observable feature of the erroneous behavior. At this purely behavioral level, are such categories as omission, insertion, substitution, and reversal. Other classifications are predicated on assumptions about the cognitive mechanisms involved in the production of errors. Since the mid-1970s, these conceptual taxonomies have usually been expressed in terms of the information-processing stage at which some failure was presumed to have occurred. Taxonomies of this kind, concerned specifically with the slips and lapses of everyday life, have been constructed by Norman (1980, 1981) and by the present author (Reason, 1976, 1977, 1979).

At a third and more fundamental level, are errors assigned to classes according to which of a number of underlying biases or determining tendencies they are thought to reveal. A seventeenth century example was Bacon's (1960) list of "the idols and false notions which are now in possession of the human understanding" (p. 47). According to Bacon, there are a number of omnipresent warps in human judgment and reasoning that exists because the mind acts like a "false mirror, which, receiving rays irregularly, distorts and discolours the nature of things by mingling its own nature with it" (p. 48). Contemporary echoes of Bacon's classification can be found in the work of Tversky and Kahneman, who since the early 1970s have demonstrated that when people are required to assess the probability of an uncertain event or the value of an uncertain quantity, they rely on a limited number of heuristic principles that work well enough for the most part but occasionally lead to severe and systematic errors (Tversky & Kahneman, 1974; Nisbett & Ross, 1980).

Because the main purpose for studying slips of action is to gain insights into the underlying cognitive mechanisms, an error classification based on a conceptual rather than a behavioral level of analysis would clearly be the more useful. But earlier attempts at constructing such a taxonomy have revealed at least two

major difficulties. First, it is rarely possible to make confident inferences about the specific nature of the mediating cognitive failure on the basis of the brief error descriptions supplied by subjects. The available evidence is hardly ever sufficient to allow the assignment of a particular slip to a unique conceptual category, although one may be fairly certain that one of a limited number of "error mechanisms" is implicated. The second difficulty is that such taxonomies almost invariably end up by mixing both the behavioral and conceptual levels of analysis (Reason, 1979).

One way to avoid these problems is to accept at the outset that the error descriptions that constitute our primary data are only sufficient to allow some form of behavioral classification. Even if, as is most likely, such behavioral categories are far from homogeneous with respect to their underlying cognitive mechanisms, they have the advantage of reducing the error corpus to a limited number of generally agreed classes. Having achieved this first stage of data reduction without going beyond the constraints imposed by evidence, it is then possible to relate these behavioral categories to a range of possible cognitive mechanisms that must, necessarily, be embodied in some model of the control of human action.

A Behavioral Taxonomy

Examination of the 625 slips of action netted in the two diary studies suggested that a large proportion of them could be assigned to one of four behavioral categories of error:

1. Repetition: Some actions in the intended sequence are repeated unnecessarily.
2. Wrong object(s): The intended actions were made, but in relation to the wrong object(s).
3. Intrusion: Unintended actions (other than those associated with repetitions or wrong object(s)) become incorporated into the sequence at some point.
4. Omission: Intended actions (other than those arising from repetitions, wrong objects, or intrusions) were left out of the sequence.

Strictly speaking, all deviations of action from intention involve an omission in that they constitute failure to carry out a particular action at the time specified by the plan. Hence, all slips are omissions to some extent. Similarly, all repetitions and wrong objects involve intrusions in the sense that they both contribute additional unintended features to the planned sequence. These distinctions become important when people other than the investigator attempt to classify slips of action according to these predetermined categories. Such a study is reported below.

A Classificatory Study

In order to determine the extent of agreement between different "judges" when they are required to allocate slips of action to these four behavioral classes,

an inventory was constructed containing 100 error statements, expressed in the first person, selected from the two diary studies. The subjects were instructed as follows:

> The only information you will have in assigning slips to categories will be brief descriptions of the errors provided by the individuals who committed them. The categories are all defined in simple behavioral terms. You will not be asked nor expected to speculate about the underlying causes of the mistakes. You merely have to decide which of the available categories best fits the described circumstances of the error. If you feel that the slip fits none of these categories, or you are not sure which one is appropriate, then you will have an opportunity to indicate this in the inventory.

The classification procedure for each slip involved making a series of yes–no decisions in a standard order. This order was the same as that shown in the previous section. In other words, the judges were required to decide whether or not the slip involved a repetition, then whether it was a wrong-object error, then whether it was an intrusion, and then whether it was an omission. If they answered no to all four, they were asked to consider whether the slip failed to fit into any of these categories. If they responded negatively, they were then asked if they were unsure which of the above categories best fitted the slip in question. If they still answered no, they were directed to repeat the decision process again. Fifty psychologists (researchers, academics, postgraduates and third-year undergraduates) acted as subjects.

For 86 of the 100 items, more than 50% of the sample selected the same category; and for 56 of the items, more than 80% of the sample were agreed on this allocation. But for 16 items, no clear majority decision was obtained (50% or less assignment to the most popular category). Further analysis indicated that confusions occurred most frequently between intrusions and wrong objects, largely arising from the subjects' uncertainty as to what constituted an object. In the item, for example, "I meant to phone my parents but rang an old friend instead," 50% of the sample judged this to involve wrong objects, whereas 42% assigned it to the intrusion category. However, no confusions were found between repetitions, wrong objects, and omissions.

The results of this study suggested that, for these fairly sophisticated subjects at least, the four behavioral categories were adequate to classify the majority of slips. Only 12 of the 100 items were allocated at any point to the "None of these" category, and there were no "unsure" responses. Furthermore, with the exception of the intrusion–wrong-object confusions, most items were assigned to categories with an acceptable level of agreement between judges.

Theoretical Considerations

A Heuristic Model of Action

In order to proceed beyond the behavioral level of analysis, it is necessary, as indicated earlier, to have at least some rudimentary model of the underlying

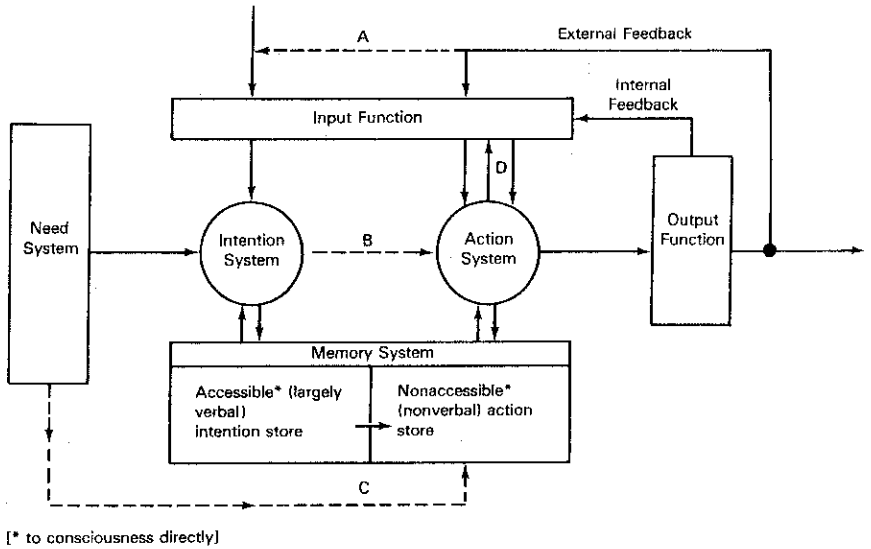

Figure 14.6 A model of human action.

mechanisms governing human action. The model to be presented here is, in most essentials, similar to that described previously (Reason, 1977). However, two important modifications have been made. First, some account is taken of the motivational springs of human action in the addition of a "need system." Second, greater significance is given to the "memory system"; in particular, the action schemata held in the nonverbal section of this system are assigned a far more active role in their potential for gaining control of the motor output. This latter modification is owed directly to Norman's (1980, 1981) theoretical statements regarding the origins of mental slips. The basic components of this revised action model are shown in Figure 14.6.

The *intention system* is the chief executive within the hierarchy of action control. It operates in close conjunction with the accessible (to consciousness) or predominantly verbal portion of the memory system to organize plans of future action, to monitor and guide ongoing activity, and to review past actions. Intentions may be prompted by external events (via the input function), or by internal states (via the need system). To a large extent, the moment-to-moment activity of the intention system is reflected in the current contents of consciousness and is a function of the breadth and direction of attentional focus that switches continually between present, past, and future events. It is this attentional component that imposes the limits that are evident in the capacity of the intention system.

The manipulanda of plannning are usually short verbal tags ("Must buy some carrots," "I want a cup of tea," and so on) that invariably encompass a large number of automatized action schemata. The fine details of these schemata are,

for the most part, beyond the reach of verbal expression and are held as intact action sequences—or more exactly, as instructions for action sequences—within the nonaccessible or largely nonverbal portion of the memory system. The current concerns of the intention system, particularly planned actions, are held in store (something akin to working memory) when attention is claimed elsewhere.

For those activities that through their frequency and recency of use have become largely preprogrammed, the detailed control of the effector organs (the *output function*) is achieved by the *action system*, which is simply the action schema that is currently governing the motor output. It is presumed that only one action schema at a time usually has control of any particular part of the musculature.

Following Norman (1980, 1981), it is proposed that the action schemata held in the nonverbal portion of the memory system vary considerably at any one point in time in their level of activation, or their likelihood of becoming the action system. This level of activation is determined by many factors: the current activities of the intention and need systems, external events, the recency and frequency of use, and the state of activation in related schemata (for example, the intention to make tea and the process of filling and boiling the kettle is likely to increase the level of activation in other "beverage schemata").

A critical feature of the model is the extent to which the intention system is involved in closed-loop (CL) control of ongoing activity. When carrying out an unfamiliar task, or when making spot checks on the progress of a largely routinized activity, the intention system may gain direct control of the output function through the closure of the two shunts shown in Figure 14.6 as the dotted lines labeled A and B. But during the execution of familiar tasks; these shunts remain open for much of the time, indicating that the activity is being open-loop (OL) with respect to the intention system. During these periods of OL control, the intention system occupies itself with matters other than the immediate control of the present behavior. These "other matters" have been labeled elsewhere as *parallel mental activity* (see Reason, 1979).

It can also be seen from Figure 14.6 that the need system has the possibility of gaining control of the action system through the dotted channel C. This feature has been added to take account of the so-called "Freudian slip" in which the control of action is achieved without the intervention of consciousness; indeed, the resulting word or action may be directly contrary to the current plan formulated by the intention system. Such a channel also allows for the motivational "priming" of action schemata (Lashley, 1951; Reason, 1979).

A further dotted channel in Figure 14.6, D, is included to accommodate the fact that during the execution of highly automatized tasks, not only the motor output but also the perceptual input associated with this activity will be largely preprogrammed to the extent that it is very predictable. Under these circumstances, it is more economical of effort to degrade the "settings" of the input

function's recognition schemata so they will accept relatively crude approximations of the various classes of stimuli expected at different points in the action sequence. The implications of this coarsening of the perceptual matching processes for the occurrence of discrimination failures has been discussed elsewhere (Reason, 1979), and is considered again at a later point in this chapter.

Relating Behavioral Error Types to Conceptual Categories of Failure

Do observable similarities in the behavioral characteristics of a group of action slips give any grounds for the supposition that they share a common failure location within the model of action? Does the available evidence suggest that all omissions arise from similar underlying causes, and likewise for intrusions, repetitions, and wrong-object errors. The answer would appear to be in the negative.

Consider the following descriptions of omissions given as items in the classificatory study described earlier. In all cases, there was better than 80% agreement among the judges as to their most appropriate behavioral class.

1. "I intended to take my pills, get my coat and go out. I put my coat on and left forgetting to take my medicine."
2. "I bought something and started to leave the shop without waiting for my change."
3. "I got into bed with my slippers on."
4. "I wrote out a cheque and put the cheque book back into my bag without tearing the cheque out."
5. "I intended to put the key in the lock and open the door. I put the key in but did not turn it and tried unsuccessfully to open the door."

In the case of Slip 1, there are at least two possible interpretations for the slip: either the plan item "take my pills" was insufficiently processed by the intention system and its associated store, and so was lost; or this intention remained intact, but was preempted by the more familiar routine of putting on a coat and leaving the house. In other words, this slip may have constituted a "strong-habit" exclusion, probably associated with preoccupation or momentary distraction. Slips 2 and 3 both appear to be instances of *premature exit;* that is, when the actor proceeds to the next stage of his or her planned sequence without having completed some necessary prior phase. Slips 4 and 5, on the other hand, seem more typical of *place-losing* errors in which the intention system makes a cursory spot check on progress of a largely automatic activity and comes up with the wrong answer: In both cases, this answer was that the activity was further along than it actually was. Another possibility, particularly in the case of the key-turning error, is that some unrecorded external event occurred that, though not directly attended to, was "counted in" as part of the door-opening sequence in lieu of the key-turning.

For the moment, however, it does not matter which of these alternatives is the most likely, nor even whether these speculations represent the only possible hypotheses; what is relevant here is that although these omission errors have common behavioral features, they are clearly far from homogeneous with regard to their underlying mechanisms. And the same is also true for intrusions, wrong objects, and, to a lesser extent, repetitions. In short, there is no simple and direct mapping of these behavioral error types onto categories of cognitive failure within the action model. Rather, the available evidence indicates that members of the same behavioral class of error are mediated by quite different cognitive failures, and that members of different behavioral classes may share common etiologies.

Possible Categories of Cognitive Failure

Consideration of the action model suggests that four loosely defined and overlapping categories of cognitive failure can be identified. These are listed in the following.

Control Mode Failures

Control-mode failures are errors that arise as the result of being in the wrong control mode with respect to the demands of the task in hand. In terms of the model displayed in Figure 14.6, this relates to whether Shunts A and B are open or closed. Two kinds of inappropriate control mode are possible: being OL at a time when a high-level decision is required of the intention system—for which the consequence is usually a strong-habit intrusion, that is, the most familiar path of action is followed rather than the intended one; or going CL during the execution of a highly automated sequence of actions for which intervention by the intention system is both unnecessary and undesirable. This possibility was referred to earlier in the case of the key-turning omission in which the intention system may have sought to establish the point reached in the sequence and arrived at the wrong answer. Other examples are considered later.

Intention System (and Associated Store) Failures

Here it must be stressed that although the intention system is depicted as a separate entity in the action model, its functions are so closely bound to the consciously accessible portion of the memory system as to be inseparable from it. Failures of this subsystem are primarily those concerned with the formation of plans and with the storage and retrieval of plan-related information. Again, these are considered in further detail at a later point.

Action System (and Associated Store) Failures

These failures involve the unintended triggering of action schemata. At least three ways in which this may occur are suggested by the corpus of action slips: the blending of elements from two currently active schemata, the unintended activation of schemata by external contextual cues, and "program counter" failures. Examples of each are provided later.

Input Function Failures

If one allocates to the input function the task of stimulus recognition, particularly for cases in which this has become largely routinized through the repeated execution of some activity in highly predictable surroundings; then it is possible to associate at least two classes of error with failures of this subsystem. One is *misdiscrimination*, in which actions are carried out in relation to wrong objects that can be similar in appearance, function, or location to the intended objects. The other is the phenomenon of *local unawareness*, a condition in which, possibly through preoccupation or distraction, the person's attention to his or her immediate surroundings and particularly to his or her own body is diminished. Examples of this are continuing to carry something one has intended to dispose of earlier or searching for something that one is actually carrying.

Varieties of Cognitive Failure

The principal rationale for collecting and analyzing slips of action is the belief that regularities in the occurrence of these usually inconsequential everyday errors will yield valuable insights into the cognitive mechanisms responsible for the initiation and guidance of action, particularly skilled or habitual action. But it is clear from the previous discussion that at this stage there are insufficient data to determine uniquely the causes of any particular slip. The evidence derived from the analysis of a large number of slips allows the formulation of only speculative inferences about the cognitive mechanisms involved in their production. Such inferences can be made most easily from a recurrent error form which, although it may vary in its precise circumstances and behavioral characteristics, seems to implicate some specific cognitive process. But this is a comparatively rare occurrence. More usually, a number of cognitive functions could conceivably be involved, and there is not sufficient information to favor one of them over the rest. In general, therefore, the best that can be hoped for from this kind of investigation is the formulation of a set of hypotheses about the possible varieties of cognitive failure. To evaluate these hypotheses, it would be neces-

sary to proceed to a more experimental mode of study by setting up the conditions believed to be sufficient to create a particular kind of error, and then studying the relationship between variations in the provocative conditions and the likelihood of eliciting this error.

But this is looking beyond the present state of progress. All that is legitimate at present is to summarize the various possible hypotheses. The list of hypotheses so far formulated is set out in the following, and is subdivided into the four possible classes of cognitive failure described in the previous section. It should be emphasized, however, that this list only includes those hypotheses that at the present stage of analysis seem the most probable. Further analysis is likely to produce additional hypotheses as well as the modification or rejection of existing ones.

Control-Mode Failure

Double-Capture Slips

Double-capture slips are so-named because they appear to involve two distinct, though causally related, kinds of capture. First, the intention system (or focal attention) is captured either by some internal preoccupation (parallel mental activity) or by some unexpected external event at a time when a higher-order intervention is necessary to set action along the intended pathway. As a consequence, the control of action is usurped by the strongest (i.e., the most frequently and/or recently used) motor program leading onwards from that particular point in the action sequence. In other words, the action system is "captured" by a strong habit.

Of all the slips that one can reasonably attribute to attentional failure, double-capture slips are the most common. Indeed, relatively few slips of action do not reveal some evidence of strong habit intrusion. These errors are so apparently lawful that one can formulate strong hypotheses as to when they will occur and what form they will take. Thus one can predict that they will occur when the open-loop mode of control coincides with a critical decision point or node in the instructional sequence beyond which the "strengths" of the connecting motor programs are markedly different, and when the current intention is to take some route other than that most recently and frequently traveled in those particular circumstances. When this occurs, one can also predict that the slip will involve the unintended activation of the strongest motor program (see also Reason, 1979).

These slips can take a wide variety of forms. Examples of some of the commonest variants are listed in the following:

1. "I had decided to cut down my sugar consumption and wanted to have my cornflakes without it. However, I sprinkled sugar on my cereal just as I had always done."

2. "We now have two fridges in our kitchen and yesterday we moved our food from one to the other. This morning I repeatedly opened the fridge that we used to have our food in."
3. "On starting a letter to a friend I headed the paper with my previous home address instead of my new address."
4. "I intended to stop on the way to work to buy some shoes, but woke up to find that I had driven right past."
5. "I brought the milk in to make myself a cup of tea. I had put the cup out previously. But instead of putting the milk into the cup, I put the bottle in the fridge."
6. "I meant to get my car out, but as I passed through the back porch on my way to the garage I stopped to put on my wellington boots and gardening jacket as if to work in the garden."
7. "I have two mirrors on my dressing table. One I use for making up and brushing my hair, the other for inserting and removing my contact lenses. On this occasion, I intended to brush my hair, but sat down in front of the wrong mirror, and removed my contact lenses instead."
8. "I went up to my bedroom to change into something more comfortable for the evening, and the next thing I knew I was getting into my pyjama trousers."
9. "I meant to take off only my shoes but took my socks off as well."
10. "I was making shortbread and decided to double the amounts shown in the recipe. I doubled the first ingredient—butter—and then failed to double anything else."
11. "I decided to make pancakes for tea. Then I remembered we didn't have any lemons, so I decided not to bother. Five minutes later, I started getting together the ingredients for pancakes having completely forgotten my change of mind."
12. "I was putting cutlery away in the drawer when my wife asked me to leave it out as she wanted to use it. I heard her, agreed, and yet continued to put the cutlery away."

Examples 1–3 are clearly very similar. They all involve a change of routine that, presumably as the result of attentional capture, leads to an old-habit intrusion. Examples 4 and 5 also show clear signs of strong-habit capture during a moment of inattention; but in these instances, the double-capture leads to an exclusion rather than an intrusion. Here then are five slips that apparently share a very similar etiology; but in three of them, the outcome is an intrusion error, whereas in the other two, it is an omission. This underlines the point made earlier about the lack of any direct relationship between the behavioral characteristics of the error and its underlying mechanics.

Examples 6 and 7 are instances of *branching errors* in which some initial common pathway leads to different outcomes, whereby attention is captured at the branch point so that the wrong route is followed. Examples 8 and 9 are conceptually very similar except that they involve overshooting a stop rule that is not regularly imposed. Compare these with William James's example (1890): "Very absent-minded persons in going to their bedroom to dress for dinner have been known to take off one garment after another and finally to get into bed, *merely because that was the habitual issue of the first few movements when performed at a later hour*" (p. 115; emphasis added).

Examples 10–12 share the failure to attend to the need for change at the critical moment. In errors 10 and 11, this results in a reversion to some earlier plan; whereas in 12, it results in the continuation of an habitual set of actions. This last example is particularly interesting because it reveals something about

the actor's attentional state. He clearly heard and remembered his wife's request, but failed to act on it. Leaving aside the possibility that this was some unconsciously motivated act of marital war, it suggests that the wife's request was attended to and recorded by the fringes of consciousness while the husband's focal attention was directed elsewhere. Such peripheral attentional states seem to be implicated in a wide variety of errors as is discussed later.

In all of the examples discussed so far, it seems reasonable to assume that the factor contributing most to the strength of the emergent but unwanted action sequence was its frequency of prior employment. However, some experiences of my own suggest that there are occasions, albeit fairly infrequent ones, in which the recency factor is dominant, even to the extent of overriding frequency considerations. Two personal examples should help to make the point clearer.

> "I had recently acquired a dictating machine and was busy getting the hang of writing letters on it. To gain some confidence with the machine, I would write the letters in note form and then record them. In reading them onto the tape, I was very scrupulous about including such things as 'comma,' 'colon,' 'semicolon,' and the like. After I had been using the machine for a few days, I gave a lecture in which I read out a passage from a book. It was only after I had read a sentence or two that I realised—to my acute embarrassment—that I was also reading out all the punctuation as if dictating into the recorder."
>
> "I pulled up outside a friend's house in a quiet residential street and parked the car facing the wrong way for the traffic flow (i.e., on the right-hand side of the street). On leaving the house with the friend, I drove off on the wrong side of the road without noticing the fact. Indeed, I wondered why the vehicle coming towards us was driving on the wrong side. Then I realised what I was doing and pulled in to the kerb—as if to park in front of another house. Two things seem to have contributed to this slip. The first was that I was attending very closely to what was being said to me, and the second was that I had just returned from driving in France—where I became accustomed for eight days or so to having the driver's side nearest the kerb."

The interesting thing about both of these examples is that the recency effect ran directly contrary to well-established skills: reading aloud and driving on the left-hand side of the road. It appears as if, in certain circumstances, the effort to modify an existing routine for another purpose leaves powerful residues for some while after the change of procedure is no longer appropriate.

Place-Losing and Place-Mistaking Errors

How slips can arise from the failure of focal attention to switch to the task at hand at the appropriate moment has just been discussed. When this happens, the reins of action are likely to be snatched by some strong habit. What is less intuitively obvious, however, is that errors can also be produced by exactly the opposite process; that is, focal attention being directed to some ongoing routine activity at a time when control is best left to the action system. Anyone who has concentrated too closely on what his or her feet were doing when running down the stairs two at a time will know how disruptive too much attention paid to a

largely automatic activity can be. But more subtle errors arise when the intention system makes a cursory check on the progress of some routine task at an inappropriate moment.

Activities such as tea making are particularly prone to these kinds of error. This is a task of the test–wait–test–exit variety (Harris & Wilkins, 1982) in which a sequence of largely automatic actions needs to be carried out in the right order, and in which there are periods of relative inactivity—while the kettle boils and the teapot brews. Furthermore, it is also a procedure in which a quick visual check on one's progress does not always yield the right answer. Consider the case in which one interrupts a parallel mental activity to ask oneself where one has got to. Low-level checks such as these can produce at least two kinds of wrong answers. Either one concludes that one is further along than one really is, and, as a consequence, omits some necessary step such as putting the tea into the pot or switching on the kettle. Or, one concludes that one is not as far along as one really is, and then repeats an action already done such as setting the kettle to boil for a second time when the pot has already been filled with freshly made tea. The interesting thing about these omissions and repetitions is that if these closed-loop checks on progress had not been made, the automatic tea-making action schema would probably have carried on without error.

In most tasks, a quick look at what one is doing will supply adequate information with which to judge progress. But on some occasions, this visual evidence is lacking and one draws a complete blank, as in the following examples:

> "I was spooning tea into the teapot, and I realised I had no idea of how many spoonfuls I'd put in."
>
> "In the shower this morning, I 'came to' to find that I didn't know whether or not I had washed my hair. It was wet and there was no easy way of telling. I could have washed it and all the soap suds could have disappeared down the plug. I certainly had no recollection of anything except my preceding thoughts."
>
> "I didn't know whether I had put water into the kettle. I had to lift the lid to check."

Another kind of slip that could arise as the result of an inadequate or inappropriate check on progress by the intention system is that in which the direction of an automatic action sequence is reversed, as in the following examples:

> "I intended to take off my shoes and put on my slippers. I took my shoes off and then noticed that a coat had fallen off the hanger. I hung the coat up and then instead of putting on my slippers, I put my shoes back on again."
>
> "I ladled soup into the soup bowl, and then started to ladle it back into the pan again."
>
> "I got the correct fare out of my purse to give to the bus conductor. A few moments later I put the money back into the purse before the conductor had come to collect it."

With these reversal slips, it is difficult to establish precisely whether they are due to inappropriate checking, or to inattention in a bidirectional sequence in which, on that occasion, the strength of the reversed path was greater than that of the intended one. In other words, they could also be caused by a form of double-capture error.

Intention System Failures

Detached Intentions

Some slips suggest that after an intention has been formed, the active component of the intention, the "verb" as it were, becomes *detached* from its proper setting and is subsequently misapplied to something other than that intended. Possible explanations are that either the intention system framed the intention incompletely, perhaps because the focus of attention was claimed elsewhere; or that the intention was formulated correctly, but was subsequently not processed to a sufficient level to allow it to be retained until the moment of its execution. Another possibility is that some of these errors arise from a combination of the presence of stored intents to carry out a particular action plus contextual triggering from another object to which the same kind of action is appropriate. For example, in the case in which a person switches off the gas fire instead of the television, it could be that the switching-off-the-gas-fire schema is jointly activated by the switch-off component of the original intention and the sight of the gas fire. Such an error could also occur as the result of misordering the going-to-bed routine; though this is less likely to be noted as an error because the turning off of both the gas fire and the television are likely to be part of the intended procedure and would in any case occur within a relatively short time of one another.

Some examples of possible detached intentions are given in the following:

> "I intended to place my hairbrush in its usual place by the bookcase. I put my boyfriend's lighter there instead."
>
> "I had an appointment at the dentist's, but went to the doctor's instead."
>
> "I intended to close the window as it was cold. I closed the cupboard instead."

Of course, the distinction between a presumed detached intention and a perceptually based confusion of objects is a fine one to draw. But the accumulated error data appear to justify the retention of the detachment possibility, at least for the present.

Lost Intentions

Whereas detached intentions indicate some partial failure of the intention system and its associated store, *lost intentions* suggest a more complete breakdown at one or more of the stages involved in the formulation, encoding, storage, or retrieval of a plan of action. Lost intentions appear as two distinct kinds of lapses.

One familiar variant manifests itself as a *retrieval* failure: the what-am-I-doing-here? experience. In the course of doing something like walking into a room or a shop, or opening a drawer or cupboard, one suddenly becomes aware that one cannot recall the purpose of this activity. Some actual examples are the following:

> "I went upstairs to the bedroom and stopped—not remembering what I had gone there for."
>
> "I opened the fridge and stood there looking at its contents, unable to remember what it was I wanted."
>
> "I stopped halfway down the stairs. I couldn't remember what I was going for."

In these instances, the most salient feature is the subjective experience of not knowing what one should be doing next. In another type of lost intention; this experience is absent, presumably because no attempt is made to interrogate the purpose of one's actions. Instead, one is deflected from one's intention by a series of small side steps, usually of the strong-associate kind. It is only later that one realizes that one's original intention has not been fulfilled, for example:

> "I went into my room intending to fetch a book. I took off my rings, looked in the mirror and came out again—without the book."
>
> "I went to the bathroom to clean my teeth. When I got there I picked up a towel and walked out again, without brushing my teeth."
>
> "I meant to get my wallet from the bedroom. Instead, I wound the bedside clock and came down again without the wallet."
>
> "I intended to go to the cupboard under the stairs to turn off the immersion heater. I dried my hands to turn off the switch, but went into the larder instead. Then I wandered into the living room, looked at the table, wandered back and then suddenly remembered my original intention."

Personal experience suggests that these multiple side steps occur when one is abstracted by some pressing mental concern, or when one is freewheeling in a state of diminished or weakened intention—a condition not dissimilar to that described by Luria (1973) for patients with frontal lobe damage. The outcome in both cases is similar: One's actions become captured by strong habits appropriate to the physical context. The failure here is not so much one of conscious retrieval, as one of the intention system to revive and activate the stored intention at the right time. The intention is not forgotten as such, because one often becomes aware of it soon afterwards.

Conceptually, very little distinction can be made between this sidestepping form of lost intention and the double-capture slips described in relation to control-mode failures. However, there does seem to be some value in juxtaposing these two kinds of lost intentions, if only to draw attention to the fact that the difference between them lies mainly in the manner in which the actor becomes aware of the lapse.

Action System Failures

Blends and Behavioral Spoonerisms

Although the action system—the "driving seat" of the effector organs—is presumed to be occupied by only one action schema at a time, certain slips suggest that two currently active schemata have dismembered themselves in the

struggle to gain control, and that the elements of these two schemata have become blended in some incongruous way. But as with verbal blends, these combinations appear to obey the syntactical rules of action. The following are two examples:

> "During a morning in which there had been several knocks on my office door, the phone rang. I picked up the receiver and bellowed "Come in" at it."
>
> "I had just finished talking on the phone when my secretary ushered in some visitors. I got up from behind the desk and walked to greet them with my hand outstretched saying "Smith speaking"."

A very similar kind of error is the behavioral spoonerism in which the correct actions are carried out, but the objects for which they were intended become reversed. Some examples were given earlier in the chapter, and some more contemporary ones are set out in the following:

> "In a hurried effort to finish the housework and have a bath, I put the plants meant for the lounge in the bedroom and my underwear in the window in the lounge."
>
> "I unwrapped a sweet, put the paper in my mouth and threw the sweet into the waste-paper basket."
>
> "I threw my glasses in the bin and kept some dirty tissues I was holding in my other hand."

An important feature of these errors is the clue they offer as to the units of action. Of particular interest is the temporal proximity of the reversed objects within the intended action sequence. As compared to verbal spoonerisms, in which the reversed elements are usually separated by milliseconds only, an action sequence is often extended over a much longer time scale; and it is presumably for this reason that partial reversals are more common in action than are complete spoonerisms. It would require an unusually sustained bout of preoccupation or distraction to divert attention for a sufficiently long enough time not to catch the reversal before its symmetry is complete.

External Activation of Action Schemata

Some errors are best understood in terms of the environmental context in which they occur, rather than the prevailing intentional state. Norman (1981) has argued that action schemata may be activated by the presence of schema-related contextual cues as well as by specific intentions. The following errors appear to support these ideas:

> "As I approached the turnstile on my way out of the library, I pulled out my wallet as if to pay—although I knew no money was required."
>
> "Walking up the front path to my friend's house, I pulled out my own front door key and was just about to place it in the lock when I realised my mistake."

In both of these cases, the actions were appropriate not to the actual circumstances, but to ones that were contextually very similar. And, in both, the erroneous actions were highly routinized. These observations suggest a direct connection between the input function and the action system store that bypasses the intention system.

Program Counter Failures

A basic requirement for the Action System is a process, analogous to a program counter, that keeps track of the point reached in the instructional sequence. Logically, this process could fail in one of two ways. It could count some extraneous event as part of the intended sequence, giving rise to an omission error. Or it could fail to count a correct action, thus giving rise to a repetition error.

The error corpus provides a number of examples that could fit the former possibility. They are all characterized by an omission error associated with some unexpected event or interruption.

> "I picked up my coat to go out when the phone rang. I answered it and then went out of the front door without my coat."
>
> "The kettle was just about to boil when I noticed the tea caddy was empty. I fetched a fresh packet of tea from the cupboard and filled the caddy. Then I poured the water into the teapot and only when I came to pour it into the cup did I notice I hadn't put any tea in the pot."
>
> "I walked to my bookcase to find the dictionary. In the process of taking it off the shelf, other books fell onto the floor. I put them all back, together with the dictionary, and went back to my desk not having looked up the word I wanted."

Examples of the second kind, the repetition errors, are harder to find, partly because these lapses are comparatively rare anyway, and partly because when they occur it is hard to distinguish the possibility of a program failure from that of inappropriate monitoring. However, the corpus contains one rather curious example that might have arisen from the failure to "count off" a particular action, or in this case repeated actions. "I intended to put 2 spoonfuls of sugar into my coffee but put in seven or eight instead."

This error bears some resemblance to the motor perseverations reported by Luria (1966) in patients suffering from deep lesions in the premotor areas of the brain. Particularly conspicuous in these patients were the frequent repetitions of circular movements in drawing or writing.

Input Function Failures

Perceptual Confusions

The nature of a fairly common class of errors suggests that they occur because the recognition schemata accept for the intended object something that looks like it, or is in a similar location, or does the same kind of job. As suggested earlier,

this may well arise because, in a highly routinized set of actions, it is not necessary to invest the same amount of attention in the matching process. It is likely that recognition schemata, as well as action schemata, become automatized, and as a consequence accept rough approximations to the expected class of stimuli. This coarsening or degradation of the acceptance criteria is in keeping with the principle of economy of effort, and its associated liberation of conscious capacity, that underlies the control of practiced action in general. The following are some examples:

"I intended to pick up the deodorant, but picked up the air freshener instead."
"I intended to pick up the milk bottle but actually reached out for the orange squash bottle."
"I meant to open a tin of Kit-E-Kat, but opened a tin of rice pudding instead."

Another common form of these errors involves pouring or placing something into a receptacle for which it was not intended.

"I put the coffee jar into the fridge instead of the cupboard."
"I put a piece of dried toast on the cat's dish instead of in the bin."
"I began to pour tea into the sugar bowl instead of the cups."

Local Unawareness

One of the obvious consequences of preoccupation, abstraction, or distraction is a reduction of the conscious attention given not only to particular key actions, but also to one's bodily state in general. An extreme form of this *local unawareness* was displayed by Archimedes who "was so absorbed in geometrical meditation that he was first made aware of the storming of Syracuse by his own death wound" (Hamilton, quoted by James, 1890). However, in lesser mortals this lack of attention tends to take more mundane forms. Two of the commonest instances in the corpus involve continuing to carry objects that should have been disposed of earlier, and looking for something that one is actually carrying or wearing.

"I left the bedroom carrying yesterday's underwear which I had intended to dispose of in a container in the bathroom before going downstairs for breakfast. However, on this occasion, I reached the kitchen before realising I was still carrying the cast-off clothes."
"After having a quick cup of coffee in the Staff Room, I went to the sink and washed the cup but, instead of putting it in the cupboard where it belongs, I kept it in my hand and walked back to the classroom with it."
"I went looking for my glasses. Then I realised I had them on."
"I took out my pen and continued to search for it in my case."

Conclusions

To summarize the story so far: It has been argued that slips of action can provide valuable information about the role of conscious attention in the guidance of highly routinized or habitual activities by indicating retrospectively those points at which the attentional mechanism was inappropriately deployed. Evidence has been presented to show that these slips occur under relatively uniform conditions: during the execution of some automatized task in a familiar setting in which attention has been claimed by some internal preoccupation or by some external distraction. Errors seem to happen either because attention was not switched back to the task in hand at a critical decision point, thus allowing the control of action to be snatched by some strong motor program normally associated with that juncture, or because attention is directed to the ongoing routine activity at a time when it would have been better to leave the guidance of action to the "automatic pilot." In the former case, the errors take the form of strong-habit intrusions or exclusions; and in the latter, omissions and repetitions.

It has also been demonstrated that slips of action can be readily classified into four behavioral categories—repetitions, wrong objects, intrusions, and omissions—on the basis of the error statements provided by the subjects. However, as the subsequent theoretical analysis has attempted to show, it is clear that behavioral categories derived from natural history studies are far from homogeneous with regard to the underlying information-processing stages at which failure is presumed to be located.

The conceptual analysis of these slips was predicated on a model of action consisting of a number of information-handling functions linked by communication channels and feedback loops so as to mimic certain aspects of human skilled performance. Examination of the error corpus suggests that explanations of slips and lapses could be organized around four theoretical mechanisms: control-mode failures, intention system failures, action system failures, and input function failures. These possible categories of failure were best regarded as overlapping "sets" rather than as hard and fast distinctions.

Associated with each of these failure types is a series of hypotheses relating to specific classes of error. It has been stressed that neither the evidence nor the theoretical assumptions are sufficient to permit the unique determination of the causes of any one error. Rather, the accumulation of distinct classes of error allow the formulation of tentative inferences about the nature of the underlying cognitive processes. The relationship between these various levels of argument is summarized diagrammatically in Figure 14.7.

In Figure 14.7, an attempt has been made to convey what one can and cannot conclude on the basis of naturalistic error data. As indicated in the preceding, one can predict with some confidence the circumstances under which these lapses occur. One can also state what behavioral forms these errors are likely to take. But, on moving to a more thoretical mode of classification, one cannot assume any direct mapping of behavioral classes on the underlying error-producing mechanisms. A particular behavioral error form could arise from a variety of possible cognitive failures, and different behavioral categories of action slips could be due to the same type of failure.

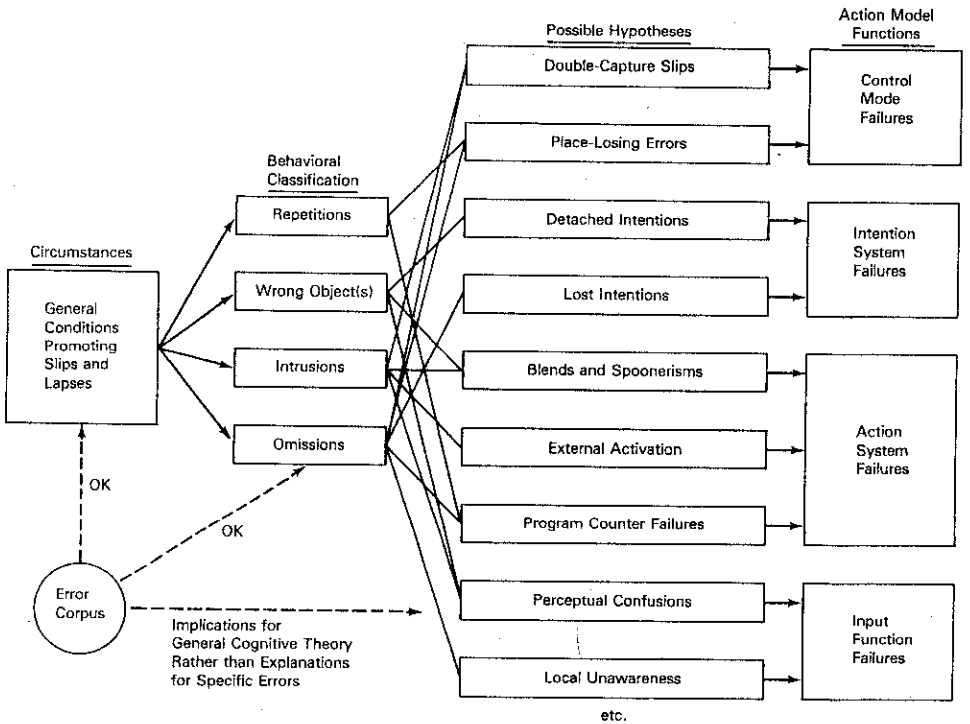

Figure 14.7 Diagrammatic summary of "the state of the art" regarding the etiology of lapses of attention.

In conclusion, it is useful to emphasize the distinction between this kind of error research and that engaged in by applied psychologists. The task of the latter is to prevent error; but when some catastrophic lapse does occur, the human factors specialist asks what knowledge of cognitive processes can reveal about the origins of this particular disaster. In this case, however, both the question and the procedure are reversed: What has been examined here is a large number of inconsequential errors, and the question asked has been what can these errors reveal about the underlying cognitive mechanisms.

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